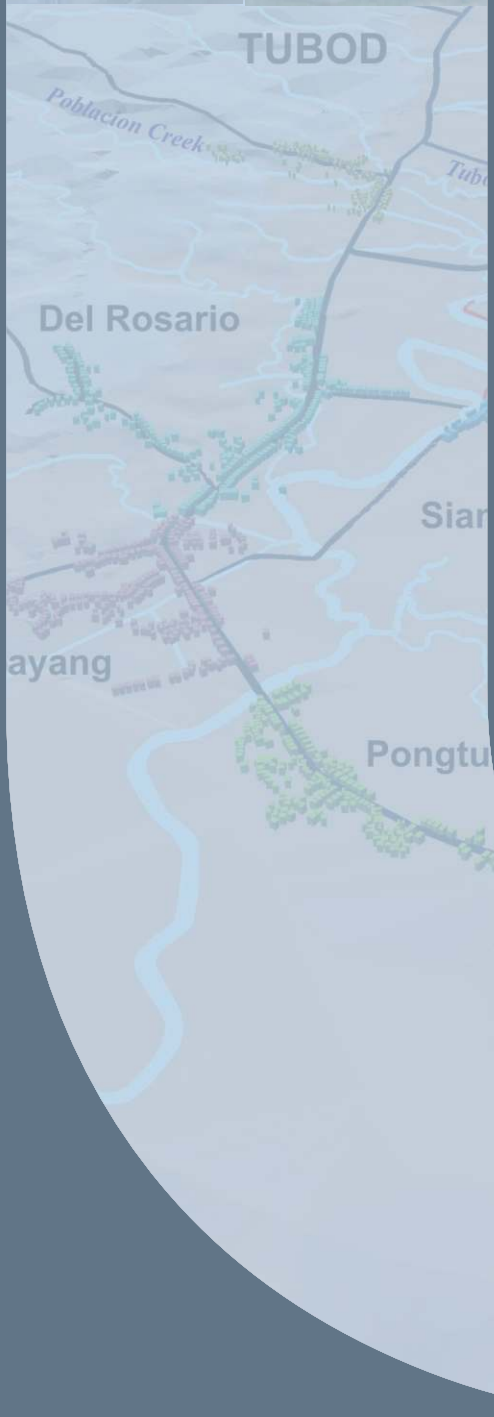
Environment - Risk Management - Feasibility Study - Social Developement - Statistics - Management - Communications - Training and Advocacy



JANUARY 2009

Environmental Impact Statement (EIS) of the Siana Gold Project

Prepared by BMP Environment & Community Care, Inc. for:

Greenstone
Resources Corporation

ENVIRONMENTAL IMPACT STATEMENT OF THE SIANA GOLD PROJECT

Prepared for

Greenstone Resources Corporation

By

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AUTHORSHIP AND REVIEW

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Revision	Date of Issue	Description	Authority	
			Name	Signature
0	14 October 2008	For GRC's review.	Rolando V. Cuaño, Ph.D. President	
1	17 October 2008	With GRC's comments and for EIARC / Stakeholder review.	Rolando V. Cuaño, Ph.D. President	
2	13 January 2009	Final copy – Additional information required by EIARC and transcript of Public Hearing integrated into the report.	Rolando V. Cuaño, Ph.D. President	

PROJECT DESCRIPTION

The Siana Gold Project of Greenstone Resources Corporation (GRC) is located in the Province of Surigao del Norte, northeastern Mindanao (Figure PF-1). It involves the redevelopment of the former Siana Mine of Surigao Consolidated Mining Company (SURICON) with the following components:

1. Dewatering of the open pit with current approximate depth of 90 m
2. Mining of the Siana gold deposit by open pit mining to an approximate depth of 200 m below the surface from the existing floor depth of about 90 m, then by underground mining over an approximately 200 m vertical interval
3. Construction and operation of a 750,000 tonnes per year (TPY), expandable to 1 million TPY, cyanidation and flotation plant
4. Construction and operation of mine tailings ponds and waste rock dumps
5. Development and use of a mine camp, workshop, administration office, and 750 KVA standby generator
6. Construction and use of a 1-km all-weather access road and a 65-tonne causeway crossing and
7. Mine rehabilitation and decommissioning.

Except for the access road, causeway crossing, and drainage channel of the emergency spillway of TSF3, all Project components are within the property of the former Siana mine.

The Project has a total life, from pre-construction to mine closure, of twelve (12) years.

EIA PROCESS

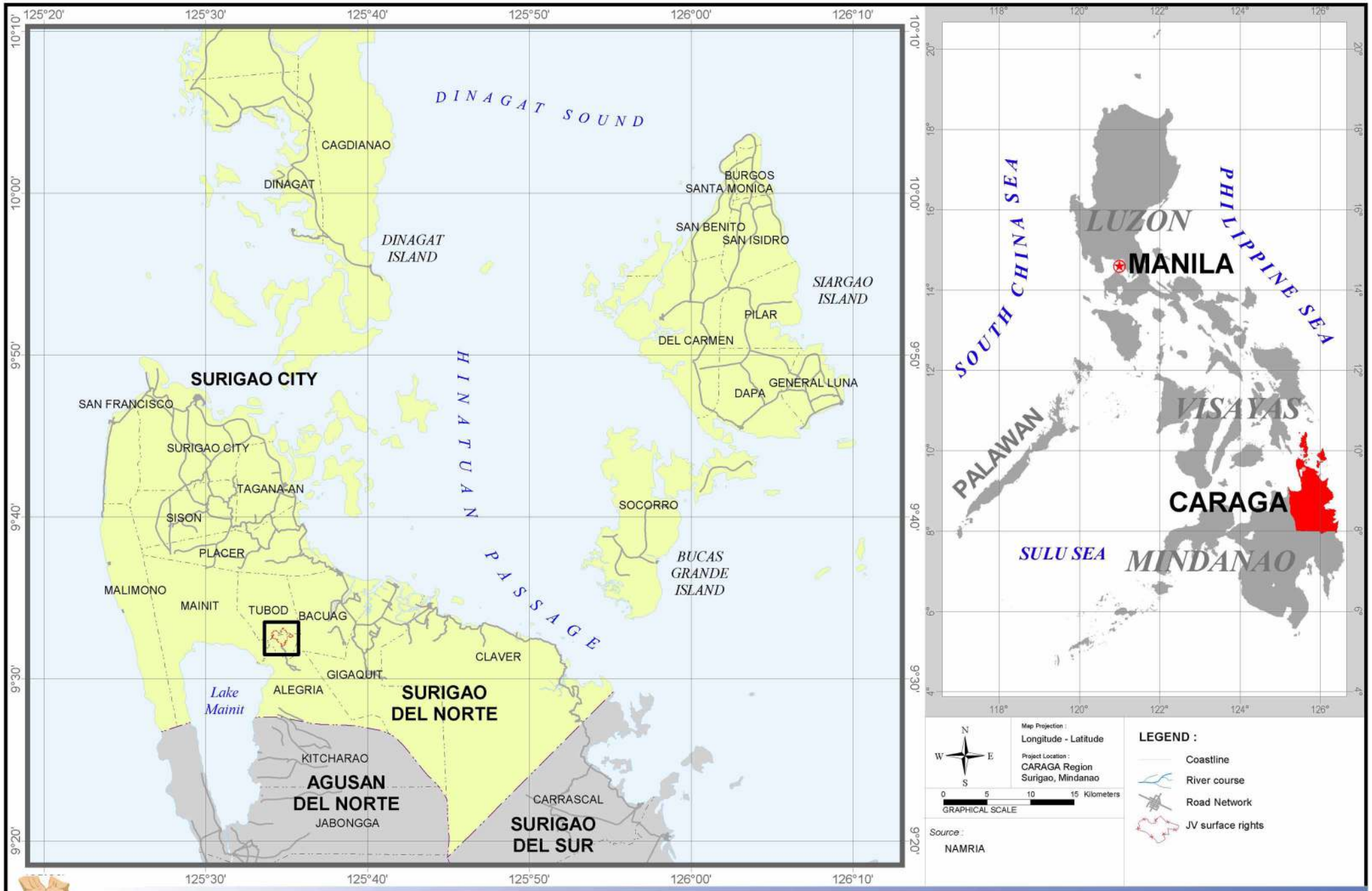
The environmental impact assessment (EIA) of the Siana Project entailed the following steps:

- Taking stock of the environment, natural resources, and social systems in the project area and vicinities through the use of primary and secondary data.
- Predicting the future state of the environment, natural resources, and social systems given the current stressors and stresses.
- Predicting the future state of the environment, natural resources, and social systems with the implementation of the Siana Gold Project, focusing on the resource use and competition and displacement of existing natural systems.
- Formulating project process modifications or management plans for the project areas or aspects found to impact on the environment, natural resources, and social systems.
- Taking into consideration the stakeholders' views, experiences, and suggestions in all of the above steps.
- Finally, documenting the entire EIA process to capture the stakeholders' concerns, perceptions, aspirations, and suggestions.

The EIA Team is composed of engineers and scientists with expertise on the various fields required by the Project's EIA.

BASELINE PROFILE, KEY IMPACTS, AND ENVIRONMENTAL MANAGEMENT MEASURES

Baseline Profile	Key Impacts	Environmental Management Measures
Land		
Land use and classification – The Project facilities will be built inside the former mine and industrial facility of SURICON. Predominantly grassland with a flooded open pit, the 240-ha Siana property is titled. Areas near the river adjacent to the property are planted to rice. A 1-km access road will be built to connect the Siana property to the National Highway. Outside of the Siana property, the proposed road alignment is a mix of grassland and agricultural land planted to rice.	Limited to the conversion of roughly 0.8 ha of rice fields into infrastructure use.	No environmental management measures required.
Soils –Alluvial and upland soil are the soil types in the area. The upland soil, which evolved from igneous rocks and limestone, is clayey, deep, and well-drained with moderate fertility. The alluvial soil is clay loam, deep, and generally poorly drained with high fertility. The alluvial soils are planted to rice; the upland soil in the Siana property is grassland. Outside of the Siana property, the upland soil is planted to coconut.	Sediment eroded from the mine development area and tailings released from the tailings storage facility (TSF) will discharge into Magpayang River and Dayano Creek and impact the stream beds and rice fields near the river banks.	Minimization of ground clearings, diversion of clean surface runoff away from disturbed areas, recovery and use of topsoil, spoils management, grading of work areas and channels, scheduling of construction during dryer months, settling ponds and geotextile tubes, monitoring of Dayano Creek and Magpayang River water quality for turbidity and total suspended solids, and mine rehabilitation and decommissioning plan at the end of mine life.
Geology and geomorphology – The Project is located in a complex tectonic region. The nearest earthquake generators are the Philippine Fault Zone, about 25 km west and the Philippine Trench, roughly 135 km eastward. Five (5) volcanoes are within 200 km from the Project site. The most active, Mt. Hibok-Hibok, is 103 km westward.	Ground shaking and liquefaction of tailings from strong earthquakes can cause failure of the proposed TSF. Ground shaking coupled with water saturation of the waste rock dump can weaken the dump. Open pit mining can cause instability of the pit wall or adjacent areas. The same effects may be expected from underground mining. During closure, the TSFs, waste rock dumps, and open pit are vulnerable to slope failure and erosion.	Geotechnical site investigation and engineering design prior to earthworks following the guidelines of the Australian National Committee on Large Dams, implementation of design with strict quality control, regular stability inspection and monitoring, observance of a buffer zone together with rock fall protection fences and bund from the edge of the TSF embankment and waste rock dump, emergency planning and testing, and mine rehabilitation and decommissioning.
Terrestrial biology – Four habitats are distinguished: remnant forest, agro-agricultural, secondary forest, and wetland. At the flooded open pit, the threatened Philippine Duck *Anas luzonica* was observed. The local residents, including the Mamanwas, gather rattan and wood for lumber and hunt wildlife for food and livelihood.	Loss of grassland, wetland habitats, and natural plant succession mechanisms near the pit and at the waste rock dumps. Wildlife at the Project site and vicinities will be displaced because of dust and noise. On the other hand, the Project will lessen the anthropogenic pressures on the remaining forests and wildlife for food and livelihood.	Enrichment planting along the edges of the Siana property to constitute the buffer zone, enforcement of wildlife hunting ban within the property, flora and fauna protection programs in the Project's Social Development and Management Program (SDMP), and mine rehabilitation and decommissioning.
Water		
Hydrology and hydrogeology – The 240-ha Siana property is within the	The flooded open pit with a total estimated volume of	Monitoring of pit dewatering throughout the year and opening of the



bmp

Project regional site location

EIS of the Siana Gold Project

Figure No. **PF-1**

Baseline Profile	Key Impacts	Environmental Management Measures
5,700-ha catchment of the Magpayang River. The Spanish Ditch to the north, Magpayang River to the west, and the Dayano Creek to the south drain the property. The streams are the community's water source for irrigation, washing of clothes, bathing, and care for animals as well as fish source. Magpayang River drains into Lake Mainit which has a catchment size of roughly 87,100 ha (Lake Mainit Development Alliance). Lake fisheries provide food and livelihood for about 31 barangays in 4 municipalities and 2 provinces. The lake drains into the Bohol Sea. BMP simulated rainfall to determine current flood conditions. Flooding occurred for 133 days in a year at depths ranging from 0.02 m to 0.79 m along Dayano Creek and from 0.01 m to 1.58 m along Magpayang River. The simulation excluded backflows from Lake Mainit. Three (3) main aquifers are noted: the alluvial aquifer, highly weathered bedrock saprolite aquifer, and the bedrock fractured aquifer. Springs and shallow wells are the sources of potable water. In 2005, GRC established a potable water supply and distribution system for Brgys. Cawilan, Siana, and Dayano using the pit water.	8.2 million m^3 needs to be dewatered prior to redevelopment. Water from the pit will discharge into Dayano Creek and Magpayang River. An uncontrolled release may alter the channel geometry and cause flooding. During operations, annual water inflows to the pit are estimated at 5.9 million m^3 from groundwater and 1.06 million m^3 from rainfall. Most of the rainfall occurs between November and March. This can flood the open pit and underground works. The ground clearings and other earthworks will increase surface runoff from the development area. This can cause flooding and erosion which will impact the adjacent ricefields. Underground works can cause the drying of rivers and wells in the immediate vicinity of the open pit.	diversion structures of the irrigation dam to divert water to the ricefields during high rainfall periods. Hydrological studies; pit perimeter drainage, dewatering bores, and pumps; drainage channels, settling ponds, and geotextile tubes; emergency planning and testing; and mine rehabilitation and decommissioning. Detailed hydrogeological studies, prediction of hydrological impacts, formulation and implementation of hydrologic control measures.
Water quality – The water quality of streams within and downslope of the Siana mine including Lake Mainit does not show any effects of prior SURICON operation and current gold small-scale mining. A tentative classification of streams following DAO No. 1990-34 shows total coliforms, oil and grease, phenols, and phosphates as phosphorus as limiting factors to a Class C or D classification. The same applies to Lake Mainit which was classified by EMB Region 13 as Class A. The pit water is classified as Class A. The sediment sampling results indicate no significant elevation of copper (Cu), mercury (Hg), cadmium (Cd), and arsenic (As) downslope of the Siana property. For lead (Pb) and zinc (Zn), a rise in concentration downstream is discernible.	The potential impacts to the receiving streams include turbidity from eroded sediment and released tailings; toxicity to terrestrial and aquatic life from accidentally released chemicals like NaOH, $CuSO_4$, HCl, NaCN, and diesel; heavy metals in released tailings, *e.g.*, As, Cr, Cu, Hg, Mn, Pb, and Zn; acid mine drainage (AMD); sewerage, and solid waste. A Langrangian dispersal modelling was conducted to determine the areas within Lake Mainit that will most likely be affected by the release of sediment or tailings via the Magpayang River. The potential impact areas include the easternmost coast of Mainit, coast of Alegria, and to a lesser degree, the coast of Kitcharao.	The management measures for sediment were discussed earlier. Tailings will be managed through cyanide detoxification of tailings prior to discharge to tailings pond and other measures listed previously. Oil, grease, and other chemicals will be managed through personnel training, physical containment systems, and procedures on transport, handling, storage, and disposal of chemicals and wastes. For AMD, the measures will include acid tests on selected blasthole cuttings; waste rock classification into potentially and non-acid forming and appropriate placement of materials in the dump. For solid waste: waste segregation, composting or disposal of waste to recyclers, landfilling. Individual sewage and wastewater treatment systems will be installed for each building.
Freshwater biology – Along Magpayang River, Motorpool which had rocky-stony substratum and riffle areas hosted the highest number of aquatic insects including the sensitive types. Going downstream, the river substratum was sandy and muddy and the number of aquatic insects decreased. The intermediate host of the blood fluke *Schistosoma japonicum* was found in Dayano Creek downslope of the Siana pit. Plankton collection was low probably due to the heavy rains. From interviews, tilapia, hito, biya, dalag, igat, and pait are caught in the rivers.	The proposed Project can cause stressors that are directly toxic to freshwater biota such as heavy metals, high pH, reduced DO, $CuSO_4$, NaCN, NaOH, HCl, and diesel. There are also non-toxic stressors that can affect ecosystems and biota like flow (from pit dewatering or tailings water release) and turbidity.	The applicable management measures are discussed in *Hydrology and Hydrogeology* and *Water Quality*.

Baseline Profile	Key Impacts	Environmental Management Measures
interviews, tilapia, hito, biya, dalag, igat, and pait are caught in the rivers. Based on Tumanda *et al.*'s (2005) Lake Mainit assessment, areas close to the ricefields along the influent rivers had very low water clarity; those close to the Malimono Range had higher visibilities. Pb was rarely detected; Cd was measured in several locations. Coliform counts were highest in Mainit and San Roque. BMP observed 13 genera of phytoplankton and 5 genera of zooplankton in the lake in 2005 - much lower than those reported in 1971, 2003, and 2004 in terms of both individuals and species. The station near the Magpayang River mouth had the least numbers. BMP noted 10 species of fish caught in the lake in 2005 compared to about 12 recorded in 1971. According to fishermen, the decline in fish catch was due to overfishing. The dominant fish caught was the benthic gobiod species. Water column species were very few.		
Air		
Meteorology – The climate at the Project site is Type II - no dry season and a very pronounced maximum rain period from November to February. Based on Surigao City data, the average annual rainfall is 3,573 mm and the average prevailing wind speed and direction is 2.4 m s^{-1} bearing 143°. The two-years' and hundred years' 24-hour storms have precipitations of 204.8 mm and 593.6 mm.	The high rainfall increases the likelihood of erosion, flooding, overtopping, and slope failure of Project structures and facilities.	The relevant management measures are discussed in *Hydrology and Hydrogeology* and *Water Quality.*
Air Quality and noise – Monitoring stations were established N, W, SW, and S of the Siana property. Ambient concentrations of particulate matter 10 micron (PM-10), total suspended particulate (TSP), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) were minimal. Ambient noise measurements exceeded the standards.	Dust and noise are the major impacts of the Project. For Brgy. Cawilan, Puroks Bulawanon and Malipayon 1 which are close to the waste rock dump, process plant, and mine services area are predicted to have ambient TSP and noise exceed the standards. The same is expected for Puroks Riverside and Relocation of Brgy. Siana.	GRC will impose a buffer or exclusion zone from the TSF and waste rock dump perimeter. The additional measures are personnel training on equipment use and maintenance; dust suppression through water sprays, enclosures, and barriers; less noisy and shielded equipment; and dust and noise PPEs to workers.
People		
Socio-economics- The direct impact barangays of the Project are Brgy. Cawilan, Tubod and Brgys. Siana and Dayano, Mainit. The indirect impact barangays are Brgy. Del Rosario, Tubod; Brgy. Magpayang, Mainit; and Brgy. Pongtud, Alegria. Agriculture is the predominant economic activity. A participatory appraisal in 2005 highlighted a general decline in agricultural productivity in the last 25 years. Average monthly cash incomes were reported at P 1,000 to P 11,000.	The positive impacts are direct and indirect employment, national and local taxes, and community programs. The negative impacts are the adverse effects on farming, fishing, land, water, and property from the eroded sediment, tailings, chemicals, and flooding. A maximum of 20 family groups engaged seasonally in	During pre-construction, GRC will inventory the local skills, suppliers, and contractors. Based on Project needs, skill gaps will be identified and training programs for local residents conducted. At construction and operation, GRC will implement the employment policy agreed upon with the impact barangays. During mine closure, GRC will provide retrenchment package and support programs to its employees. The transfer of social assets and services like water and electricity will be discussed with the communities

Baseline Profile	Key Impacts	Environmental Management Measures
In 2005, local leaders identified as major problems potable water system, employment and livelihood opportunities, agricultural inputs, and health services. GRC, though still in the exploration stage, implemented community programs including a potable water supply. Household surveys in 2005 disclosed an 86 % and 80 % Project acceptance in the direct impact and indirect barangays, respectively. The meetings with local leaders and residents of the direct impact barangays in April 2008 confirmed the high Project acceptance.	small-scale gold mining will be displaced. GRC allowed these groups to operate with the understanding that they will vacate the area once development works by the company commence.	discussed with the communities. For the SDMP, GRC will adopt the community-driven development approach. To prevent the adverse effects on community livelihoods and resources, the management measures for erosion and sediment, tailings, chemicals, and flooding will be implemented.
Culture – Some 20 Mamanwa families reside in makeshift houses in Purok Bulawanon, Brgy. Cawilan. Most rely on wage labor, supplemented by backyard gardening, wood gathering, gold panning, and hunting. Since 2002, GRC employed Mamanwa males from Alegria, Mainit, and Tubod as security guards and utility men on a work rotation basis.	Mamanwa acculturation and discrimination.	Inclusion of qualified Mamanwas in priority hiring, provision of training to those who have the potential, and the preservation of Mamanwa culture and improvement of social services for the Mamanwas as part of the SDMP.
Public health – Filariasis, schistosomiasis, and malaria are endemic diseases. The leading causes of illness are acute respiratory infection, pneumonia, diarrhea, bronchitis, tuberculosis, skin diseases, influenza, and hypertension. For Mainit and Alegria, schistosomiasis is a leading cause of illness. The leading causes of death are pneumonia, tuberculosis, septicaemia, cerebro-vascular accident or stroke, heart diseases, cancer, and diabetes mellitus. For Alegria, schistosomiasis is a leading cause of death. Since 2003, GRC provided to the community a full-time doctor and nurse, medicines, and feeding programs to the malnourished children.	Spread of diseases by migrant workers, vector- and water-borne diseases, traffic hazards, respiratory diseases, rockfalls from the TSF and waste rock dumps, dust, noise, toxic chemicals, and heavy metals.	Hiring and regular medical check-up of all employees, contractors, and selected samples from the impact barangays; implementation of Department of Health programs for vector-borne diseases; continuation of GRC's community water treatment and distribution system; vehicle speed limits, safety signages, and pedestrian walkways and restriction; management measures for dust, noise, tailings, and chemicals. To ensure safety along the edges of the TSF and waste rock dump, some 42 to 56 households in Brgy. Siana and 7 to 13 households in Brgy. Cawilan may be relocated.

TABLES

FIGURES

PHOTOS

ANNEXES

A&D	Alienable and disposable
AAS	Atomic absorption spectrophotometer
AEPEP	Annual Environmental Protection and Enhancement Program
AMD	Acid mine drainage
AMMTEC	AMMTEC Ltd
ANCOLD	Australian National Committee on Large Dams
APCFTL	Annual per capita food threshold level
APCPTL	Annual per capita poverty threshold level
APIS	Annual Poverty Indicators Survey
ARD	Acid rock drainage
ARI	Average Return Interval
ASDMP	Annual Social Development and Management Program
AWD	All-wheel drive
BCM	Bank cubic meters
BFAR	Bureau of Fisheries and Aquatic Resources
BFS	Bankable Feasibility Study
BHS	Barangay Health Service
BHW	Barangay Health Worker
BMG	Bureau of Mines and Geosciences
BMP	BMP Environment & Community Care, Inc.
Brgy	Barangay
CAP	Community Acquired Pneumonia
CaVA	Cardio vascular accident
CaVD	Cardio vascular disease
CBC	Complete Blood Count
CeVA	Cerebro vascular accident
CHF	Congestive heart failure
CIDSS	Comprehensive and Integrated Delivery of Social Services
CIL	Carbon-in-leach
CIP	Carbon-in-pulp
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
COPD	Chronic Obstructive Pulmonary Disease
CPP	Communist Party of the Philippines
CPTu	Cone penetrometer testing with pore water pressure measurements
CRL	CRL Environmental Corporation
CTWG	Community Technical Working Group
DA	Department of Agriculture
DAO	DENR Administrative Order
DEC	Diethyl Carbamazine
DENR	Department of Environment and Natural Resources
DMMC	Direct Mining and Milling Cost
DNA	Deoxyribonucleic acid
DOH	Department of Health
DOST	Department of Science and Technology

DOT	Department of Tourism
ECC	Environmental Compliance Certificate
ECM	Environment and Community Manager
EFA	Ecological Function Analysis
EIA	Environmental Impact Assessment
EIARC	EIA Review Committee
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau
EMBRO	EMB Regional Office
EPEP	Environmental Protection and Enhancement Program
ERA	Environmental Risk Assessment
ERPP	Emergency Response Preparedness Program
ERT	Emergency Response Team
ESS	Environmental Systems and Services Pty Ltd
FGD	Focus group discussion
FISRWG	Federal Interagency Stream Restoration Working Group
FMRDP	Final Mine Rehabilitation and Decommissioning Plan
FMRDF	Final Mine Rehabilitation and Decommissioning Fund
FoS	Factor of Safety
FRTR	Federal Remediation Technologies Roundtable
GCA	Graeme Campbell and Associates Pty Ltd
GHD	GHD Pty Ltd
GI	Galvanized iron or Gastro-intestinal
GPS	Global Positioning System
GRC	Greenstone Resources Corporation
HDPE	High-Density Polyethylene
IBC	Intermediate bulk container
IEC	Information, Education, and Communication
IFC	International Finance Corporation
IP	Indigenous People
IPRA	Indigenous People's Rights Acts
IR	Individual risk
IRR	Internal Rate of Return
ISCLT3	Industrial Source Complex – Long Term
ISCST3	Industrial Source Complex- Short Term
IUCN	Internal Union for the Conservation of Nature and Natural Resources
JCG	JCG Resources Corporation
JORC	Joint Ore Reserves Committee of the Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Minerals Council of Australia
KBCM	Kilo bank cubic meters
KCGM	Kalgoorlie Consolidated Gold Mines Pty Ltd
KT	Kilotonnes
L	Liter
LCM	Loose cubic meters
LMDA	Lake Mainit Development Alliance

masl	Meters above sea level
mbsl	Meters below sea level
MCC	Merrill Crowe Corporation
MCLUP	Municipal Comprehensive Land Use Plan
MDE	Maximum Design Earthquake
MEPEO	Mine Environmental Protection and Enhancement Office
mg	Milligram
MGB	Mines and Geosciences Bureau
MGBRO	MGB Regional Office
MMT	Multipartite Monitoring Team
MO	Memorandum Order
MOA	Memorandum of Agreement
MPSA	Mineral Production Sharing Agreement
MRF	Mine Rehabilitation Fund
MRFC	Mine Rehabilitation Fund Committee
MTF	Monitoring Trust Fund
MWES	Meyer Water Environmental Solutions
MWTF	Mine Waste and Tailings Fee
NAAQS	National Ambient Air Quality Standards
NAAQGV	National Ambient Air Quality Guideline Values
NAF	Non-Acid-Forming
NAG	Net Acid Generation
NAMRIA	National Mapping Resources Information Authority
NEDA	National Economic and Development Authority
NGO	Non-Government Organization
NFPA	National Fire Protection Association
NPA	New People's Army
NPV	Net Present Value
NNW	North to northwest
NSCB	National Statistical Coordination Board
OBE	Operating Basis Earthquake
OHSS	Occupational health and safety standards
OSCC	Office of Southern Cultural Communities
PAF	Potentially Acid-Forming
PAGASA	Philippine Atmospheric Geophysical and Astronomical Sciences Administration
PAWB	Protected Areas and Wildlife Bureau
PD	Presidential Decree No.
PERF	Philippine Employee Retirement Fund
PFZ	Philippine Fault Zone
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PIA	Philippine Information Agency
PICOP	PICOP Resources, Inc.
PMP	Probable maximum precipitation
POM	Princeton Ocean Model

PPE	Personal protective equipment
QC	Quality Control
R&M	Repairs and maintenance
R5AI	Red5 Asia Incorporated
RA	Republic Act
RAP	Resettlement action plan
RCF	Rehabilitation Cash Fund
RCNM	Road Construction Noise Model
RDA	Recommended dietary allowance
RH	Relative Humidity
RHU	Rural Health Unit
RMR	Rock mass rating
ROM	Run-of-mine
RQD	Rock quality designation
RSG	RSG Global Consulting Pty Ltd
RL	Reference level
S	Second
SAG	Semi-autogenous grinding
SDR	Sediment Delivery Ratio
SE	Southeast
SRC	Seismology Research Centre
SSE	South to southeast
SDMP	Social Development and Management Program
SHIC	Surigao Holdings and Investments Corporation
SPT	Standard penetration test
STD	Sexually transmitted disease
STP	Sewage Treatment Plant
SURICON	Surigao Consolidated Mining Company
TB	Tuberculosis
TLV	Threshold Limit Value
TPY	Tonnes Per Year
TSF	Tailings Storage Facility
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
TWA	Time Weighted Average
UCS	Unconfined/uniaxial compressive strength
URTI	Upper respiratory track infection
USEPA	United States Environmental Protection Agency
USFHWA	United Stated Federal Highway Administration
UTI	Urinary Tract Infection
WAD	Weak acid dissociable
WPT	Water pressure test

ANFO	Ammonium nitrate fuel oil
As	Arsenic
BOD	Biochemical Oxygen Demand
Cd	Cadmium
CEC	Cation Exchange Capacity
CN	Cyanide
CNO	Cyanate
CO_3	Carbonate
Cu	Copper
$CuSO_4$	Copper Sulfate
DO	Dissolved Oxygen
FeS_2	Pyrite
HCl	Hydrochloric acid
Hg	Mercury
H_2SO_4	Sulfuric acid
H_2O_2	Hydrogen peroxide
H_2SO_5	Peroxymonosulfuric acid
K	Potassium
LC_{50}	Median lethal concentration
MIBC	Methyl isobutyl carbinol
Mn	Manganese
MPN	Most probable number
N	Nitrogen
NaCN	Sodium cyanide
NaOH	Sodium hydroxide
NH_4	Ammonium
Ni	Nickel
NO_2	Nitrogen Dioxide
P	Phosphorus
Pb	Lead
PbS	Galena
SCN	Thiocyanate
SIX	Sodium isobutyl xanthate
SMBS	Sodium Metabisulfite
SO_2	Sulfur Dioxide
TDS	Total Dissolved Solids
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
Zn	Zinc
ZnS	Sphalerite
$ZnSO_4$	Zinc Sulfate

EXECUTIVE SUMMARY

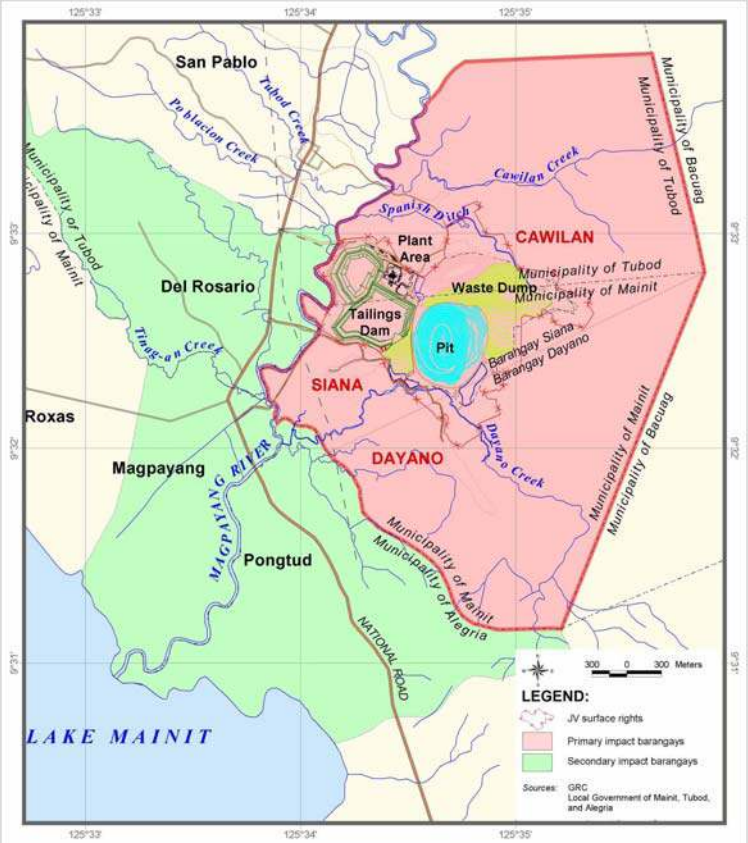


Figure ES- 1. Siana Gold Project and impact communities

1. BRIEF PROJECT DESCRIPTION

Table ES-1 highlights the parameters of the Project. The location of the Project components vis-a-vis the communities is shown in Figure ES-1.

Table ES 1. Parameters of the Siana Gold Project

Aspect	Description
Project location and area	The Siana Gold Project is located roughly 39 km south of Surigao City, northeastern Mindanao. It is within the 240-ha Siana property, portions of which fall within Brgy. Cawilan of the Tubod Municipality and Brgys. Siana and Dayano of the Mainit Municipality, Province of Surigao del Norte.
Rationale	Greenstone Resources Corporation (GRC) has blocked a probable reserve of 3.16 million t grading 3.4 g t^{-1} Au and 8.5 g t^{-1} Ag, mineable by open pit for 4.5 years, in the Siana property formerly operated by SURICON. GRC inferred additional resources extractable by underground mining method which can prolong mine life to 10 years and result in the total recovery of 720,000 oz Au and 1.34 million oz Ag. By adding a sulfide flotation circuit in the process plant during underground mining, a Zn concentrate and combined Cu-Pb-Zn concentrate can be produced. GRC's redevelopment of the Siana mine will ensure that the remaining mineral resources are extracted to the benefit of the local and national economies. It will also enable the completion of a Final Mine Rehabilitation and Decommissioning Plan that will address the physico-chemical stability risks spawned by SURICON's sudden mine closure in 1990.

Aspect	Description
Components	The components of the Project are: a. Dewatering of the open pit with current approximate depth of 90 m b. Mining of the Siana gold deposit by open pit mining to an approximate depth of 200 m below the surface from the existing floor depth of about 90 m, then by underground mining over an approximately 200 m vertical interval c. Construction and operation of a 750,000 tonnes per year (TPY), expandable to 1 million TPY, cyanidation and flotation plant d. Construction and operation of mine tailings ponds and waste rock dumps e. Development and use of a mine camp, workshop, administration office, and 750 KVA standby generator f. Construction and use of a 1-km all-weather access road and a 65-tonne causeway crossing and g. Mine rehabilitation and decommissioning.
Project phases	The Project has two phases, namely, open pit and underground mining, roughly spaced 3 years apart. For the open pit phase, the stages are: a. Pre-construction – Community consultations and management program, exploration, pre-feasibility study, environmental impact assessment and other environmental studies, geotechnical studies, geochemical tests, hydrologic and hydrogeologic investigations, feasibility study, land acquisition (for the road), permitting, detailed engineering, and procurement b. Construction – Installation of environmental and social management systems; power line and substation; access road and causeway crossing construction; pit dewatering and development; construction of tailings storage facility (TSF) and pipelines, waste rock dumps, process plant and ancillaries, mine services area, administration building, accommodations, water supply, sewage treatment, stormwater and sediment control system; and plant commissioning c. Operation – open pit mining, gold cyanidation, cyanide detoxification, build-up of TSF and waste dump, implementation of environmental protection and enhancement program (EPEP) and social development and management program (SDMP), periodic review of final mine rehabilitation and decommissioning plan (FMRDP). For the underground mine, the stages are: a. Pre-construction – Exploration, detailed hydrology and geotechnical studies, feasibility study, detailed engineering, and procurement b. Construction – Development of portal and decline, electrical substation, waste and ore levels, ventilation raises, and fill batch plant, and installation of flotation circuits at the process plant c. Operation – Mining by up-hole benching or other suitable technique, void filling, flotation and gold cyanidation, cyanide detoxification, build-up of TSF, implementation of EPEP and SDMP, and periodic review of FMRDP. For both the open pit and underground mines, the abandonment activities include the implementation of FMRDP. The activities include the removal of wastes, dismantling of plant structures, re-flooding of open pit and underground workings, drying of tailings pond, recontouring and drainage works, spread of topsoil and revegetation, retrenchment package and labor support programs for the employees, and transfer of social assets.
Process	The open pit cycle involves drilling, blasting, loading, and hauling of ore to the run-of-mine (ROM) pad and waste rock to the TSF or waste rock dump. From the ROM pad, the ore is brought to the process plant for crushing and grinding, gravity concentration, and cyanidation. The gold and silver adsorbed in the carbon is stripped and recovered in electrowinning cells. The tailings prior to discharge to the TSF go through the cyanide detoxification plant. The underground mining cycle entails developing strike drives to the extent of mineralization, then retreating to a central pillar by drill and blast. The broken ore is loaded into low-profile trucks and hauled to the surface. A flotation circuit is added to the gold cyanidation plant to allow recovery of Zn concentrate

Aspect	Description
	and Cu-Pb-Zn concentrate.
Production capacity	The process plant will have a capacity of 750,000 TPY expandable to 1 million TPY.
Types of major waste streams	The Project's wastes are: • All Phases – Domestic solid waste, sewage, surface runoff and suspended sediments, dust, noise, and used oil • Construction – Pumped out pit water and suspended sediments, waste rocks, reagent spills, and tailings • Operations – Waste rocks, surface runoff and suspended sediments, reagent spills, tailings, and supernatant tailings water • Abandonment – Unnecessary structures, equipment, and ancillaries, surface runoff and suspended sediments, and dust
Manpower	GRC estimates its peak manpower requirements during construction and operations at 350 and 500, respectively. During construction, the contractor is expected to require an additional 350 personnel.
Project cost	The total capital cost for a 750,000 TPY open pit mining operation is US $ 60 million.
Project duration and schedule	Permitting works, detailed engineering, procurement, and construction will require 1.5 years. The estimated life of the open pit and underground mineral resource is 10 years. Mine decommissioning and rehabilitation works are expected to take 0.5 year. Hence, the total project life is 12 years.

2. BRIEF SUMMARY OF PROJECT'S EIA PROCESS

EIA Team

Table ES 2. BMP's EIA Team

Consultant	Areas of Expertise
Rolando V. Cuaño, Ph.D.	• Geology and geohazards • Erosion and sediment control • Environmental risk assessment • Environmental management system
Jose N. Tanchuling	• Water quality • Project description
Felixberto M. Centeno (CRL Environment Corporation for air quality and noise measurements)	• Meteorology • Air quality and noise • Hydrology
Perfecto P. Evangelista, Ph.D.	• Soils and erosion • Agriculture and land use
Bibiano P. Ranes, Ph.D.	• Terrestrial flora and fauna
Carmela P. Española	• Terrestrial fauna
Roberto C. Pagulayan, Ph.D.	• Freshwater biology
Cesar L. Villanoy, Ph.D.	• Hydrodynamic modeling
Marita G. Cuaño	• Socio-economics • Public health • Stakeholder engagement
Nestor T. Castro, Ph.D.	• Indigenous people and culture

EIA Study Period

The First-Level EIA Scoping meeting was held in December 2004. The Second-Level Scoping meeting followed a month later. BMP conducted the environmental and social baseline studies from January to May 2005. Further works on impacts assessment and mitigation were placed on hold pending GRC's finalization of the Project definition.

In December 2007, GRC provided BMP the Feasibility Study for the Siana Gold Project. For the updating of BMP's baseline studies, GRC made available its reports on water quality monitoring, streamflow measurements, and community development. BMP complemented said reports with site assessments. From January to April 2008, BMP updated the environmental and social baselines and completed the impacts assessment and mitigation and environmental management planning for the Project.

In March 2008, BMP advised EMB of the resumption of the EIA process for the Siana Project. Due to non-availability of most of the members of the EIA Review Committee (EIARC) formed in December 2004, EMB created a new EIARC for the Project. This committee met on 27 March 2008 to rescope the EIA.

BMP and GRC finalized the Environmental Impact Statement (EIS) for the Siana Project based on the 2008 rescoping from May to September 2008.

EIA Study Area

The EIA study covers the direct impact areas of Brgy. Cawilan, Tubod and Brgys. Siana and Dayano, Mainit as well as the indirect impact areas of Brgy. Del Rosario, Tubod; Brgy. Magpayang, Mainit; and Brgy. Pongtud, Alegria (Figure ES-1). The major water bodies are Magpayang River, Dayano Creek, and Lake Mainit.

EIA Method

BMP employed methodologies compliant with the standards of the DENR and EMB on the conduct of EIAs. Table ES-3 summarizes the EIA study scope and methodology.

Table ES 3. EIA study scope and methodology

EIA Study Module	Scope	Methodology
Land		
Land use and classification	Land classification; land use; locations of ecological, cultural, historic, and recreational significance	Mainly review of secondary data complemented by results of site assessment and interviews
Geology	Regional geology, geologic cross-sections, stratigraphy, geomorphology, g factor	Review of geologic reports complemented by field mapping
Pedology	Slopes, soil types, soil fertility, soil erosion, vegetation	Review of topographic map and soil reports updated by soil sampling and site assessment
Terrestrial biology	Flora and faunal species inventory; species endemicity and conservation status; species abundance, frequency, and distribution	Review of secondary data, species inventory using the transect and sampling plot methods, interviews, and computation of diversity indices
Water		
Hydrology and hydrogeology	Regional hydrogeology, drainage system, streamflow measurements, flood peaks, spring and well inventory	Review of geologic reports and topographic map; site assessment; stream channel survey; flow velocity measurement using the float method; interviews, and numerical modeling for flood peaks and mean monthly

EIA Study Module	Scope	Methodology
		flows
Water quality	Physico-chemical and bacteriological characteristics of river waters, wells, and springs	Review of secondary data; water sampling, and laboratory analyses of samples
Freshwater biology	Density and abundance of planktonic and benthic algae, benthic fauna, fish species biomass, ranks and proportion of commercially and non-commercially important indicator species	Review of secondary data; site assessment; water sampling; benthic macroinvertebrate sampling, and electrofishing
Lake hydrodynamics	Hydrodynamics of Lake Mainit and delineation of potential impact areas from sediment or tailings releases	Bathymetric survey; measurement of temperature, conductivity, and surface currents; and hydrodynamic modeling using the Princeton Ocean Model
Air		
Meteorology	Monthly average rainfall, climatological normals and extremes, wind rose diagrams, and frequency of tropical cyclones	Review of secondary data
Air quality and noise	Ambient air quality and noise levels	Air quality sampling and noise measurements; air pollutant dispersion and noise modeling
People		
Socio-economics	Population, settlements, land area, income sources, sex and age, literacy, employment status, water supply and demand, transportation, power supply and demand, public perception	Review of secondary data; focus group discussions; community mapping; site assessment; interviews, and household survey
Public health	Morbidity and mortality rates and trends, notifiable diseases including endemic diseases, local health resources, environmental health and sanitation	Review of secondary data; focus group discussions; site assessment, and interviews
Indigenous people and culture	Mamanwa baseline cultural assessment, impact assessment, and socio-cultural management plan	Review of secondary data, focus group discussion, interviews, observation, and household survey
Environmental risk assessment (ERA)	System description, hazard identification, consequence analysis, frequency analysis, risk estimation, risk management and emergency preparedness and response plan	Review of secondary data; scoping of ERA, and conduct of ERA

Summary of Public Participation

The EIA maximized the participation of local residents, community workers, leaders, and organizations as providers of information about the study area and as sources of concerns and suggestions for the Siana Project. The avenues for public participation during the EIA process include the following:

- Meetings with Alegria Municipal Mayor Jessie Aguilera and Mainit Mayor Rogelio Gatpolintan in January 2005 and Tubod Municipal Mayor Guillermo Romarate, Jr. in April 2005
- Meeting with Engr. Kaiser Recabo, Project Director of the Lake Mainit Development Alliance in January 2005

- Small meetings with leaders of Brgy. Pongtud, Alegria; Brgys. Magpayang, Siana, and Dayano, Mainit; and Brgy. Cawilan, Tubod in January 2005 on community timeline, problems, EIA process, and GRC's Siana Project
- Second-level EIA Scoping meeting in January 2005
- Participatory agriculture and fishery resources and livelihood assessment for Brgy. Cawilan, Tubod Municipality; Brgys. Magpayang, Dayano, and Siana, Mainit Municipality; and Brgys. Pongtud and San Juan, Alegria Municipality in February and March 2005
- Grassroots information, education, and communication (IEC) campaign about the Project at Brgys. Cawilan, Siana, Dayano, Magpayang, del Rosario, and Pongtud in March and April 2005
- Interviews of local residents during the environmental and social baseline surveys of January to May 2005
- Household surveys on 30 April to 1 May 2005 at Bgrys. Cawilan and Del Rosario, Tubod Municipality; Brgys. Siana, Dayano, and Magpayang, Mainit Municipality; and Brgy. Pongtud, Alegria Municipality
- Meetings with officials, health workers, and leaders and representatives of farmers', irrigators', women's, and youth groups of Brgys. Cawilan, Siana, and Dayano on 24 April 2008 about the Siana Project including the underground mine and stakeholder perceptions and approval.

3. SUMMARY OF BASELINE CHARACTERIZATION

Table ES 4. Key findings on the environmental baselines

Environment	Key Findings or Conclusions
Land	1. The 240-ha Project site is the former mine and industrial facility of SURICON. The major land features are a flooded open pit, two (2) dried and grassed tailings ponds, one tailings pond with a pool of water, three (3) grassed waste dumps, and a workshop. 2. The site, which is predominantly grassland, is relatively flat with a mean elevation of 50 – 60 masl and mean slope of 8 – 18 %. Soils in the area consist of clayey to loam over clay, deep, and well-drained upland soil with moderate fertility and clay loam to silty clay loam over clay, deep, and generally poorly drained alluvial soil with high fertility. The alluvial soils are planted to rice; the upland soil in the Siana property is grassland. Outside of the Siana property, the upland soil is planted to coconut. 3. The Project site occurs in a complex tectonic region. The nearest earthquake generators are the Philippine Fault Zone, about 25 km to the west and the Philippine Trench, roughly 135 km eastward. Mt. Hibok-Hibok, an active volcano, is 103 km westward. 4. The Siana deposit targeted for mining is a complex disseminated replacement style of gold deposit hosted within a fault-bounded limestone breccia. 5. Four habitats are distinguished: remnant forest-agro, agricultural, secondary forest, and wetland. At the flooded open pit proposed for dewatering and mining, the Philippine Duck *Anas luzonica*, which is listed as threatened in the IUCN Red List (IUCN 2007), was observed. The local residents, including the Mamanwas, gather rattan and wood for lumber; they hunt wildlife for food and livelihood.
Water	1. The Project site is within the 5,700-ha catchment of the Magpayang River. The river drains into Lake Mainit which has a total catchment size of 87,100 ha (LMDA). The 17,100-ha lake (BFAR) drains into the Bohol Sea. 2. The Spanish Ditch to the north, Magpayang River to the west, and the Dayano Creek to the south drain the property. The maximum flow recorded for the three (3) streams was more than 0.12 $m^3 s^{-1}$, 12 $m^3 s^{-1}$, and 2.5 $m^3 s^{-1}$, respectively. Direct rainfall and groundwater accumulated 8.2 million m^3 of water in the old 90-m deep Siana open pit. 3. Based on a simulation using 2003 daily rainfall data for PAGASA's Surigao City station and excluding the effects of stagnation or backflows from Lake Mainit, surveyed sections along Dayano Creek and Magpayang River were found to overflow 133 days in a year. The overflow depths ranged from 0.02

Environment	Key Findings or Conclusions
	m to 0.79 m for Dayano Creek and from 0.01 m to 1.58 m for Magpayang River. Tumanda *et al.* (2005) noted that during maximum rain periods, the lake water level is raised by as much as 1 m. During episodic storms, the rise is as high as 2 to 3 m. 4. Three (3) main aquifers are observed at the site, namely, the 6 to 12-m thick alluvial aquifer, bedrock saprolite aquifer, and the bedrock fractured aquifer, notably basalts and karstic limestone. 5. Up to 2005, springs and shallow wells are the sources of potable water in the area. In 2005, GRC established a potable water supply and distribution system for the direct impact barangays of Cawilan, Siana, and Dayano. 6. The water quality of receiving streams does not show any effects of prior SURICON operation and current gold small-scale mining. A tentative classification of streams following DAO No. 1990-34 indicates total coliforms, oil and grease, phenols, and PO_4-P as limiting factors to a Class C or D classification. The pit water is classified as Class A. 7. Along Magpayang River, from the Motorpool station going downstream, the number of aquatic insects and sensitive types is noted to decline. Plankton collection was low probably due to the heavy rains at the time of sampling. The intermediate host of the blood fluke *Schistosoma japonicum* was found in Dayano Creek. Tilapia, hito, biya, dalag, igat, and pait are caught in the rivers. 8. At Lake Mainit, phytoplankton, zooplankton, and fish species were assessed in 2005. The plankton species and individuals observed were much lower than those reported in 1971. The station near Magpayang River, observed to be the most turbid, had the least numbers.
Air	1. Following the Modified Coronas Classification, the climate is Type II, *i.e.*, the absence of a dry season and a very pronounced maximum rain period from November to February. 2. Based on climate data for 1984 to 2004 from the nearest PAGASA station which is Surigao City roughly 39 km northward, the average annual rainfall is 3,573 mm; maximum annual rainfall is 4,098 mm; maximum 24 hour rainfall is 566 mm; average prevailing wind speed and direction is 2.4 m s^{-1} bearing 143^{o}; and maximum wind speed and direction is 56 m s^{-1}, bearing 88^{o}. 3. The residents of communities adjacent to the Project site recall the devastating effects of two typhoons – one in 1964 and the other in 1984. The latter reportedly destroyed 60 % of the houses in Brgy. Pongtud, Alegria Municipality. 4. Air quality and noise monitoring stations were established at sensitive sites surrounding the Siana property. Concentrations of particulate matter 10 micron (PM-10), total suspended particulate (TSP), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) in the air were minimal. Noise measurements exceeded the standards.
People	1. The direct impact barangays of the Project are Brgy. Cawilan of Tubod Municipality and Brgys. Siana and Dayano of Mainit Municipality. In 2007, the populations of the three (3) barangays are 1,290; 872; and 402, respectively. The indirect impact barangays are Brgy. Del Rosario, Tubod; Brgy. Magpayang, Mainit; and Brgy. Pongtud, Alegria Municipality. The populations of these barangays are 1,249; 1,498; and 1,216, respectively. 2. Tubod and Alegria are fifth-class municipalities, *i.e.*, annual incomes range from P 7 to P 13 million; Mainit is fourth-class, *i.e.*, annual income is from P 13 to P 21 million. Their economies are agriculture-based with coconut and rice as the major crops. The major fish sources are Lake Mahacdum for Tubod and Lake Mainit for Mainit and Alegria. 3. A participatory rural appraisal conducted in 2005 indicated a general decline in agriculture and fishery productivity over the last 25 years. The decline was attributed to soil erosion in the upland due to deforestation, soil erosion from SURICON operations, sedimentation and flooding of rice fields, sedimentation of rivers and Lake Mainit, water pollution from SURICON tailings and gold panning, backflow of Lake waters, pests infestation, and illegal fishing methods. The participants reported monthly incomes based on average cash receipts of P 1,000 to P 11,000. Brgy. Cawilan had the least number of households engaged in agriculture at 3 %; Brgys. Siana and Dayano had 40 %. Brgy. Cawilan also had the least number of households engaged in fishing at 1 %; Brgy. Siana had 2 %; Brgys. Dayano and Pongtud had 3 %. 4. Some 20 Mamanwa families reside in makeshift houses in Purok Buluwanon, Brgy. Cawilan. The Mamanwas comprise a Negrito group mainly found in the provinces of Surigao del Norte, Surigao del Sur, and Agusan del Norte. They used to subsist primarily on shifting cultivation supplemented by

Environment	Key Findings or Conclusions
	hunting, fishing, and foraging activities. Presently, most of the Mamanwas in Brgy. Cawilan rely on wage labor. 5. Majority of the leading causes of illness in the area are communicable diseases such as acute respiratory infection, pneumonia, diarrhea, bronchitis, tuberculosis, skin diseases, and influenza. Hypertension is the only non-communicable disease. For Mainit and Alegria, schistosomiasis is a leading cause of illness. As regards deaths, pneumonia, tuberculosis, and septicaemia are the top killers. Lifestyle diseases such as cerebro-vascular accident or stroke, diseases of the heart, cancer, and diabetes mellitus are dominant. For Alegria, schistosomiasis is a leading cause of death. The endemic diseases include filariasis, schistosomiasis, and malaria. 6. Meetings with the local leaders of the direct and indirect impact barangays in 2005 led to the identification of major community problems: potable water system, employment and livelihood opportunities, agricultural assistance, medical assistance, farm-to-market roads, inaccessibility of higher education, inadequacy of income for education, poor or inadequate school facilities, and absence or inadequate maintenance of day care centers, multi-purpose buildings, terminals, and recreation centers. 7. As a result of the 2005 meetings, GRC, though still in the exploration and feasibility study stage, implemented major community programs for the direct impact barangays. These include potable water supply, medical assistance, educational assistance, malnourished children's feeding program, and children's playgrounds. 8. Household surveys in April and May 2005 disclosed an 86 % project acceptance in the three (3) direct impact barangays and an 80 % acceptance in the three (3) indirect impact barangays. Meetings with officials, health workers, and leaders and representatives of farmers', irrigators', women's, and youth groups of Brgys. Cawilan, Siana, and Dayano in April 2008 confirmed the high community acceptance of the Project.

4. SUMMARY OF IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

Table ES 5. Environmental impacts and management plan

Key Activity	Impacts		Environmental Management Plan
	Environmental Component	Characterization	
All Project Phases	Land		
	• Visual aesthetics	Solid waste – Negative, short-term, moderate	• Segregation of waste into biodegradable and non-biodegradable • Composting or disposal of wastes to recyclers • Dumping of non-recyclable, non-biodegradable, and non-hazardous waste in the landfill
	Water		
	• Water quality • Freshwater biology	Turbidity, oil and grease, sewage – Negative change, temporary duration, moderate effect	<u>Turbidity</u> • Minimized ground clearings and disturbances • Scheduling of construction during dryer months • Surface runoff diversion from disturbed areas • Recovery and use of topsoil • Spoils management • Grading and sloping of work areas and channels

Key Activity	Impacts		Environmental Management Plan
	Environmental Component	Characterization	
			• Use of settling ponds and geotextile tubes <u>Oil and grease</u> • Training on proper oil handling • Oil spills containment • Collection and containment of used oil <u>Sewage</u> • Sewage treatment plants
	People		
	• Socioeconomics	Employment, taxes, community programs – Positive, temporary, significant	• Inventory of skills and local suppliers and contractors and identification of gaps based on Project requirements • Training programs for local residents • Implementation of employment policy agreed upon by the Chairmen of direct impact and indirect impact barangays • Preference to qualified local suppliers and contractors • Transparent consultative mechanisms for the identification and prioritization of SDMP projects
	• Culture	Mamanwa acculturation and discrimination – Positive/ negative, medium-term, significant	• Inclusion of qualified Mamanwas in priority hiring • Improvement of social services for the Mamanwa community • Education of workers on Mamanwa culture and need for ethnic tolerance • Education of Mamanwa workers on other people's culture including the corporate culture • Cultural revival activities
	• Occupational safety and health	Exposure to elements and rockfalls, musculo-skeletal stress, physical injuries, loss of hearing, respiratory diseases, exposure to hazardous reagents – Negative, temporary to permanent, moderate	• Stringent policies and programs of GRC on occupational safety and health • General employee induction and regular safety training • Safety inspections and toolbox meetings • Regular medical examinations • PPEs • Bunds at the waste dump area • First-aid and mine rescue trainings
	• Public health	Vector and water-borne diseases, traffic hazards, respiratory diseases, spread of diseases by migrant workers, heavy metals, AMD, hazardous	• Coordination with the Department of Health (DOH) for the implementation of programs for vector-borne diseases • Continuation of GRC's community water treatment and distribution system

Key Activity	Impacts		Environmental Management Plan
	Environmental Component	Characterization	
		reagents, rockfalls – Negative, temporary to permanent, moderate	• Vehicle speed limits, safety signages, pedestrian walkways and restriction from mine access and haul roads • Observance of buffer or exclusion zone from the TSF and waste rock dump perimeter. Some 49 to 69 households are targeted for relocation. • Rockfall protection fence south of TSF3 • Management measures for dust, noise, AMD, and reagents • Hiring and regular medical check-up of all employees and contractuals and selected samples from the impact barangays
Construction			
• Surface earthworks and civil works – roads, tailings storage facility (TSF), settling pond, open pit, accommodations, plant, warehouse, shops, installations, etc.	Land		
	• Terrestrial biology	Limited loss of grasslands and ricefield habitats – Negative, medium-term, moderate	• Minimized ground clearings and disturbances • Recovery and use of topsoils • Enrichment planting along edges of the property • Ban on wildlife hunting and gathering of duck eggs within the property
			• Inclusion of flora and fauna protection programs in the SDMP
	Air	Dust and noise – Negative, temporary, moderate	• Training on proper equipment use • Water sprays • Enclosures, barriers, and buffer zones surrounding the TSF embankment and waste rock dump perimeter. Some 49 to 69 households are targeted for relocation. • Use of less noisy and shielded equipment • Proper maintenance of equipment • Dust and noise PPEs to workers
• Pit dewatering	Land		
	• Terrestrial biology	Loss of wetland habitat of Philippine Duck – Negative, medium-term, moderate	• Enrichment planting to include fruit trees along edges of the property • Enforcement of ban on wildlife hunting and gathering of duck eggs within the property • Inclusion of flora and fauna protection programs in the SDMP
	Water		
	• Hydrology	Change in channel geometry – Negative, temporary, moderate Flooding along Dayano Creek – Negative, temporary, moderate	• Monitoring and control of pit dewatering flow rates during high-rainfall periods • Opening of the diversion structures of the irrigation dam to divert water to the ricefields

Key Activity	Impacts		Environmental Management Plan
	Environmental Component	Characterization	
	• Water quality • Freshwater biology	Dissolved solids and flow – Negative, temporary, moderate	• Monitoring and control of pit dewatering flow rates during high-rainfall periods • Discharge of pumped out pit water into a settling pond and then geotextile tubes prior to discharge to Dayano Creek • Regular monitoring of pit water quality at the settling pond prior to discharge
	People		
	• Socioeconomics	Loss of community water supply – Negative, temporary, moderate	• Installation of 5 dewatering bores near the eastern edge of the pit • Use of water pumped out from the bores to feed the community water supply
• Pit development and build-up of TSF and waste rock dump	Land		
	• Geomorphology	Physical instability of pit, TSF, and waste rock dump – Negative, temporary, moderate	• Geotechnical site investigations and engineering design of structures • Design implementation with strict quality control (QC) • Use of dewatering bores and ground support where required at the open pit
			• Regular stability inspections and monitoring, including phreatic surface of the TSF embankments and waste rock dump • Observance of buffer or exclusion zone from the edge of TSF embankment and waste rock dump. • Non-placement of large continuous volumes of clay-rich material within the waste rock dump • Construction of safety bunds or catch fences around the pit edge • Emergency planning and testing
	Water		
	• Hydrology	Flooding of open pit – Negative, temporary, moderate	• Hydrological and hydrogeological studies to determine pit, TSF, and waste rock dump water balances • Installation of pit perimeter drainage, dewatering bores, TSF decant, spillway, and freeboard, and stormwater system • Flood monitoring during heavy rains • Use of settling ponds and geotextile tubes • Emergency planning and testing
		Overtopping of TSF embankment – Negative, temporary to medium-term, minor to significant	
		Flooding and erosion at waste rock dump area - Negative, temporary to medium-term, minor to significant	

Key Activity	Impacts		Environmental Management Plan
	Environmental Component	Characterization	
	• Water quality • Freshwater biology	Heavy metals, AMD - Negative, temporary to medium-term, minor to significant	• Geochemical testworks of waste rocks • NAG pH=4 tests as required on blasthole cuttings of Domain 600 primarily and Domains 100 and 400, secondarily; classification of waste rocks from the open pit into potentially acid-forming materials (PAF) and non-acid-forming (NAF); and placement of materials in a manner to prevent acid generation • Collection of surface runoff including pumped pit water into a settling pond • Regular monitoring of pond water quality prior to discharge • pH treatment at the pond if required
	Air	Dust and noise – Negative, short-term, and moderate	• Training on proper equipment use • Water sprays • Enclosures, barriers, and buffer zones • Proper maintenance of equipment • Use of less noisy and shielded equipment • Dust and noise PPEs to workers
		Air blast and flyrocks – Negative, short-term, and moderate	• Use of delays, reduced hole diameter and deck loading to reduce the maximum instantaneous charge
			• Complete isolation of the area prior to blasting. A siren is sounded 5 minutes before the blast for warning
• Gold cyanidation plant commissioning and subsequently, flotation plant commissioning	Water		
	• Water quality • Freshwater biology	pH, NaOH, $CuSO_4$, HCl, diesel, NaCN, metals – Negative, temporary, moderate	• Physical systems to fully contain chemicals, *e.g.*, events ponds and bunds • Personnel training on chemicals and their management • Management system and procedures for chemicals handling • CN detoxification of tailings prior to discharge to TSF
• Underground development works – Portal and decline, levels, raises, and electricals	Land		
	• Geomorphology	Ground subsidence – Negative, temporary to short-term, negligible	• Detailed geotechnical and hydrogeological studies • Subsidence prediction, formulation, and implementation of subsidence control measures
	Water		
	• Hydrology	Drying of rivers and wells - Negative, temporary to short-	• Detailed geotechnical and hydrogeological studies

Key Activity	Impacts		Environmental Management Plan
	Environmental Component	Characterization	
		term, negligible	• Hydrological impacts prediction, formulation, and implementation of hydrologic control measures
		Flooding of underground workings – Negative, temporary, moderate	• Hydrological and hydrogeological studies • Installation of pit perimeter drainage and dewatering bores • Emergency planning and testing
	• Water quality • Freshwater biology	AMD, heavy metals – Negative, temporary, moderate	• Discharge of pumped out underground water into a settling pond • Regular monitoring of underground water quality at the settling pond prior to discharge • pH treatment of water if necessary • Discharge of compliant water into geotextile tubes for filtration of suspended solids
Operations			
• Open pit, TSF, and waste rock dump operations	Land		
	• Geomorphology	Physical instability of pit, TSF, waste rock dump – Negative, temporary, moderate	• Construction with strict QC • Use of dewatering bores and ground support where required at the open pit • Regular stability inspections and monitoring, including phreatic surface of the TSF embankments and waste rock dump
			• Observance of buffer or exclusion zone from the edge of TSF embankment and waste rock dump • Non-placement of large continuous volumes of clay-rich materials at the waste rock dump • Emergency planning and testing
	Water		
	• Hydrology	Flooding of open pit – Negative, temporary, moderate	• Operation and maintenance of pit perimeter drainage, dewatering bores, decant and pump, and stormwater system • CN detoxification of tailings prior to discharge to TSF • Recovery of tailings water for process plant use • Flood monitoring during heavy rains • Emergency planning and testing
		Overtopping of TSF embankment – Negative, temporary to medium-term, minor to significant	
		Flooding and erosion at the waste rock dump area – Negative, temporary to medium-term, minor to significant	
	• Water quality • Freshwater biology	Turbidity, NaCN, heavy metals, tailings, and AMD – Negative, temporary to medium-term, minor to significant	• Classification of waste rocks into PAF and NAF and placement of materials in a manner to prevent acid generation • Stormwater drainage to keep clean water away from dirty water

Key Activity	Impacts		Environmental Management Plan
	Environmental Component	Characterization	
			• Collection of surface runoff and pumped out pit water into a settling pond • Regular monitoring of pond water quality • pH treatment at the pond if required • CN detoxification of tailings prior to discharge to the TSF • Reuse of tailings water for processing • Use of settling ponds and geotextile tubes
	Air	Dust and noise – Negative, short-term, moderate	• Training on proper equipment use • Water sprays • Enclosures, barriers, and buffer zone from TSF embankment and waste rock dump edge • Proper maintenance of equipment • Use of less noisy and shielded equipment • Dust and noise PPEs to workers
		Airblast and flyrocks – Negative, short-term, moderate	• Use of delays, reduced hole diameter and deck loading to reduce the maximum instantaneous charge • Complete isolation of the area prior to blasting. A siren is sounded 5 minutes before the blast for warning
• Gold cyanidation plant operations (combined with flotation plant subsequently)	Water		
	• Water quality • Freshwater biology	Turbidity, pH, CN, heavy metals, and other reagents such as NaOH, $CuSO_4$, HCl, NaCN, and diesel – Negative, temporary, moderate	• Physical systems to fully contain chemicals, *e.g.*, events pond and bunds • CN detoxification of tailings prior to discharge to TSF • Personnel training on chemicals and their management • Management system and procedures for chemicals handling
• Underground operations – Drill, blast, load, haul, and dewater	Land		
	• Geomorphology	Ground subsidence – Negative, temporary to medium-term, minor to significant	• Regular stability monitoring both surface and underground • Use of suitable mine support • Filling of void with combination of waste material, tailings, and cement • Implementation of subsidence control measures • Observance of buffer or exclusion zone from the TSF embankment and waste rock dump perimeter • Emergency plan for cave-ins and subsidence
	Water		

Key Activity	Impacts		Environmental Management Plan
	Environmental Component	Characterization	
	• Hydrology	Drying of rivers and wells – Negative, temporary to medium-term, minor to significant	• Monitoring of streamflows and well discharges • Implementation of hydrologic control measures • Filling of voids with combination of waste materials, tailings, and cement
		Flooding of underground workings – Negative, temporary, moderate	• Operation of pit perimeter drainage, and dewatering bores, and pumps • Emergency plan for flooding
	• Water quality • Freshwater biology	Turbidity, heavy metals, AMD – Negative, temporary, moderate	• Discharge of pumped out underground water into a settling pond • Regular monitoring of underground water quality at the settling pond prior to discharge • pH treatment of water if necessary • Discharge of compliant water into geotextile tubes
Abandonment			
• Closure of operations	Land		
	• Visual aesthetics	Wastes, non-blending of structures with background – Negative, medium-term, moderate	• Haul out of reagents, oil and chemical spills, and waste • Removal of cables, pipes, concrete, masonry, storage tanks, equipment, and structures that will not fit the post-mining land use or will not be needed by the barangays • Consistent with the post-mining land use, deep ripping of hardstands and recontouring of surfaces and slopes to blend structures with natural background
	• Geomorphology	Physical instability of structures – Negative, medium-term, moderate	• Slope, surface, and drainage modifications to suit minimum factors of safety (FOSs) and design rainfall at closure • Drying of tailings pond
		Subsidence – Negative, medium-term, moderate	• Monitoring of mining-related subsidence within the property and vicinities and implementation of control measures
	• Land use	No post-mining land use – Negative, medium-term, moderate	• Determination of the best post-mining land use of the 240-ha property considering local needs, socio-economics, and physical conditions of the site
	• Terrestrial biology	Abandoned site not conducive to flora and faunal propagation – Negative, medium-term, moderate	• Consistent with the post-mining land use, deep ripping of hardstands and recontouring of surfaces and slopes • Soil conditioning • Planting of endemic species including fruit trees

Key Activity	Impacts		Environmental Management Plan
	Environmental Component	Characterization	
			• Reflooding of pit and underground workings as habitat for the Philippine Duck
	Water		
	• Hydrology	Re-flooding of open pit and underground workings	• Monitoring of water level and water quality changes in Dayano Creek, Magpayang River, and wells • Implementation of corrective measures if required
		Drying of rivers and wells – Negative, medium-term, moderate	
	• Water quality • Freshwater biology	Turbidity, metals in tailings, oil and grease, reagents – Negative, medium-term, moderate	• Slopes and surfaces including dried tailings fully stabilized and covered with endemic floral and fruit-bearing species • Drainage for design rainfall installed • Stockpiles, reagents, and wastes removed from the site
	Air	Dust – Negative, medium-term, moderate	• Consistent with the post-mining land use, recontouring of surfaces and slopes for long-term physical stability • Soil conditioning • Planting of endemic species
	People		
	• Socioeconomics	Loss of jobs and community programs – Negative, temporary to short-term, significant	• Retrenchment package • Labor support programs • Possible transfer of social assets and services such as water supply and electricity

Notes:

Environmental impacts are characterized in terms of the following:

1. Change – Positive (beneficial), negative, or neutral
2. Duration – Temporary (impact lasting 1 year or less), short-term (impact lasting 1 to 7 years), medium-term (impact lasting 7 to 20 years), long-term (impact lasting 20 to 50 years), and permanent (impact lasting over 50 years) and
3. Effect – Negligible (no environmental damage), minor (temporary impact; no impact on sensitive resources), moderate (recoverable environmental loss with localized impact on sensitive resources), significant (severe environmental loss with regional impact on sensitive resources), and serious (widespread chronic environmental loss with widespread impact on sensitive resources).

5. SUMMARY OF ENVIRONMENTAL MONITORING PLAN

Table ES 6. Environmental monitoring plan

Monitoring Objectives	Project Phase	Monitoring Parameters	Limit Level for Compliance (Ambient, effluent)	Sampling	
				Station	Frequency
To monitor the water quality and quantity impacts of the Project	Construction, Operation, and Abandonment	TSS (mg L^{-1})	≤ 30 % increase, 70	W/B 1 to 8	Quarterly
				IW 1 to 6	Daily
		Oil and grease (mg L^{-1})	2, 5	W/B 1 to 8	Quarterly

Monitoring Objectives	Project Phase	Monitoring Parameters	Limit Level for Compliance (Ambient, effluent)	Sampling	
				Station	Frequency
		L^{-1})		IW 1 to 6	Quarterly
		BOD_5 (mg L^{-1})	7(10), 50	W/B 1 to 8	Quarterly
				IW1	Quarterly
		Total coliform (MPN 100 mL^{-1})	5000, 10000	W/B 1 to 8	Quarterly
				IW1	Quarterly
		Total dissolved solids (mg L^{-1})		W/B 1 to 8	Quarterly
				IW 1 to 6	Quarterly
		Heavy metals – As, Cd, Cu, Hg, Mn, Pb, Zn (mg L^{-1})	As 0.05, 0.2; Cd 0.01, 0.05; Cu 0.05; Hg 0.002, 0.005; Pb 0.05, 0.3	W/B 1 to 8	Quarterly
				IW 1 to 6	Quarterly
		pH	6.5 – 8.5, 6.5 - 9	W/B 1 to 8	Quarterly
				IW 1 to 6	Daily
		Free CN (mg L^{-1})	0.05, 0.2	W/B 1 to 8	Quarterly
				IW 1 to 6	Daily during Plant commissioning and operations
		Changes in composition and structure of stream macroinvertebrate communities		W/B 1 to 8	Quarterly
		Participatory fish stock assessment for Lake Mainit		LM 1 to 6	Quarterly
		Streamflow (L s^{-1})		W/B 2,W/B 4 to 7	Weekly
		Water level (m)		W/B 2, W/B 4 to 5, W/B 7	During heavy rains
				IW 1 to 6, TSF, open pit and underground works	
		Complaints on water quality, water supply, flooding, fish catch and their resolution		Direct and indirect impact barangays	Weekly and as needed
To monitor the land impacts of the Project	Construction and Operation	Ground subsidence – tension cracks and other signs of surficial failure		Within a 500-m distance from the pit edges	Weekly

Monitoring Objectives	Project Phase	Monitoring Parameters	Limit Level for Compliance (Ambient, effluent)	Sampling	
				Station	Frequency
		Stability factors – tension cracks, scarps, settling, erosion, rockfalls, seepage, phreatic surface		TSF, waste rock dump, pit walls	Weekly
		Acid generation potential of waste rocks through net acid generation (NAG) pH=4		Blasthole cuttings of waste rocks at open pit	During blasthole drilling when Domains 100, 400, and 600 are observed
		Heavy metals – As, Cd, Cu, Hg, Mn, Pb, Zn (mg kg^{-1})	As indicated earlier	W/B 1 to 8	Quarterly
		Terrestrial flora and fauna – Species composition and dominance, diversity indices, ecological communities		TB 1 to 6	Quarterly
		Complaints on rice land inundation, erosion, and subsidence and their resolution		Direct and indirect impact barangays	Weekly and as needed
	Abandonment	Visual aesthetics – types and volumes of wastes left at site		Project area	Weekly
		Ground subsidence – tension cracks and other signs of surficial failure		Within a 500-m distance from the pit edges	Monthly
		Stability factors – tension cracks, scarps, settling, erosion, rockfalls, seepage		TSF, waste rock dump	Monthly
		Drainage channels stability – blocks and scour		TSF, waste rock dump, other areas	Monthly
		Vegetation – transects, density cover, diversity, ecological function analysis (EFA), regeneration		TSF, waste rock dump, other areas	Semestral

Monitoring Objectives	Project Phase	Monitoring Parameters	Limit Level for Compliance (Ambient, effluent)	Sampling	
				Station	Frequency
		Complaints on rice land inundation, erosion, and subsidence and their resolution		Direct and indirect impact barangays	Weekly and as needed
To monitor the air and noise impacts of the Project	Construction, Operation, and Abandonment	TSP, SO_2, NO_2, (µg Ncm^{-1}); noise	TSP 230, 300; SO_2 180, 340; NO_2 150, 260; noise – various	A/N 1 to 4	Quarterly
		Airblast and flyrocks		Open pit area	During blasts
		Complaints on dust, noise, and foul smell and their resolution		Direct and indirect impact barangays	Weekly and as needed
To monitor the socio-economic, cultural, and health impacts of the Project	Construction, Operation, and Abandonment	Socioeconomics – percentage of population below poverty/ subsistence line; employment, industries, and income – Project and non-project-related; proportion of 6-12 years old not in elementary school; proportion of 13-16 years old not in secondary school; proportion of households with make-shift houses; new malaria/TB cases per 1,000 population; under 5 mortality rate per 1,000 live births; percentage of malnourished children below age of 5.		Direct and indirect impact barangays	Annual

Monitoring Objectives	Project Phase	Monitoring Parameters	Limit Level for Compliance (Ambient, effluent)	Sampling	
				Station	Frequency
		Culture - Proportion of Mamanwas directly employed to total Mamanwas in the direct impact barangays; number of skills and training activities, trainees, and trainees actually employed; number of cultural awareness programs and participants; changes in material culture		Direct and indirect impact barangays	Semestral
		Occupational safety and health – Safety and health program; monthly safety reports; safety meetings, trainings, and inspections; PPEs; accident statistics and reports; medical records		GRC and contractors	Quarterly
		Public health – Blood chemistry for metals, hepatitis test, basic blood chemistry, CBC and blood typing, urinalysis and fecalysis		Samples from the direct and indirect impact communities	Annual
		Complaints on employment, SDMP, culture, and health and their resolution		Direct and indirect impact barangays	Weekly and as needed

Notes:

1. The locations of the monitoring stations are shown in Figure 6-1.
2. Ambient values without parentheses are yearly averages; value with parentheses is maximum .
3. Effluent values are maxima which must not be exceeded.

6. EMF AND EGF COMMITMENTS

After the grant of an environmental compliance certificate (ECC) to the Siana Project, GRC will comply with the requirements of DENR Administrative Order (DAO) No. 1996-40 on the establishment of a Mine Rehabilitation Fund (MRF).

The MRF consists of a Monitoring Trust Fund (MTF) which supports the activities of the Multipartite Monitoring Team (MMT) amounting to no less than P 100,000.00 and a Rehabilitation Cash Fund (RCF), equivalent to whichever is lower

of 10 % of the budget required for an Environmental Protection and Enhancement Program (EPEP) or P 5 million. The RCF will fund the Project's approved rehabilitation activities and schedules including research programs as defined in the EPEP or Annual Environmental Protection and Enhancement Program (AEPEP). The MRF is deposited as a trust fund in a government bank and maintained by GRC up to the end of the post-decommissioning period of ten (10) years.

The MMT is established by the Mines and Geosciences Bureau (MGB) Regional Office prior to construction to monitor the Project's compliance with the conditions of the ECC, Environmental Management Plan of the Environmental Impact Statement (EIS), EPEP, and AEPEP. GRC proposes the following composition of the MMT:

- MGB Regional Office and EMB Regional Office representatives as Co-chairpersons
- Representatives of the Barangay Governments of Cawilan, Siana, Dayano, del Rosario, Magpayang, and Pongtud as members
- Representative of the Lake Mainit Development Alliance as member
- Representative of an environmental NGO as member.

GRC will also put up a Mine Waste and Tailings Fee to compensate any damages to property caused by the Project.

1 BASIC PROJECT INFORMATION

Parameter	Project Particulars
Project Name	Siana Gold Project
Project Site Location	Brgy. Cawilan, Tubod Municipality; Brgys. Siana and Dayano, Mainit Municipality, Province of Surigao del Norte, Region 13, Northeastern Mindanao
Nature of Project	Mining Project
Mining Tenement	MPSA No. 184-2002-XIII
Threshold Limits Applied For	
Open pit mine extraction	121,000 to 10.5 million tonnes per year (TPY) waste rocks 40,000 to 800,000 TPY ore
Underground mine extraction	300,000 TPY expandable to 500,000 TPY
Process plant capacity	750,000 TPY expandable to 1 million TPY
Products	Gold and silver dore bars, zinc concentrate, zinc-lead-copper concentrate
Proponent Name	Greenstone Resources Corporation
Contact Details	
Contact Person	Gregory C. Edwards
Designation	Managing Director
Address	Level 2, NOL Tower, Commerce Avenue cor. Acacia Avenue, Madrigal Business Park, Ayala Alabang, Muntinlupa City
Telephone/Fax Number	+632 8072790, +632 8076658
Email address	gedwards@red5limited.com, lgovey@red5limited.com
EIA Preparer	BMP Environment & Community Care, Inc.
Contact Details	
Contact Person	Rolando V. Cuaño, Ph.D.
Designation	President
Address	12C PET Plans Tower, EDSA Guadalupe, Makati City
Telephone Number	+632 8905902, +632 8974012
Fax Number	+632 8973984
Email address	bmpenvironment@yahoo.com

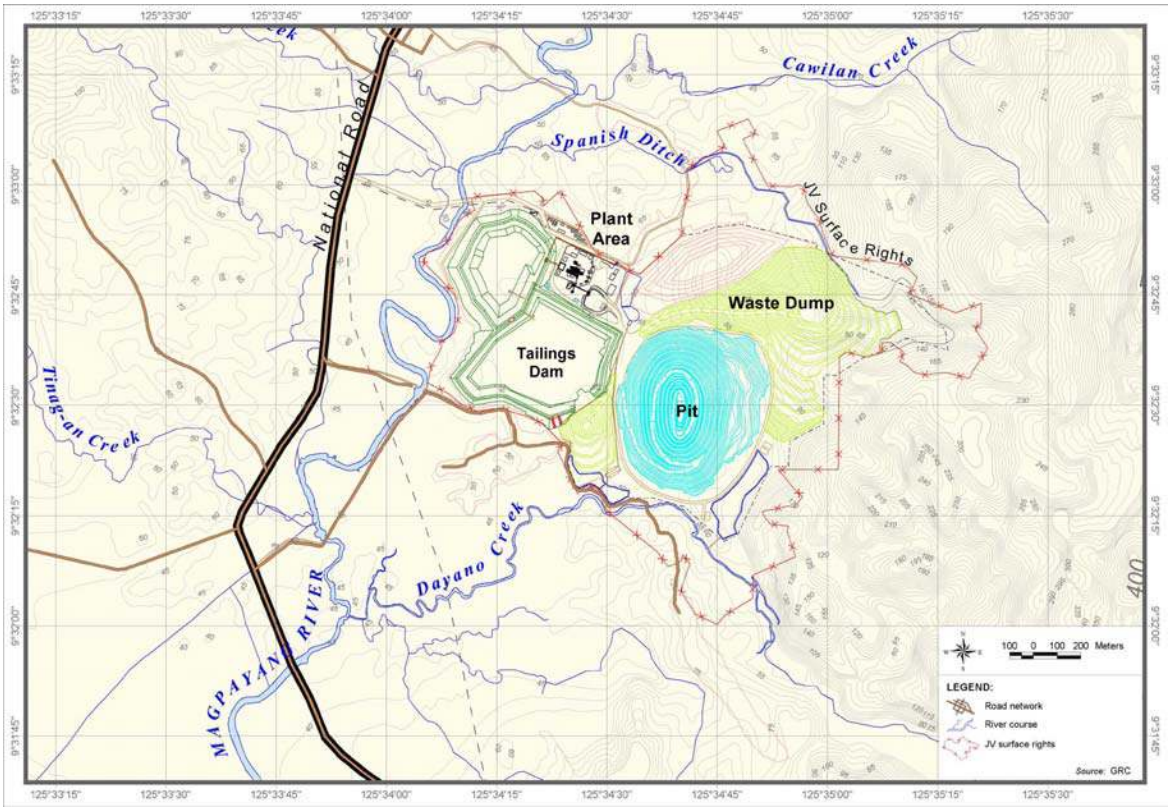


Figure 1-1. Project site map

2 PROJECT'S EIA PROCESS

TERMS OF REFERENCE OF THE EIA STUDY

Table 2-1. Major issues of the Siana Project

Major Issue	Finding or Reference to Resolution in this EIS
EIARC	
Socioeconomic and biodiversity importance of Lake Mainit	Lake Mainit is not a protected area. However, it ranks high in the Philippine Biodiversity Conservation Priorities (Ong, *et al.*, 2002). The fourth largest freshwater lake in the country, it has an approximate surface area of 17,100 ha (BFAR), a water volume of 18 km^3, lakeshore circumference of around 69 km, and a total catchment of 87,100 ha (LMDA). The lake fisheries provide food and livelihood to about 31 barangays in four (4) municipalities and two (2) provinces. The 240-ha site of the Siana Project is within the 5,700-ha catchment of the Magpayang River. The river, together with 27 other streams, drains into Lake Mainit which ultimately discharges to Bohol Sea. A stream discharge and sediment loading study conducted in 2003 found that Magpayang River contributes a mere 1.09 % of the lake's total sediment load (Tumanda, 2005). BMP observed 13 genera of phytoplankton and 5 genera of zooplankton within the lake in 2005. In terms of species and individuals, the numbers are much lower than those reported in 1971, 2003, and 2004. The station near Magpayang River had the least numbers. BMP also noted 10 species of fish caught in the lake compared to about 12 which were recorded in 1971. Fishermen who were interviewed lamented the decline in fish catch which was reportedly due to overfishing. The dominant fish caught was the benthic gobiod species. Very few water column species were being caught.
Long-term benefits of the Project to the community	The closure of the SURICON mine in 1990 was premature. Based on GRC's exploration and feasibility study, some 5.4 million t of gold ore remain. If extracted and managed properly from the socio-environmental viewpoint, the wealth generated by the Project will benefit the host and adjoining communities in terms of poverty reduction, development of sustainable skills and industries, education, health, sanitation, community organizations, physical infrastructures, and governance. The Project will also allow the completion of a Final Mine Rehabilitation and Decommissioning Plan that will remove the site physical and chemical stability risks and transform the Project site to its best post-mining land use.
Effects of dewatering to the community	Direct rainfall and groundwater accumulated 8.2 million m^3 of water in the 90-m deep Siana open pit. Since 2003, GRC has sampled the pit water for metals, pH, DO, BOD_5, coliform, NO_3-N, and PO_4-P. In 2005, BMP sampled the pit water column at 5, 15, 20, and 40-m intervals down to the bottom for TDS and metals. The sampling results established the pit water quality at Class A of DENR's river classification system. Because of the superior water quality, GRC, since 2005, has used the pit water as source for the potable water supply and distribution system it set up for the three (3) direct impact barangays of Cawilan, Siana, and Dayano. Compared to the Dayano Creek water, the pit water is better in terms of total coliforms and probably phenols. Thus, its discharge to the Dayano Creek will actually improve the creek's water quality. In terms of water quantity, a simulation using the 2003 daily rainfall data for PAGASA's Surigao City station over the surveyed sections of the Dayano Creek and Magpayang River assuming a pit water discharge at 780 L s^{-1} during the less rainy months of April to September found that the overflow would occur only six (6) days more than the baseline case. No significant difference was observed on the overflow depth. The simulation assumed that both diversion gates of the Dayano Creek irrigation dam were fully opened.
Basic design and drawings of pollution control devices	The major pollution control devices of the Project are SO_2-air cyanide detoxification circuit, TSF3, TSF4, waste rock dump, sediment traps, plant water feed pond , and geotextile tubes.

Major Issue	Finding or Reference to Resolution in this EIS
	The basic design, drawings, and photographs of these devices are shown in Section 3 of this EIS.
Community	
Fairness, transparency, and absence of politics in the Project's hiring process	During the Re-scoping Meeting with sectoral representatives of the direct impact barangays on 24 April 2008, GRC's G Edwards assured the participants that hiring for the Project will be fair. BMP's M Cuaño said that the Brgy. Captain's certification is merely to ensure that the applicant is a resident of the barangay.
Can GRC prevent the recurrence of floods, sediments, and fish kills when it operates?	The reason for the hydro-meteorological studies that preceded the TSF and waste rock dump design as commissioned by GRC is to ensure that these structures will have a stormwater drainage to rout the flows and minimize erosion during heavy rains. At the TSFs, a decant system will minimize the impounded water by pumping to the process plant or to a storage pond. An emergency spillway that discharges to Dayano Creek is likewise provided. At the waste dump and open pit areas, sized diversion canals will keep clean water out. The dirty water will be conveyed by drainage channels to the sediment traps, settling ponds, and then the geotextile tubes. The traps and pond will capture the coarse sediments; fine sediments will be trapped in the tubes.
What are the adverse effects of the pit dewatering to the river and farmlands?	The pit water will improve the quality of the Dayano Creek water. By restricting the flow to the creek to a maximum of 780 L s^{-1} and monitoring and control of pit dewatering flow during high rainfall periods, the pit water can be used to irrigate the ricefields of Brgys. Siana, Magpayang, and Pongtud without causing floods.
Project's compensation of damages to crops and property may be unfair as what happened during SURICON days.	The compensation of mining-related damages to crops and property is assured and facilitated by DAO No. 1996-40 which was issued after the closure of SURICON operations in 1990. The compensation will be drawn from the Mine Waste and Tailings Fee (MWTF) which GRC is required to pay to the MGB. Claims for compensation are investigated by a Regional Investigation and Assessment Team headed by the MGB Regional Director and withmembers drawn from the regional offices of the Bureau of Soils and Water Management, Bureau of Plant Industry, Bureau of Fisheries and Aquatic Resources, and the National Irrigation Administration, among others. The Contingent Liability and Rehabilitation Fund Steering Committee headed by the MGB Director decides on the claims for compensation.
What will happen to the people living close to the Project facility? What is the company's relocation policy?	In the interest of safety, people living close to TSF3 and the waste rock dumps, numbering about 42 to 56 households within Puroks Riverside and Hilltop of Brgy. Siana and 7 to 13 households in Purok Bulawanon of Brgy. Cawilan, are earmarked for relocation. The relocation will be implemented after due consultation with the affected households. The households are given the option of cash compensation or resettlement within the same barangay with improved living conditions. If necessary, livelihood restoration or employment may be provided.
Will the mined-out and disturbed areas be rehabilitated during closure?	At the end of Project life, GRC will implement the FMRDP. The major activities are removal of unused reagents and wastes, dismantling of plant structures and removal of unnecessary equipment, re-flooding of pit and underground workings and drying of TSFs, recontouring and drainage works, spread of topsoil or soil reconditioning and revegetation, retrenchment package and labor support programs for employees, and transfer of social assets to the communities.
GRC must implement livelihood and community development projects.	GRC has implemented major community programs even during exploration while the company is not earning any income from mining. The company will continue to implement similar programs during construction and operation as part of the Project's SDMP. The programs will be formulated, prioritized, and implemented in close collaboration with the community and MGB.
What are the assurances for all these?	GRC is required to pay the MWTF at a government bank every six (6) months for each tonne of mine waste and tailings generated. It is also required to deposit the Mine Rehabilitation Fund in a government bank. This fund is earmarked for the physical and social rehabilitation of areas and communities affected by mining activities. DAO 1996-40

Major Issue	Finding or Reference to Resolution in this EIS
	establishes systems and controls on the use of these funds. Every year, GRC will submit an AEPEP and ASDMP to the MGB Regional Office. Once approved, this Office will monitor GRC's compliance with the approved programs and required expenditures.

EIA TEAM

GRC commissioned BMP Environment & Community Care, Inc. (BMP) to undertake the EIA for the Project. Based on the EIA needs, BMP organized an EIA Team whose membership is shown in Table 2-2. Messrs. Gary Gomonit and Ricky Oclarit of GRC provided the BMP Team logistical support including coordination with the local leaders and community members. They also conducted grassroots information, education, and communication (IEC) about the Project at the direct and indirect impact barangays. For the updating of GRC's community programs including the potable water supply and the documentation of the April 2008 meeting with the stakeholders, Mr. Ricky Oclarit was very helpful.

Table 2-2. BMP's EIA Team and module assignments

Consultant	Areas of Expertise	EIS Module
Rolando V. Cuaño, Ph.D.	• Geology and geohazards • Erosion and sediment control • Environmental risk assessment • Environmental management system	• Geology and geohazards • Environmental risk assessment • Team leadership, editing, and integration of EIS
Jose N. Tanchuling	• Water quality • Mining process	• Project description • Water quality
Felixberto M. Centeno (CRL Environmental Corporation for air quality and noise measurements)	• Meteorology • Air quality and noise • Hydrology	• Meteorology • Air quality and noise • Hydrology
Perfecto P. Evangelista, Ph.D.	• Soils and erosion • Agriculture and land use	• Soils and erosion • Land use
Bibiano P. Ranes, Ph.D.	• Terrestrial flora and fauna	• Terrestrial flora and fauna (2005)
Carmela P. Española	• Terrestrial fauna	• Terrestrial fauna (2008)
Roberto C. Pagulayan, Ph.D.	• Freshwater biology	• Freshwater biology of streams • Freshwater biology of Lake Mainit
Cesar L. Villanoy, Ph.D.	• Hydrodynamic modeling	• Hydrodynamic modeling of Lake Mainit
Marita G. Cuaño	• Socio-economics • Public health • Stakeholder engagement	• Socio-economics • Public health
Nestor T. Castro, Ph.D.	• Indigenous people and culture	• Mamanwa culture

EIA STUDY SCHEDULE

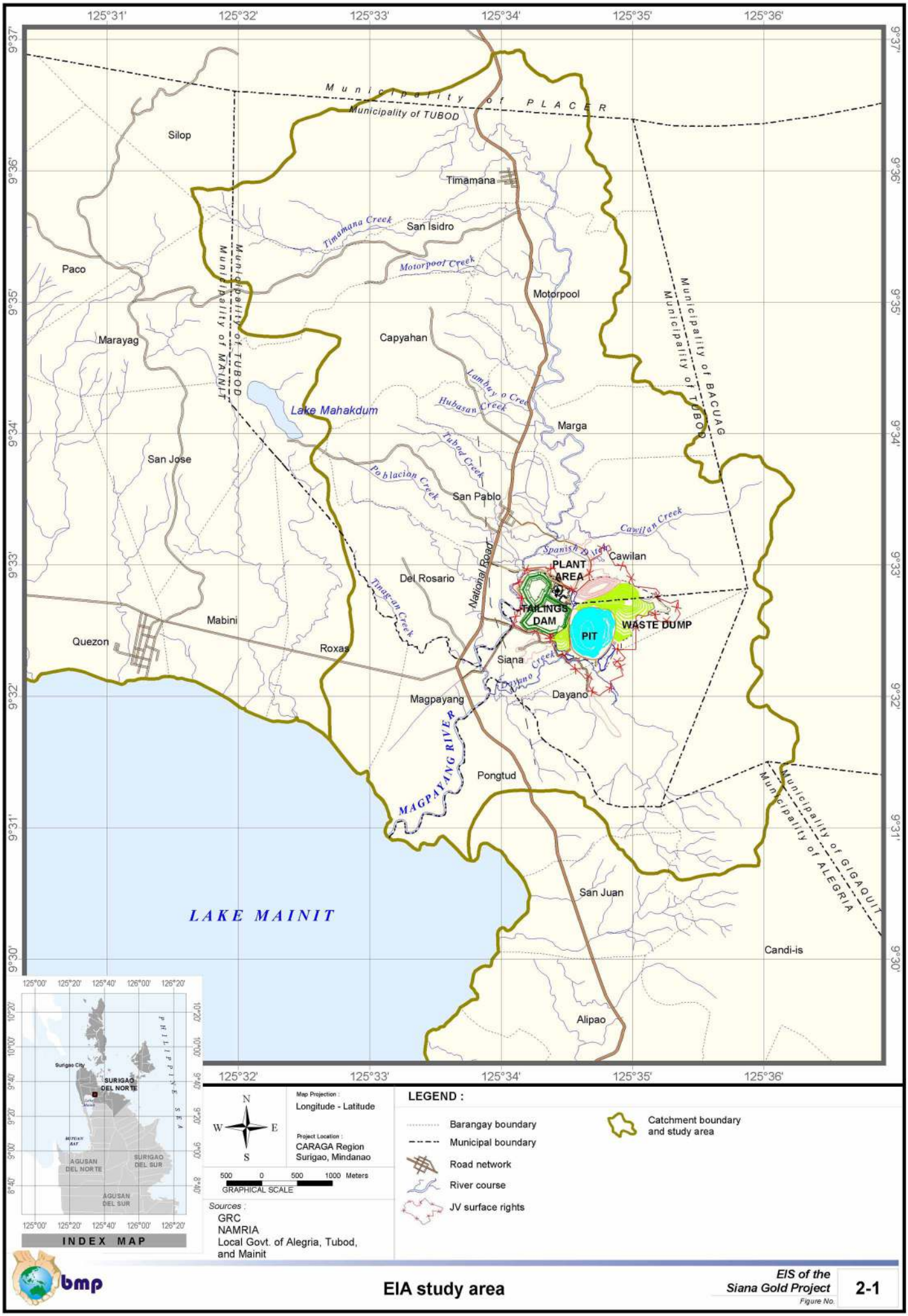
Table 2-3. EIA study period

Activity	Date	Season
BMP's initial site inspection of Project area	11 December 2004	Rainy
Ambient air and noise measurement	6 to 7 January 2005	Rainy
Terrestrial flora and faunal survey	6 to 8 January	Rainy
Site assessment of Mamanwa culture	6 to 8 January	Rainy
Freshwater biological assessment of inland rivers	6 to 8 January	Rainy
Community timelining and situational assessment with leaders of Brgy. Pongtud, Alegria; Brgys. Magpayang, Siana, and Dayano, Mainit; and Brgy. Cawilan, Tubod	13 to 14 January 2005	Rainy
Soil and land use assessment	15 to 17 January	Rainy
Bathymetric and hydrodynamic assessment of Lake Mainit	17 to 19 February	Rainy
Participatory agriculture and fishery resources and livelihood assessment	15 to 17 February	Rainy
Water and sediment quality sampling along rivers	18 February	Rainy
Data gathering and interviews on socioeconomics and health	16 to 18 March	Rainy
Water sampling of the open pit	19 March	Rainy
Grassroots IEC about the Project at Brgys. Cawilan, Siana, Dayano, Magpayang, del Rosario, and Pongtud	20 March; 10, 16, 17, and 27 April	Rainy and less rainy
Limnological survey of Lake Mainit	29 April to 1 May	Less rainy
Community mapping with Barangay Health Workers and training on household survey	29 April	Less rainy
Household surveys for Brgys. Cawilan, Siana, Dayano, del Rosario, Magpayang, and Pongtud	30 April to 1 May	Less rainy
Topographic and bathymetric survey of Dayano Creek and Magpayang River sections	20 to 26 April 2008	Less rainy
Site re-assessment to update physical conditions at the Project site	23 April	Less rainy
Meeting with Officials and Sectoral Representatives of Brgys. Cawilan, Siana, and Dayano	24 April	Less rainy
Avifaunal survey at the Project area and vicinities	9 to 11 May	Less rainy

EIA STUDY AREA

The EIA study area covers the 240-ha Siana mine property and radiates outward to the direct impact barangays of Cawilan to the north, Siana to the west and east, and Dayano to the south (Figure 2-1). The indirect impact barangays of del Rosario to the west, Magpayang to the southwest, and Pongtud to the south are covered as well.

The Project area is part of the Magpayang River catchment which drains into Lake Mainit. For completeness, a water and biological sampling station was established in Motorpool, the northernmost point of the EIA study. Down south,



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EIA study area

EIS of the Siana Gold Project

Figure No. 2-1

the bathymetry and hydrodynamics of Lake Mainit were studied to predict potential impact areas of sediment or tailings releases. This was supplemented by a limnological study of the lake.

EIA METHODOLOGY

Table 2-4. EIA Methodology

EIA Study Module	Methodology	
	Primary	Secondary
Land		
Land use and classification		
• Land classification		Land classification map Nos. 689 and 1224, NAMRIA
• Land use	Field mapping	Ikonos 2005 satellite image
• Locations of ecological, cultural, historic, and recreational significance		Municipal Comprehensive Land Use Plan of Tubod (1999 – 2008) Municipal Comprehensive Land Use Plan of Mainit (2001-2011) Municipal Comprehensive Land Use Plan of Alegria (1999 – 2008) 2004 Statistics on Philippine Protected Areas and Wildlife Resources Philippine Biodiversity Conservation Priorities, 2002
Geology		
• Economic geology		Feasibility Study, Siana Gold Project, September 2007, GRC and Intermet Engineering Mineral Resource Estimate, Siana Gold Project, October 2006, H&S
• Geomorphology	Field mapping	Geology and Mineral Resources of the Philippines, 1981, BMG Ikonos 2005 satellite image Landsat 7 2005 natural color image NAMRIA's 1:50,000 topographic map, 1988
• Regional geology and stratigraphy		Geology and Mineral Resources of the Philippines, 1981, BMG
• Structures and Geohazards	Interviews and community timelining	PHIVOLCS' Subduction zones in the Philippine archipelago PHIVOLCS' Location of nearest active volcanoes PHIVOLCS' Record of significant earthquakes Siana Gold Project TSF, Surigao Philippines, Seismic Hazard Assessment, October 2006, SRC and ES&S Siana Gold Project Proposed Revisions to the Feasibility Study, 1 October 2008, GHD Pty Ltd

EIA Study Module	Methodology	
	Primary	Secondary
		Bankable Feasibility Study, Tailings Storage Facility, Siana Gold Project, Philippines, June 2007, Golder Associates Bankable Feasibility Study, Geotechnical Investigation for the TSF, June 2007, Mining One Pty Ltd Further Waste Dump Stability Assessment, 30 August 2008, PETER O'BRYAN & Associates
• Geochemistry		Semi-detailed Assessment of Abandoned/Inactive Mine Sites in the Philippines, 2003, Tetra Tech Acid-base Accounting of Waste Rock Samples Siana Gold Project, 2007, BMP Geochemical Characterization of Process-Tailings-Slurry Sample (Static Testwork), 2006, GCA
Pedology		
• Soil type	Auger borings and soil characterization using FAO Guidelines for soil description and the Maunsell soil color chart	Bureau of Soils' Soil Map of Surigao del Norte, 1984 NAMRIA's 1:50,000 topographic map, 1988 Ikonos 2005 satellite image
• Soil fertility and suitability	Field mapping Comparison of soil properties with plant requirements and of agricultural yields with national standards	Bureau of Soils and Water Management's Micronutrient status of some Philippine soils, 1988
Terrestrial biology		
• Flora and faunal species inventory, abundance, frequency and distribution	Habitat description Transects and sampling plots Ethnobiological survey	Avifauna of Lake Mainit Mindanao, 2003, CJ Garingarao and OM Nuneza PICOP Bislig Surigao del Sur trip Report, 2004, Wild Bird Club of the Philippines
• Species endemicity and conservation status	Interviews Assessment of stressors	2004 Statistics on Philippine Protected Areas and Wildlife Resources Philippine Red Data Book: Red List of Threatened Animals, 1997, Wildlife Conservation of the Philippines IUCN Red List of Threatened Species, 2007, International Union for the Conservation of Nature
Water		
Hydrology and hydrogeology		
• Drainage system	Topographic and bathymetric survey of riverbanks and river system from pit outflow into Dayano Creek down to Magpayang River	Ikonos 2005 satellite image NAMRIA's 1:50,000 topographic map, 1988 Conceptual Site Runoff Version 2 – Incorporating New Waste Dump Design

EIA Study Module	Methodology	
	Primary	Secondary
	Numerical modelling for flood peaks and mean flows	Siana Gold Project, 7 September 2008, Meyer Water & Environmental Solutions Water Report for Bankable Feasibility Study, Siana Gold Project, April 2007, MWES
• Hydrogeology		Hydrogeological Reconnaissance of Mainit at Surigao del Norte, 2003, MGB Water Report for Bankable Feasibility Study, Siana Gold Project, April 2007, MWES
• Water usage	Field mapping Interviews of water users	Water Report for Bankable Feasibility Study, Siana Gold Project, April 2007, MWES
Water quality		
• Streams and lake	Field mapping Water and sediment quality sampling	Surigao Consolidated Mining Co., Inc., Semi-detailed Assessment of Abandoned/Inactive Mine Sites in the Philippines, 2003, Tetra Tech MWES' Quarterly Water Reports
• Wells and springs		Hydrogeological Reconnaissance of Mainit at Surigao del Norte, 2003, MGB Water Report for Bankable Feasibility Study, Siana Gold Project, April 2007, MWES
• River classification	Water quality sampling	DENR Administrative Order No. 1990-34
Freshwater biology		
• Macroinvertebrate species composition, abundance, and pollution sensitiveness	Characterization of water physico-chemical properties Rapid biological assessment – sampling for macroinvertebrates, plankton, and fish Interviews with residents	Limnological and Water Quality Assessment of Lake Mainit, 2005, Tumanda, M.I. Biology and Fishery of Indigenous Gobies of Mainit Lake, 2000, Galicia A.M. *et al.* Limnological Survey of Lake Mainit, 1973, Lewis W.M.
• Planktonic composition and abundance		
• Fish species composition, abundance, and type		
Lake hydrodynamics		
• Bathymetric survey	Bathymetric survey using sounder with transducer and GPS	Limnological and Water Quality Assessment of Lake Mainit, 2005, Tumanda, M.I.
• Hydrodynamic modeling	Measurements of temperature of surface currents Modeling using the Princeton Ocean Model	
• Prediction of potential impact areas from sediment release	Estimation of dispersal patterns using a Lagrangian dispersal model	
Air		
Meteorology		
• Climatological normals and extremes		PAGASA's Modified Coronas Climate Classification PAGASA's Climatological Normals for Surigao

EIA Study Module	Methodology	
	Primary	Secondary
		City 1971 to 2000 PAGASA's Climatological Extremes for Surigao City, Temperature 1903-2003, Greatest Daily Rainfall 1902 – 2003, Highest Wind 1950 – 2003, Sea Level Pressure 1949 - 2003 PAGASA's Rainfall Intensity-Duration-Frequency Data for Surigao City based on 39 years of record
• Wind rose diagrams		PAGASA's Wind rose analysis for Surigao City 1987 - 1996
• Tropical cyclones	Interviews and Community timelining	PAGASA Office of Civil Defense
Air quality and noise		
• Ambient air quality and noise	Ambient air quality and noise measurement	
• Air pollutant dispersion modeling	1-hour short term and long-term air dispersion modelling using ISCST3 and ISCLT3 models of USEPA	Standby generator data and typical mine extraction and hauling fleet provided by GRC Topography and receptors data 2003 daily climatological data of PAGASA
• Noise modeling	Prediction of construction noise using the US Federal Highway Administration's Roadway Construction Noise Model	Typical mine extraction and hauling fleet data provided by GRC
People		
Socioeconomics		
• Population, settlements, land area, sex and age, literacy, water supply and demand, transportation, power supply and demand	Big meetings, focus group discussions, workshops, interviews, community mapping, household surveys	Census conducted by GRC in 2004 Municipal Land Use Plans and Socio-economic Profiles and Annual Investment Plans of Tubod, Mainit, and Alegria Provincial Physical Framework Plan of Surigao del Norte, 1993 – 2002 Provincial Medium-Term Development Plan of Surigao del Norte, 2001 – 2005 National Census and Statistics Office and National Statistical Coordination Board data on population, income, and poverty Department of Interior and Local Government website Department of Budget and Management website National Economic and Development Authority website Mines and Geosciences Bureau website
• Resources, livelihood, income, inputs	Participatory agriculture and fishery resources and livelihood assessment	Tubod Agrarian Reform Community Development Plan, 2003

EIA Study Module	Methodology	
	Primary	Secondary
• Public perception	Big meetings, focus group discussions, workshops, interviews, and household surveys	GRC Report on Grassroots IEC, 29 April 2005
Public health		
• Morbidity and mortality data and trends	Interviews of the Municipal Health Officers of Tubod, Mainit, and Alegria Interviews of the BHWs of the direct and indirect impact barangays Field mapping	Mortality and morbidity data and environmental health and sanitation data of Tubod, Mainit, and Alegria Department of Health website Food and Nutrition Research Institute website
• Notifiable diseases including endemic diseases		
• Local health resources		
• Environmental health and sanitation		
Indigenous people and culture		
• Mamanwa culture, impact assessment and management	Interviews and focus group discussions with Mamanwas, household survey, observation of Mamanwa daily life in Cawilan	Survey of the Socioeconomic, Religious, and Educational Conditions of Mamanuas of Northeast Mindanao, 1954, Maceda, M.N. Culture of the Mamanua as Compared with that of the Other Negritos of Southeast Asia, 1964, Maceda, M.N.
Environmental risk assessment (ERA)	Hazards analysis, quantitative risk assessment, risk management, emergency response planning	Feasibility Study, Siana Gold Project, Surigao del Norte Philippines, 2007, GRC and Intermet MSDSs of various chemicals World Bank's Techniques for Assessing Industrial Hazards, 1988

PUBLIC PARTICIPATION

Table 2-5. Public participation

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
Pre-Public Scoping	6 January 2005	Alegria Mayor Jessie Aguiliera	None	
		Alegria Municipal Council	None	
		Mainit Mayor Rogelio Gatpolintan	Project is alright as long as it does not affect Magpayang River and Lake Mainit	The Project has built-in pollution control measures such as controlled pit dewatering, cyanide detoxification circuit, sediment traps, settling pond, geotextile tubes, sewage treatment plant, and chemical management plan to protect Magpayang River and Lake Mainit.
			Why will the Project employ open pit mining and not underground mining?	As discussed in Section 3 of the EIS, the mining method is defined by the location, dimensions, and physical properties of the orebody as well as project economics, health and safety, and the environment. Surface mining is employed when the deposit is found near the surface, where the overburden is relatively thin, or when the deposit is structurally not suitable for tunnelling. When the deposit occurs deep below the surface, where the overburden is thick, or the mineral occurs as veins in hard rock, underground mining methods are used. GRC's geotechnical, engineering, and economic evaluation showed that open pit mining initially to a depth of 200 m from the initial depth of 90 m and subsequently by underground mining appear feasible. The approach is also environmentally sound because it will not excessively enlarge the present open pit area.
			The process plant must be located in Mainit.	To minimize the Project's environmental footprint, GRC confined its Project facilities within the 240-ha old SURICON property (Figure 1-1). Available Brgy. Siana space inside this property is limited and occupied by the TSF3 and the open pit. The only viable location for the process plant is north of TSF3

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
				which is in Brgy. Cawilan.
			Potable water system must be developed for Brgys. Siana and Dayano.	GRC installed a potable water supply, storage, and distribution system for Brgys. Cawilan, Siana, and Dayano in 2005. Since then, the residents have been enjoying high-quality drinking water.
			GRC must implement community livelihood projects.	Even during exploration when no income from mining is realized, GRC has implemented major community development and livelihood programs. GRC will continue to implement similar programs during Project construction and operations as part of the SDMP.
			GRC must fund the repair of the Harrison bridge.	The repair of the bridge together with other proposed projects will be considered during the formulation of the SDMP by the community.
	7 January 2005	LMDA Project Director Kaiser Recabo	A minimum 200 m setback of tailings pond from the river and water depth in the pond of no more than 7 m. The latter is to ensure the breakdown of cyanide in the tailings water by sunlight.	As mentioned, the Project has minimized its environmental footprint. Thus, the required setback cannot be provided. Also, water ponding will be minimized to ensure the stability of the dam embankment. In lieu of passive natural degradation of cyanide, the Project will put up an SO_2-air process of cyanide detoxification which will treat the tailings for compliance with DENR standards prior to discharge to the TSF.
Public Scoping (Second-Level)	15 January 2005	George Leros (Cawilan resident)	Would crops damaged by GRC be compensated?	GRC's G Edwards said that damaged crops will be compensated fairly. Qualified residents will be considered for employment.
		Ramie Antonio	If land would be affected by the Project, the compensation may be unfair as was the experience with SURICON.	G Edwards said that GRC would pay the landowners a fair price based on the zonal valuation.
		Donald Preston	Can the affected landowners be hired by the Project? His son was employed in the drilling but was terminated without a month's notice.	G Edwards explained that the son was hired when the drilling was inside D Preston's area and his employment was extended even when the drilling activity was over.
		Johnny Villapane (Sangguniang	What would happen if the operation commits a grave	EMB's Reynaldo Digamo replied that the ECC is only a

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
		Bayan of Mainit)	environmental violation, would the ECC be revoked to stop the operation? Does the proponent have a written rehabilitation plan for the project? Can the proponent guarantee that nothing environmentally threatening will happen during their operation?	compliance certificate. To stop the operations, it is the MPSA which needs to be revoked. A grave environmental violation may warrant the revocation of the ECC. G Edwards said that the rehabilitation plan would be incorporated in the EIS and a copy would be given to the local government unit. On the last point, G Edwards answered that technology has improved a lot since SURICON's operations. GRC's project will include a cyanide destruction plant that neutralizes the cyanide before it leaves the plant. Settling ponds will be used to catch sediment.
		Mainit Mayor Roger Gatpolintan	The people of Mainit, Tubod, and Alegria should be given priority in the hiring process.	This is the primary objective of the employment policy agreed upon by GRC and the Brgy. Chairmen of the direct and indirect impact areas.
		Alegria Vice Mayor Ernesto Odjinar	Nothing negative will happen to the rivers and farmlands during the pit dewatering?	Based on quality, the pit water is classifiable as Class A. There are no toxic or deleterious substances. In fact, it is the feed water for GRC's potable water system. The pitwater discharge will also be controlled and confined to the less rainy months of April to September to minimize flooding. The agricultural lands of Brgys. Siana, Magpayang, and Pongtud can use the water for irrigation.
		George Banzon (former Mainit Mayor)	What would happen to the lands bought by GRC when the Project closes?	MGB's Josefino Bernaldez stated that the lands, being privately owned, belong to whoever has the title. The law, however, provides that the operator must rehabilitate the disturbed lands.
		Evelyn Amancio, Luzviminda Fabiosa, Neciporo Leyros, and Pablito Manliques	What compensation package will GRC provide to farmers currently farming inside the mine property?	G Edwards answered that the farmers will be compensated fairly. A resettlement area will be provided to those families whose land would be used by the Project.
		Joel Pacatang (Cawilan resident and president of farmers' group)	Can GRC help the farmers and community with livelihood programs or domestic water system?	R Digamo explained that the law requires mining operators to spend 1 % of direct mining and milling cost for social development programs. The two items can be considered by

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
				GRC.
		Leopoldo Suyman (Municipal Sanitary Officer of Tubod)	The Visayan term used in the handout to describe rehabilitation means the restoration to the original form which he doubts can be done by GRC.	Dr. R Cuaño apologized for the wrong choice of word and explained that the intention is to rehabilitate the disturbed lands into something useful.
		Reynaldo Juanite (Cawilan Brgy. Councilor)	Is the amount of 1 % of direct mining and milling cost enough to build infrastructures and roads?	R Digamo said that it is not the responsibility of GRC to build all the structures. Rather, it is the local government's.
		Marcelo Galido (Pongtud resident)	The waste solution being released by the operation is not totally free of toxic chemicals. In case it overflowed and goes to our creeks, our water will be affected. Is there a way to completely free the solution of any toxic chemicals?	The SO_2-air cyanide detoxification circuit will make the tailings water compliant with DENR standards prior to discharge to the TSF. The sediment traps, plant water feed pond, and geotextile tubes will capture the coarse and fine sediments in the surface runoff. In the process plant area, containment bunds and pond will prevent chemical spills from reaching the streams.
		Rosalita Amarille (Siana resident)	We rely on CIDSS for the fish cages within the pit lake. What will happen to us once GRC uses the pit?	Fish cages, which were present in 2005, no longer existed in 2008. According to GRC's R Oclarit, the operators pulled out because fish growth was stunted.
		Maria Ajoc (Treasury Office, Mainit)	There were destructions during SURICON operations. GRC may add more destruction especially to rice fields.	The rationale for the EIA is to minimize, if not prevent, the negative impacts of the Project such as the destruction to the rice fields. The EIS specifies the needed measures and structures in the Environmental Management Plan.
		Remegio Lopez (Cawilan resident)	Does GRC have the solutions to prevent the recurrence of destruction during SURICON operations, particularly the floods which brought stones and silt to our creeks and rice lands?	GRC commissioned hydro-meteorological studies to enable the correct layout and sizing of stormwater, erosion, and sediment control systems. Coupled with standard operating measures, the control systems can minimize the floods and sediments from the Project site.
		Esmeraldo Flores (Farmer and Cawilan Purok President)	We live in Purok Bulawanon at the Duplex Compound. We request GRC to give us a new house when operations start.	Households living close to TSF3 and the waste rock dumps will be relocated to assure their safety. They will be consulted and given the option of cash payment or resettlement within the barangay with improved living conditions. If necessary, livelihood restoration or employment may be provided.

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
		Carmelito Manting (Mainit Chief Sanitary Inspector)	Does GRC provide its personnel with PPE? Is there a health and safety committee?	GRC provides PPE to its workers. A health and safety committee is in place.
		Marlene Coquilla (Alegria Sangguniang Bayan member)	What benefits can Brgy. Pongtud get from the operation? We will be affected because the waste passes through us. Can the Municipality of Alegria get a portion of the excise tax, the same as Tubod and Mainit Municipalities?	As an indirect impact area, Brgy. Pongtud will have a share in the Project's employment and SDMP. It is not entitled to a share in the excise tax because national revenue regulations are clear on the matter: the reckoning of excise tax beneficiary is the point of extraction of ore.
Grassroots IEC on the Siana Project, Brgy. Cawilan	20 March 2005	Joel Pacatang	Considering the life of only 5 to 6 years and the high cost of reopening the mine and dewatering the pit, it's hard to believe there will be investors.	R Gomonit of GRC said the feasibility study is continuing. At completion, GRC will decide what to do with the property. Based on the most recent Project design, the mine will have an operating life of 10 years.
		Boy Moril	Cawilan residents need a job. Can they be given a higher share of the employment since Cawilan has a bigger population?	R Gomonit said if the company will operate, the sharing will be resolved by the Brgy. Officials of the direct and indirect impact areas.
		Brgy. Captain Guilalas	Based on the ongoing negotiations, Cawilan will get a bigger share of employment because of its population.	
		Wilson Cadenas	Is there an assurance the area mined will be rehabilitated after decommissioning?	R Gomonit said that the law requires companies to deposit a Mine Rehabilitation Fund before operating.
			Can the tailings dam withstand calamities and chemical spills prevented?	R Gomonit explained that part of the EIA study is better understanding of the climate which is vital to the design of structures.
			Students of Tubod enjoy free miscellaneous fees through the generosity of Mayor Romarate. What benefits can GRC offer?	R Gomonit stressed that though in the exploration stage, GRC has provided school supplies, school painting, and other infrastructure assistance to the schools.
		Joel Pacatang	Is the development stage included in the 5 to 6 years operation?	R Cuaño said that development is around 2 years, operation 5 to 6 years, and 1 year rehabilitation after decommissioning. Based on the most recent Project design, development is around 1.5 years, operation will be for 10 years, and decommissioning and rehabilitation is another 0.5 year.

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
		Simeon	If the company will operate, is it open cut or underground? Is there assurance what happened to SURICON will not recur?	R Gomonit answered that if GRC will operate, it will be open cut. The laws are more stringent now to make sure the failures of the past don't happen again.
		Wilson Cadenas	If the company will operate, where do we apply?	R Gomonit said there is a MOA requiring that employees for the project come from the host barangays with the Bargy. Captain's recommendations.
		Esmeraldo Flores	Is it possible Purok Bulawanon will be relocated?	R Cuaño said that if relocation will happen, a standard resettlement plan will be made. Based on the final Project development plan, some 13 households within Purok Bulawanon will be relocated.
Grassroots IEC on the SIana Project, Brgy. Pongtud	10 April 2005	Cenesia Perayo	If there is a calamity, can we expect help from GRC? Is there any guarantee structures like the tailings dam can withstand calamities?	R Gomonit said GRC plans to put up disaster response teams if it decides to operate. Part of the EIA study is better understanding of the climate which is vital to the design of structures.
		Mrs. Taer	If my land in Bayagnan becomes part of GRC's development plan, can I refuse to sell my land?	R Gomonit stressed that GRC's policy is to consult and discuss first with the landowner with the full knowledge of the Brgy. Captain.
		Andres Madelo	During SURICON days, many ricefields were damaged in Brgy. Dayano. If this recurs, do we have assurance for compensation?	R Gomonit explained MGB's requirements for a Mine Waste and Tailings Fee and mandatory compensation of mine-related damages.
		Virgilio Aposaga	If the landowner sells the land, will the tenants be paid separately? Who will claim the compensation in case of mine damages?	R Gomonit said that he would refer the matter to management and MGB.
		Manuel Josue	What is GRC's plan for rehabilitation?	R Gomonit explained the process of Mine Rehabilitation Fund and the preparation by the company of a Final Mine Rehabilitation Plan for discussion with the community.
		Lourdes	Not all residents will be employed, what other benefits can the people expect?	R Gomonit explained that through the SDMP, sustainable livelihood programs will be implemented. It will be a joint effort of GRC, community, and government agencies.

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
		Virgo Aposaga	You presented a cyanide destruction machine. How do we know it is effective?	R Gomonit replied that tests are ongoing for the design of the machine. The results will be presented to the people.
Grassroots IEC on the Siana Project, Brgy. Siana	16 April 2005	Calinico Lazarte	What will be the situation of the community if there will be a mine?	R Gomonit explained that GRC's policy is to inform and consult the community on future plans. If a mine will be put up, there will be jobs and business opportunities. An SDMP will be implemented.
			Will there be relocation?	R Gomonit said that he cannot answer the question now. If there will be, proper information and consultation will be done by GRC. Based on the final Project development plan, some 42 to 56 households within Puroks Riverside and Hilltop of Brgy. Siana and 7 to 13 households of Purok Bulawanon of Brgy. Cawilan need to be relocated.
			From what I learned from a friend geologist, no investor is willing to operate a small deposit because their standard is 15 years or more.	R Gomonit replied that the Project is still in the feasibility study stage.
		Isabel Garcia	If there will be an operation, will it be open cut or underground?	R Gomonit said it will be open pit. The Project's final development plan provides for open pit mining initially, followed by underground mining.
			If open pit, when will dewatering start? When will operations commence?	R Gomonit explained that the project is still in the feasibility study stage. The people will be informed when the study is completed.
		Maria Ajoc	Why does GRC pay a bigger tax in Tubod Municipality than in Mainit? Why is the address of the Siana Project Cawilan, Tubod?	R Gomonit promised to refer the matter to management.
			Based on the presentation, 1 % of direct mine and milling cost (DMMC) goes to the SDMP. How much is the DMMC?	R Gomonit clarified that the DMMC will be estimated in the feasibility study.
			We heard the plan to use the pitwater as water source for the impact barangays. Is the water safe for consumption? A DOH approval is needed.	R Gomonit explained that continuous water sampling by GRC confirmed the water's best quality. GRC will put up a water treatment plant to ensure safety. The RHU will be involved in

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
			DOH approval is needed.	the water quality tests.
		Brgy. Captain Raul Ajoc	Based on what I learned, after SURICON closed down, Mainit converted the industrial land classification to agricultural land. That is why Tubod gets bigger taxes. What they said about the pit water quality is true.[1]	R Gomonit stressed that the water treatment and distribution system will be installed before the mine is put up. Thus, in case GRC decides not to operate, the system will be left as GRC's legacy to the barangays.
		Diochar Patagan	People plant on GRC land and in their own lands. If GRC uses these lands, will they be compensated?	R Gomonit noted that in the Public Scoping which some of the residents attended, G Edwards said that they will be compensated.
		Rosalinda Amarille	If the pit will be dewatered, can I be compensated for my fish cage?	R Gomonit committed to refer the matter to management.
		Brgy. Captain Ajoc	G Edwards said that GRC will help relocate the fish cage.	
		Rosario Mijares	How sincere is GRC in its proposal?	R Gomonit said that the written proposal was already submitted to the three barangays.
		Brgy. Captain Ajoc	He showed the proposal and enumerated GRC's community assistance projects.	
		William Sardovia	If Siana residents won't agree to a mine, will GRC push through? Is there an assurance of rehabilitation?	R Gomonit explained that the EIA is ongoing. Part of the study is to determine the social acceptability of the project and GRC. He explained the legal requirements on rehabilitation.
		Mr. Abella	If there will be a mine, what areas will be affected? Is there an assurance the affected residents will be paid? How much?	R Gomonit answered that the feasibility study is ongoing. If there is a mine, issues such as relocation, payments, etc. will be discussed with the community.
Grassroots IEC on the Siana Project, Brgy. Magpayang	16 April 2005	Hermelito Cadavero	SURICON closed down after 1995. Why was it not covered by Mining Act?	R Gomonit clarified SURICON closed down in 1990.
			Is there an assurance of rehabilitation if GRC will operate?	He explained the legal requirements on mine rehabilitation.
		Bebie Jumamoy	During SDMP implementation, in case a livelihood project fails, will the members be obliged to pay?	R Gomonit said no.

[1] Based on Mainit's Municipal Comprehensive Land Use Plan for 2001 to 2011, the old SURICON 240-ha property is still classified as an industrial area.

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
		Mr. Richard	In Manila Mining which is covered by the Mining Act, why is it that many employees are not being paid their length of service rendered? Is there an assurance this won't happen in GRC?	R Gomonit said that from what he learned from MGB, Manila Mining is not declaring a permanent shutdown.
		Alner Alce	On the SDMP, the barangays must manage it well for the future generations. We must not repeat the mistakes with past grants and associations. We must be vigilant in safeguarding our community and environment in case there will be another operation.	
		Bonnie Amplayo	In 1964, SURICON's tailings pond overflowed and damaged the riceland and killed the fishes. What is the assurance this will not recur?	R Gomonit said that the EIA and feasibility studies are looking closely at the environmental and operational factors to ensure that this does not happen.
		Hermelito Cadavero	Did the Mining Act violate DENR laws?	He stressed that the Mining Act was created in consultation with government agencies.
		Bebe Jumamoy	What is the process of breaking down the cyanide?	R Gomonit said that cyanide is composed of carbon and nitrogen. Their bond is broken through exposure from oxygen. The cyanide destruction machine hastens the decomposition process.
		Aida Montero	How is the rehabilitation program carried on?	R Gomonit explained the legal provisions on mine rehabilitation.
		Bonnie Amplayo	There are primary and secondary impact barangays. If there is a mine, what is the employment share of secondary impact barangays?	For now, there is no agreement yet. If the decision is to operate, GRC will discuss the issue with the barangay captains.
Grassroots IEC on the Siana Project, Brgy. Dayano	17 April 2005	Cerelo Bug-os	What are the mitigating measures of the company to address the mining environmental risks?	R Gomonit said that the EIA and feasibility study are ongoing. The measures will be presented once the studies are completed.
		Rico Cuizon	We are interested in the results of the EIA to comprehend what is going to happen socially and environmentally if there's a mine.	R Gomonit promised to come back once the studies are completed.

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
		Mr. Peñaflor	Is there an assurance that the SDMP as presented will be provided by GRC?	R Gomonit stressed that if GRC will operate, the SDMP will be implemented. That's a requirement of the MGB.
			What will the company do if the residents won't agree to the reopening of the mine?	R Gomonit explained that the EIA is ongoing, part of that is social acceptability.
			There are residents inside the company property. If GRC will operate, are they going to be paid?	He recalled that the question was raised during the Public Scoping. G Edwards' reply was they would be paid.
		Rico Cuizon	Why is the CTWG meeting limited only to Brgy. Officials and sectoral leaders?	R Oclarit of GRC said these officials represent the residents.
Grassroots IEC on the Siana Project, Brgy. Del Rosario	27 April 2005	Mrs. Ragas	If the company will operate, what works and skills are needed?	R Oclarit said that definitely, many workers will come from the impact barangays. No exact figures are available.
		Brgy. Captain Ronaldo Esmeralda	What happened to the summer job for the impact barangays? I've sent applicants but until now, no response.	R Gomonit said that last year, the summer job was for the primary impact barangays. This year, it will be expanded. The matter will be referred to management.
		Mr. Marcos	Is Brgy. Del Rosario primary or secondary impact?	R Gomonit answered it is secondary.
			Why is it that nobody from del Rosario was given work during exploration?	He said tha the EIA identified del Rosario as a secondary impact barangay. Because of this, it is now included in the proposed job and community programs during operations.
		Luzviminda Dano	Is it true that applicants for GRC need Barbers' recommendations?	R Gomonit answered no. Only a recommendation from the Brgy. Captain is required. It is the company which decides if the applicant is qualified.
		Kgwd. Ajoc	Who are qualified for the summer job?	R Gomonit answered preferably college students. They will be given 15 days to work on a rotation basis. Five each will come from the direct impact barangays and the rest will be shared by the secondary impact ones.
Re-Scoping Meeting with Officials of Brgys. Cawilan, Siana, and Dayano	24 April 2008	Virgilio Elsisura (Brgy. Kagawad of Cawilan)	Who is the real owner of the Siana property? Mr. Bagondol who claims to be Gotesco's caretaker had the old SURICON staffhouse torn down. He is collecting rent and asking for a half of copra income as Gotesco's share.	G Edwards explained that the surface rights and MPSA were transferred from Gotesco to Merrill-Crowe of Metrobank. Love Manigsaca of GRC advised that the problem has already been referred to Merrill-Crowe and GRC will follow up.

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
				Bebot Gonzales of GRC said that he will give the Cawilan Brgy. Council a copy of the agreement between GRC and Merrill-Crowe.
		Alfredo Pagapong (Brgy. Kgwd. of Siana)	Water from Dayano is limited during summer. Once operations start, will our irrigation water be affected? During SURICON time, water in the river became dirty.	R Cuaño said that during the pit dewatering, the water will be distributed to the farmers. During operation, the bores will continue to supply the community potable water supply and irrigation. Ricky Oclarit of GRC said that mitigating measures will be implemented to make sure the sediment does not go to the river.
		Virgilio Elsisura (Brgy. Kgwd. of Cawilan)	In case GRC operates, what happens to the people living in the Duplex?	R Cuaño explained that the area is near the waste dump where dust and noise impacts are likely. If the EIA study finds the noise level to be high, mitigating measures will be recommended. If the impact is too much, the affected households will have to be relocated.
		Soniefe Lopez (Brgy. Cawilan)	Many in Cawilan don't have jobs. All they do is plant. In case the Project starts, what happens to their plants?	R Cuaño stated that once the plants and lands to be affected are ascertained, the community will be informed and negotiations with GRC can commence.
		Dioschar Patagan (Brgy. Kgwd. Of Siana)	Will GRC need additional lands for its operation?	R Cuaño said that as per the plan, GRC will confine its operations within the Merrill-Crowe property.
		Ariel Odtojan (Siana SK Chairman)	Will the community be deformed after operation?	M Cuaño explained that mining companies are required to submit a final mine rehabilitation plan. This plan is discussed with the community. G Edwards said that the mine will not wait for closure to commence rehabilitation.
		Dioschar Patagan (Brgy. Kgwd. Of Siana)	How about the employment policy?	G Edwards said that GRC will stick to the prior agreement by the six barangays on employment. R Orcullo discussed the agreement – 95% of total employment will come from the six barangays. Magpayang, del Rosario, and Pongtud get 10 % share each. The remaining 65 % is allotted to Dayano at 18 %, Siana 23 %, and Cawilan 25 %.

EIA Stage	Date	Sectors Engaged	Issues Raised	Proponent's Commitment/Response
Re-Scoping Meeting with Sectoral Representatives of Brgys. Cawilan, Siana, and Dayano	24 April 2008	Cenecio Onque (Dayano Irrigators Association)	We accept that the project will proceed. But there were problems during SURICON days with silt. Will GRC pay for damages to ricelands?	M Saclag explained that the damaged palay will be paid and the damaged land will be rehabilitated. If planting cannot be done in the next cropping season, lost income will be compensated. The prices are based on fair market values.
		Leticia Serrano (Siana)	We own land near the tailings dam. Will GRC pay for our plants? If the land will be used by the company, can we still pass and harvest the coconuts?	G Edwards said that GRC's policy is to allow the use of land by others if the company does not need it yet. If GRC will use the land, notification is done three (3) months ahead.
		Isabel Garcia (Siana)	If GRC operates, can our sons work?	G Edwards explained that the employment policy assigns a fixed percentage to the primary impact barangays. This will be followed by the contractors.
		Joel Pacatang (Cawilan Farmers and Irrigators Association)	GRC's rice production program seems unfair because there was no consultation on the recipients.	R Oclarit said that GRC consulted with the Barangay Councils. The Councils determined the recipients based on guidelines and lot specification by GRC.
		Titing Gabeon	During operation, what will happen to Purok Bulawanon?	M Cuaño said that will depend on the results of the EIA since the area is close to the waste dump. Based on the final Project development plan, some 7 to 13 households within Purok Bulawanon are targeted for relocation.
		Teofilo Peñaflor (Dayano Farmers Association)	With the present hiring practice, an applicant needs a Barangay Chairman's certification. If one is not close to the Chairman, he is not given a certification and so he cannot work. This is the practice in UPD (drilling contractor) now.	M Cuaño said the certification is to ensure the applicant is a barangay resident. G Edwards assured there will be fair hiring for all residents of affected barangays.

Photo 2-1. The original First-Level Scoping of the Siana Gold Project (22 December 2004).

Photo 2-2. The original Second-Level Scoping at the GRC corehouse (15 January 2005).

Photo 2-3. Mainit Mayor Gatpolintan addresses the crowd.

Photo 2-4. Cawilan's George Leros wanted to know if crops damaged by the Project would be compensated.

Photo 2-5. GRC's G Edwards responds to a participant's question.

Photo 2-6. Community timelining and situational analysis at Brgy. Pongtud, Alegria (13 January 2005).

Photo 2-7. Community timelining and situational analysis at Brgy. Magpayang, Mainit (13 January 2005).

Photo 2-8. Community timelining and situational analysis at Brgys. Siana and Dayano, Mainit (14 January 2005).

Photo 2-9. Community timelining and situational analysis at Brgy. Cawilan, Tubod (14 January 2005).

Photo 2-10. Brgy. Pongtud residents doing the trend diagram for the participatory livelihood and resources assessment (15 February 2005).

Photo 2-11. Brgy. Pongtud residents present their output tables and diagrams.

Photo 2-12. Participatory resources and livelihood assessment at Brgy. Cawilan (16 February 2005).

Photo 2-13. Participatory resources and livelihood assessment at Brgy. Dayano (16 February 2005).

Photo 2-14. Brgy. Magpayang residents listen to the objectives of the participatory assessments (17 February 2005).

Photo 2-15. Brgy. Siana residents build up their diagrams for the participatory assessment (17 February 2005).

Photo 2-16. Grassroots IEC on the Siana Project at Brgy. Cawilan (20 March 2005).

Photo 2-17. BHWs doing the community map as guide for the selection of samples for the household survey (29 April 2005).

Photo 2-18. BHWs get ready to present their community maps.

Photo 2-19. The Re-scoping Meeting for the Project (27 March 2008).

Photo 2-20. Siana Brgy. Kgwd. Pagapong inquires about the effects of the Project to the irrigation water (24 April 2008).

Photo 2-21. Siana SK Chairman A Odtojan is concerned with mine rehabilitation.

Photo 2-22. Cawilan Brgy. Captain Juanite discusses the Bagondol issue.

3 PROJECT DESCRIPTION

PROJECT LOCATION AND AREA

The Siana Gold Project is located approximately 39 km south of Surigao City, northeastern Mindanao (Figure 3-1). It is within the 240-ha Siana mine property formerly operated by Surigao Consolidated Mining Company (SURICON), portions of which fall within Brgy. Cawilan of the Tubod Municipality and Brgys. Siana and Dayano of the Mainit Municipality, province of Surigao del Norte. It is covered by a Mineral Production Sharing Agreement (MPSA).

Access to the project is either from Surigao City through a 40-minute land trip or from Butuan City through a 2-hour land trip, both via the National Highway. Surigao City and Butuan City can be reached from Manila through commercial planes.

The Siana property is within the 5,700-ha catchment of the Magpayang River, about 6 km upstream of Lake Mainit. Lake Mainit has an approximate surface area of 17,100 ha (BFAR) and catchment size of 87,100 ha (LMDA). It is not a protected area. Based on the second iteration of the National Biodiversity Strategy and Action Plan in 2002, the lake is rated very high in the Philippine Biodiversity Conservation Priorities (Ong *et al.*, 2002).

PROJECT BACKGROUND AND RATIONALE

The Siana property was operated as an underground mine between 1938 and 1960 by SURICON. The mine produced 614,200 oz of gold (Au) from 1.59 million t of ore with an average grade of 12.01 g t^{-1} Au. From 1981 to 1990, the property was operated as an open pit mine. It produced 321,000 oz Au from 2.98 million t of ore with an average grade of 3.35 g t^{-1} Au.

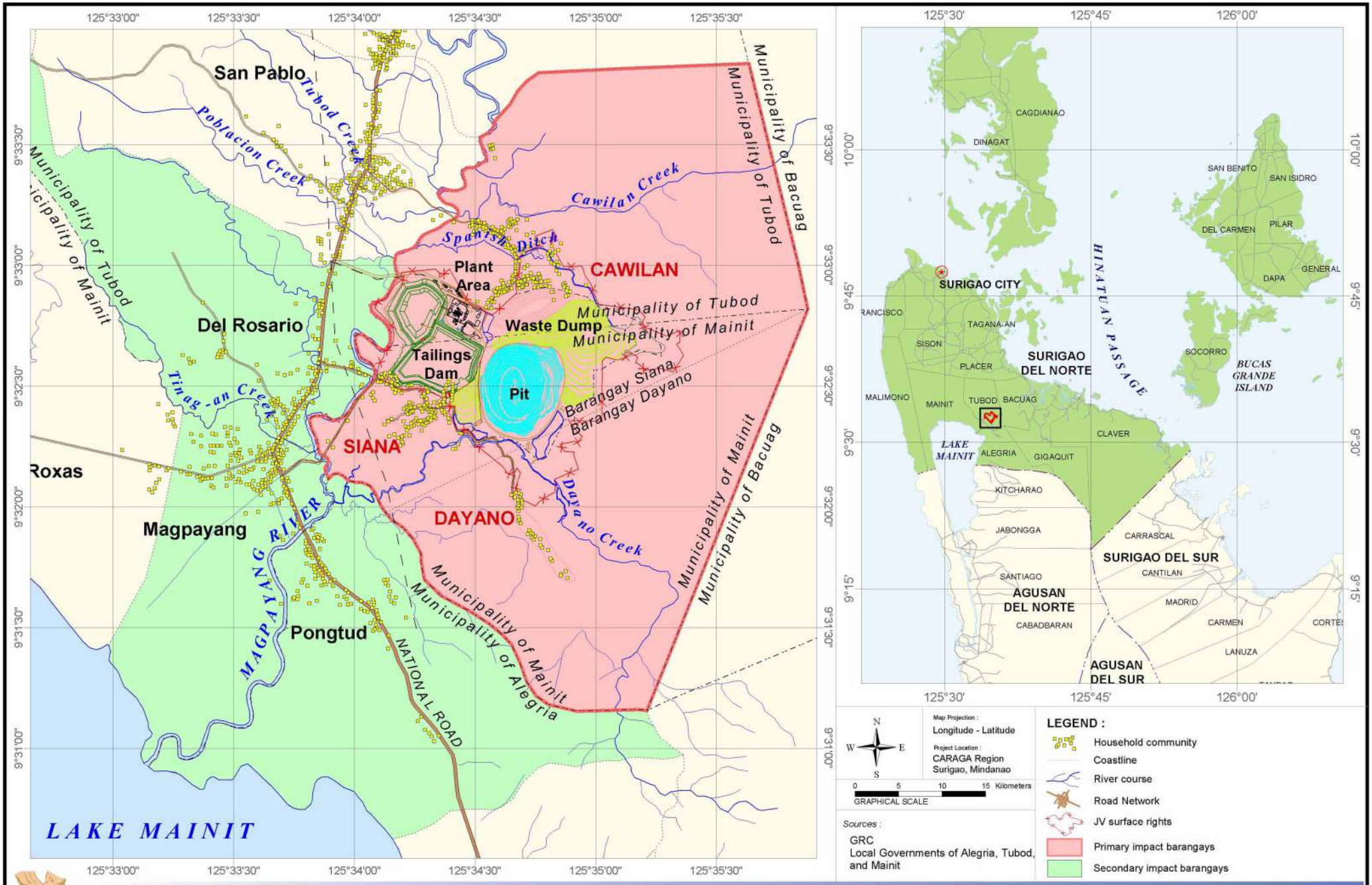
The closure of operations in 1990 was premature. The immediate cause was two major pit wall failures that cut the main access ramp and covered a substantial portion of the ore. The remnants of SURICON operations are a flooded open pit, two dried and grassy tailings pond, one tailings pond with a pool of water, three grassy waste rock dumps, and a workshop.

In September 1997, JCG Resources Corporation (JCG) applied for an MPSA covering the Siana property and other areas. In June 2002, Bremer Resources NL executed a Siana Joint Venture Heads of Agreement with JCG. The Agreement has several phases, namely, due diligence and technical review, initial drilling, exploration, and mining joint venture. In December 2002, JCG was granted MPSA No. 184-2002-XIII which covered the Siana property. Bremer later assigned its interest in the Joint Venture to GRC.

GRC commenced reverse circulation percussion and diamond drilling in February 2003. In view of encouraging results, this was followed by a major resource diamond drilling program from November 2003 to February 2005. Additional drilling works were undertaken. By October 2006, a total of 64 holes with an aggregate length of 25,133 m were completed and became the basis of the Bankable Feasibility Study (BFS) for the Siana Project.

On 15 August 2005, through a Deed of Assignment, JCG assigned to Merrill Crowe Corporation (MCC), a company of MetroBank Corporation, its rights and obligations on the Siana MPSA and conveyed to the same entity full possession and control of the entire land area covered by the MPSA. On 19 August 2005, through an Agreement, GRC, among others, affirmed its consent to the assignment of claims. The Agreement likewise provided that MCC will immediately cause the transfer of the Siana MPSA from JCG to MCC and immediately thereafter to a Filipino company.

Figure 3-2 shows the corporate structure that will operate the Siana Project. Philippine tax and legal experts confirm that the corporate structure shown complies with Philippine foreign ownership laws and particularly with the Philippine requirement which limits non-Filipino ownership of Philippine “patrimony” property to not more than 40 %.



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Project location and impact areas

EIS of the Siana Gold Project

Figure No. **3-1**

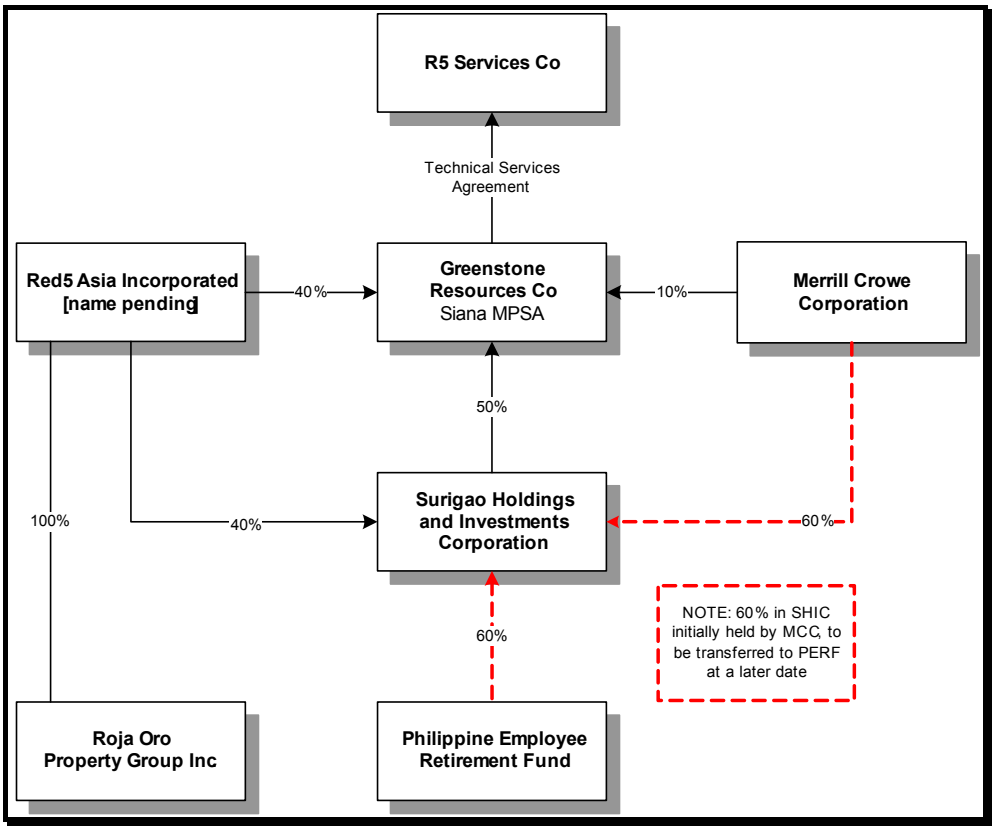


Figure 3-2. Corporate structure of Greenstone Resources Corporation

Central to the Project structuring is the conversion of GRC to a 60 % Philippine shareholding (with 50 % owned by Surigao Holdings and Investment Corporation (SHIC) and 10 % owned by MCC. The balance of 40 % will be held by a newly incorporated Red5 wholly owned Philippine subsidiary, Red5 Asia, Inc. (R5AI).

Upon transfer from MCC, GRC will become the mining operating entity and the registered holder of MPSA 184-2002-XIII and relevant surface rights.

As part of this corporate structure, a newly formed Philippine Employee Retirement Fund (PERF) to be administered by MetroBank will become a major stockholder of SHIC. Dividends (with a minimum safety net) will flow into PERF for the benefit of the Filipino employees of GRC.

The BFS estimated a total probable reserve of 3.16 million t at 3.4 g t^{-1} Au and 8.5 g t^{-1} silver (Ag), equivalent to 339,700 oz Au and 0.87 million oz Ag and mineable by open pit over a 4.5-year mine life.

In late 2006, a series of encouraging high-grade drill intersections immediately below the proposed pit prompted an evaluation of the underground mining potential of the Siana deposit. A scoping study based on an underground inferred resource model and a preliminary mine design indicates that a combination open pit/underground operation can recover approximately 720,000 oz Au and 1.34 million oz Ag from a 5.4 millon t inventory over a ten (10) – year mine life. At a gold price of US $ 650 oz^{-1}, silver price of US $ 13 oz^{-1}, and discount rate of 8 %, GRC estimated a pre-tax net present value (NPV) and internal rate of return (IRR) for a 10-year combined open pit/underground operation at US $ 86.6 million and 38.3 %, respectively. The estimates are rough and need to be refined by a drilling program, development of a resource model, detailed geotechnical evaluation, estimation of underground capital costs, and source quotations from local mining contractors.

If extracted and managed properly from the environmental and social viewpoints, the wealth from a redevelopment of the Siana property will benefit the impact and adjoining communities in terms of poverty reduction, development of

skills and industries, education, health, sanitation, community organizations, physical infrastructures, and governance. The redevelopment will also allow the completion of a Final Mine Rehabilitation and Decommissioning Plan that will remove the site physical and chemical stability risks and transform the Project site to its best post-mining land use.

PROJECT ALTERNATIVES

Table 3-1. Project alternatives and evaluation

Project Parameter	Alternatives	Evaluation
Facility siting	The siting of facilities for a mining project is constrained primarily by the location of the orebody. This is because of the volume of materials for extraction and transport and the high dependence of the costs on transport distances. Thus, for the Siana Project, facilities for ore processing, waste storage, offices, and accommodations are sited as close to the orebody as possible.	GRC deliberately minimized its project footprint by confining all facilities within the 240-ha Siana property. The only new area for development is the access road. This will be built to avoid project impacts on the available narrow roads that pass through Brgys. Cawilan and Siana. Around 0.8 ha of rice land is within the proposed road alignment.
Mining method	The mining method is defined by the location, dimensions, and physical properties of the orebody as well as project economics, health and safety, and the environment. Surface mining is employed when the deposit is found near the surface, where the overburden is relatively thin, or when the deposit is structurally not suitable for tunnelling. When the deposit occurs deep below the surface, where the overburden is thick, or the mineral occurs as veins in hard rock, underground mining methods are used.	The current maximum depth of the Siana pit is approximately 90 m. GRC proposes to extract the remaining ore in the pit down to 200 m depth by open pit. The open pit method is technically feasible. It is also environmentally sound because it will not excessively enlarge the present pit surface area of 21 ha. In the proposed open pit plan, the maximum pushback of the pit is about 70 m at the northeastern portion. The final pit surface area is about 32 ha. Beyond the 200 m depth mineable by open pit, the ore extension will be mined by underground mining. This is to avoid the large costs of pit development, *i.e.,* overburden extraction, and the associated environmental impacts.
Processing method	The processing methods for gold are flotation, gravity concentration, amalgamation, and cyanidation. Flotation is used mainly on finely disseminated base metal ore that contains small quantities of gold. Gravity concentration is applicable mostly to gold placer deposits. Amalgamation is most effective on loose or free gold particles with clean surface. Its use is now restricted because of costs, inefficiency, non-suitability of available ores, and environmental concerns. Cyanidation is the predominant method of gold beneficiation. It is best suited to fine-grained gold in disseminated deposits. Economics as well as occupational health and safety and environmental considerations led to the research and development of lixiviants that will replace cyanide in gold leaching. Seven (7) alternatives gained recognition, namely, thiourea, thiosulfate, thiocyanate, bisulfide, ammonia, halogens, and malononitrile.	The drawbacks of cyanide use in gold leaching pertain to toxicity, *i.e.,* handling and environmental toxicity. The lixiviants superior to cyanide in terms of toxicity are thiosulfate and thiocyanate. However, both suffer in terms of extraction economics and cost. Thiosulfate is also inferior because of its limitations and non-recyclability. Thiocyanate has no large-scale application. Another lixiviant, malonitrile, is better than cyanide in terms of handling. However, it has problems in availability, costs, recyclability, and large-scale application. Thus, cyanide is still the best and most common lixiviant for gold-bearing ores. Metallurgical testworks by GRC's various consultants confirmed the suitability of the Siana ore to cyanidation with gravity pre-concentration. To offset cyanide's disadvantage of environmental toxicity, GRC proposes to detoxify the tailings prior to discharge to the

Project Parameter	Alternatives	Evaluation
	Gos and Rubo (undated) developed a set of criteria for the evaluation of the lixiviants. This includes from the economic viewpoint, capital investment, extraction economics, availability, and costs considering detoxification and recycling; in terms of process applicability, limitations, recyclability, detoxifiability, and large scale applications (proven technology); and with respect to toxicity, emissions, handling, and environmental toxicology. They found thiourea and thiosulfate not favorable in terms of extraction economics, costs, limitations, and recyclability. Thiourea was also not favorable with regard to handling and environmental toxicity. Thiocyanate, bisulfide, and ammonia were not favorable with respect to capital investment. Thiocyanate and ammonia also suffered from extraction economics. Thiocyanate and bisulfide were not favorable in cost and large-scale application. Bisulfide had additional disadvantages such as limitations, handling, and environmental toxicity. Ammonia was not favorable in regard to capital investment, extraction economics, detoxifiability, large-scale application, handling, and environmental toxicity. Halogens had problems in terms of costs, detoxifiability, handling and environmental toxicity. Finally, malononitrile was found to be unfavorable with respect to availability, costs, recyclability, large-scale application, and environmental toxicity.	TSF.

PROJECT DEVELOPMENT PLAN AND PROJECT COMPONENTS

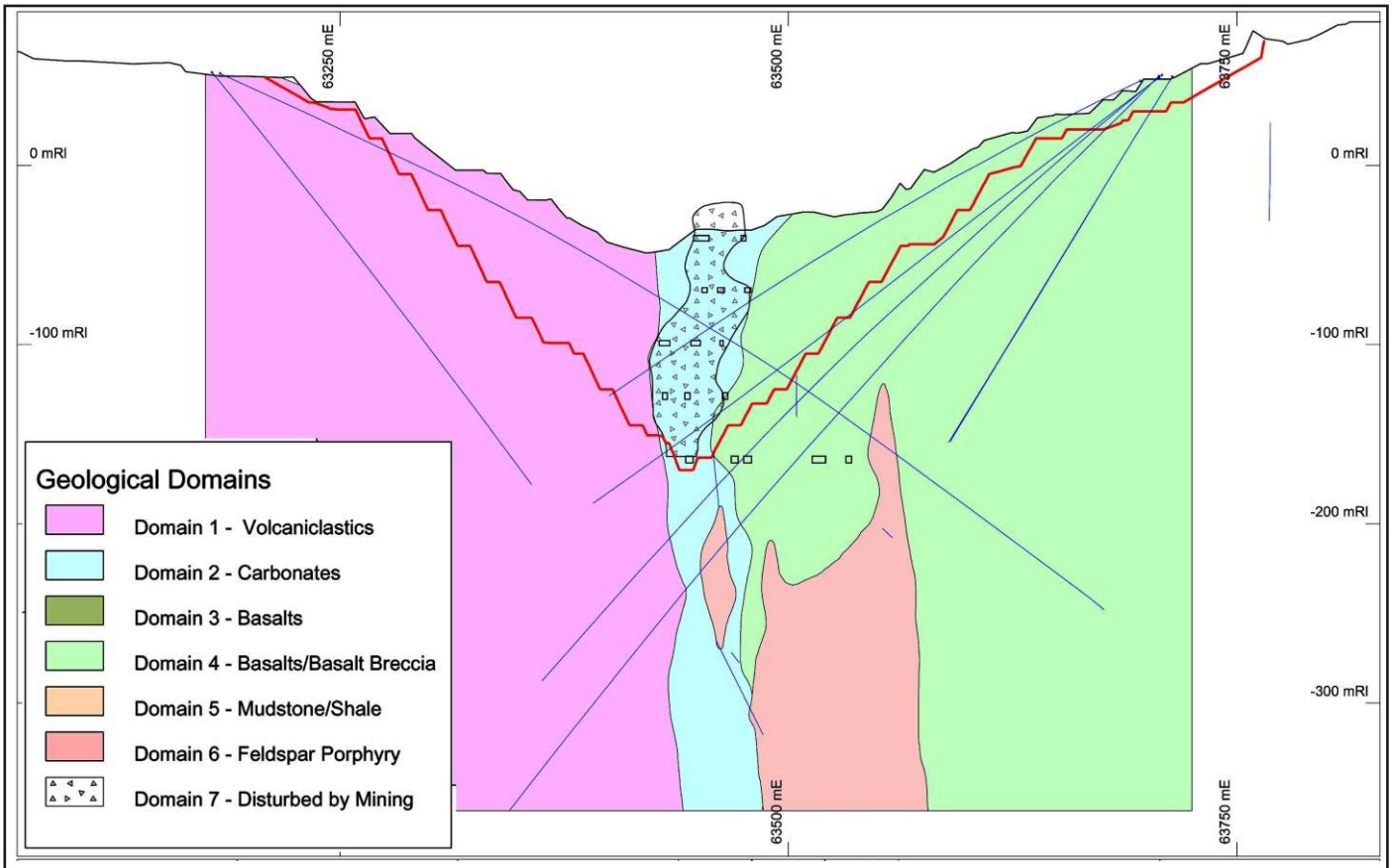
Project Development Plan

Siana Deposit

The Siana gold (with silver, lead, and zinc) mineralization is considered a high-sulphidation regime of epithermal affiliation, hosted predominantly within tectonized and altered carbonate and basaltic lithological assemblages.

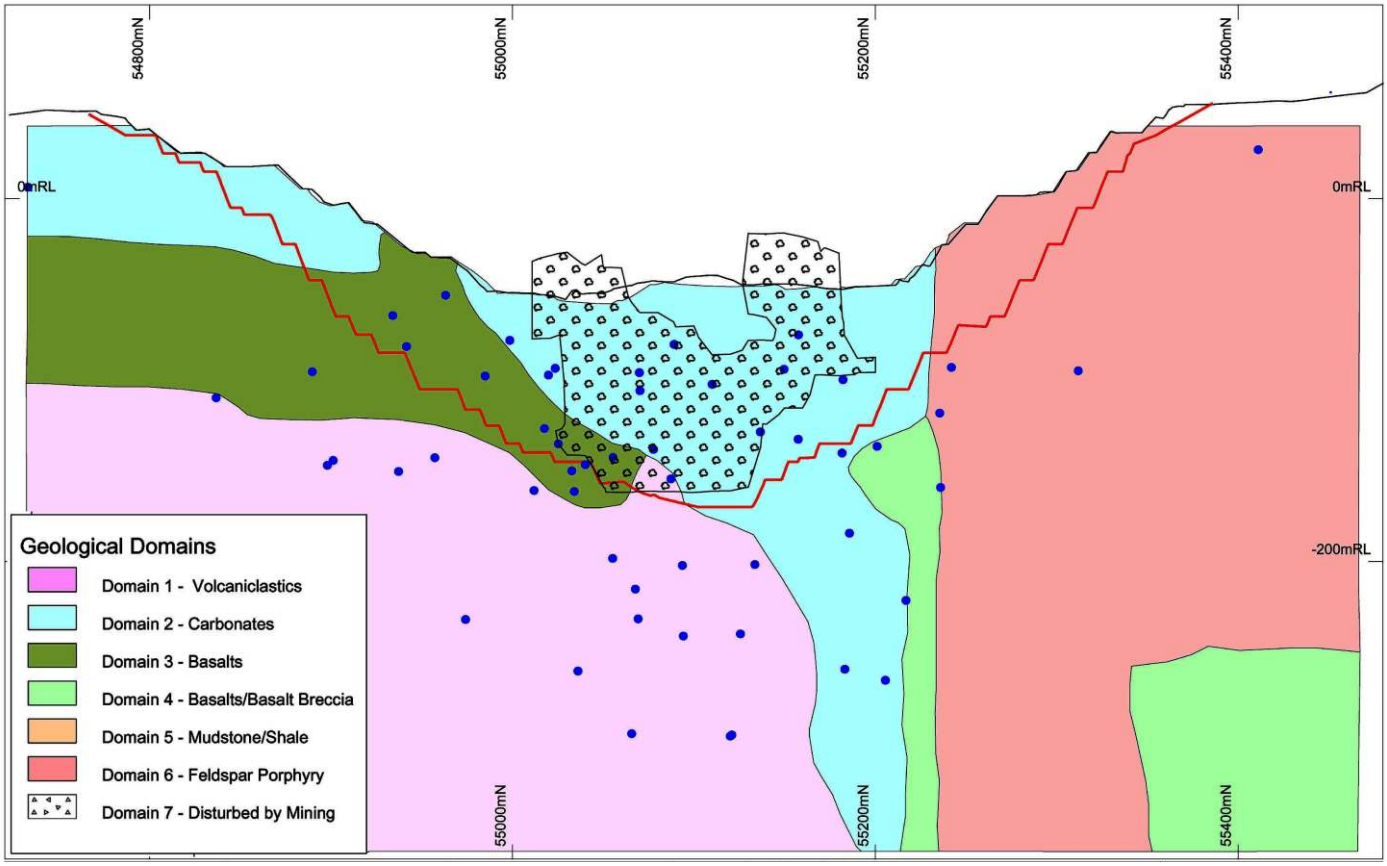
The stratigraphy of the area is grouped into six (6) lithological domains, namely (GRC and Intermet, 2007 and Figure 3-3):

- From west to east are the three (3) major domains – Domain 100 which is a package of barren to weakly mineralized west dipping sediments and interbedded basalts; Domain 200, a central strongly mineralized black to dark grey carbonate-rich sedimentary package; and Domain 400, a well-mineralized eastern basalt assemblage with interbedded sediments and breccias.



E - W Cross Section

Central Pit Region



N - S Cross Section

Central Pit Region

Source: **GRC**

- Domain 200, the central carbonate assemblage which is often brecciated and consists of a very poorly sorted accumulation of manganoan limestone fragments with minor mudstone, siltstone, coal, sandstone, and volcaniclastic debris set in a dark, calcareous muddy matrix. It includes as sub-domain, Domain 700, an area disturbed by underground mining.

- Less volumetrically important are Domain 300, a thin domain of mixed basalt and sediments immediately west of the central carbonate zone; Domain 500, an essentially barren black mudstone unit underlying the carbonate zone, and Domain 600, a barren to weakly mineralized feldspar porphyry intrusive.

Mineralization is predominantly hosted in the central carbonate (Domain 200) and eastern basalt domains (Domain 400) with strongly altered zones comprising the fine grained clays, quartz, and carbonate. The three (3) major domains are interpreted as separated by major faults. As a consequence, the central carbonate domain has been largely and strongly brecciated and veined during multiple tectonic and hydrothermal alteration events (*Ibid.*)

Gold is generally fine grained, *i.e.*, finer than 75 µm, and well distributed within the altered host rocks. SURICON operations and metallurgical testworks conducted during the BFS confirm that the gold ore is free-milling, *i.e.*, amenable to gold cyanidation.

Site Conditions

The 240-ha Project site is the former mine and industrial facility of SURICON. The major land features are a flooded open pit, two (2) dried and grassed tailings ponds – Tailings ponds 1 and 2, one tailings pond with a pool of water – Tailings pond 3, three (3) grassed waste rock dumps – Waste dumps 1, 2, and 3, and a workshop.

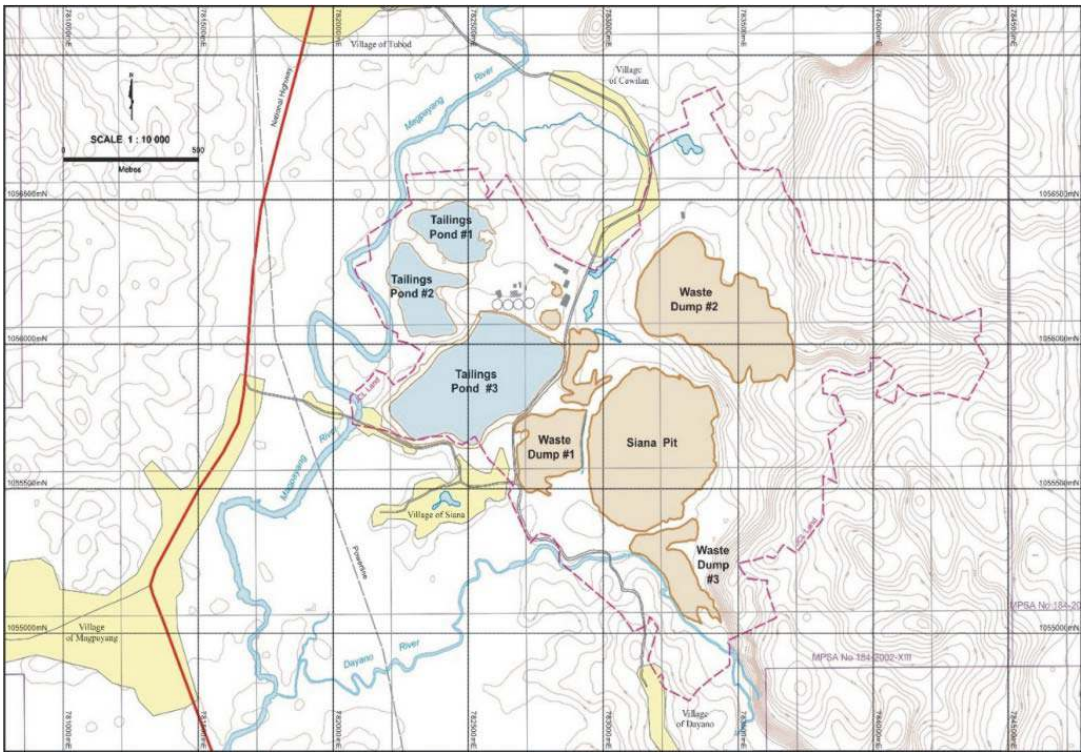


Figure 3-4. Major features of the Siana property

Photo 3-1. The flooded Siana open pit.

Photo 3-2. The dried and grassy portion of SURICON's tailings pond 3.

Photo 3-3. The dried tailings pond 1.

Photo 3-4. The grassy waste dump 2 immediately north of the flooded pit.

Project Development Objectives and Challenges

The overriding consideration in GRC's Project Development Plan is to confine all mine facilities and development works inside the 240-ha Siana property. This will minimize the new areas for disturbance and the Project's environmental and social impacts.

For the open pit, the first major challenge is dewatering. The impounded water volume is estimated at 8.2 million m^3. The excellent quality of the water is confirmed; the task is to prevent flooding along the channels of Dayano Creek and Magpayang River during water release. The less rainy period of April to September provides a good window for the dewatering.

The next challenge is to minimize the surface impacts of mining the Siana deposit. The BFS found that a total probable reserve of 3.16 million t is mineable by open pit over a 4.5-year mine life. The open pit operation will employ drills, excavators, front-end loaders, AWD trucks, graders and dozers. RSG Global Consulting Pty Ltd (RSG) estimates the total pit shell at 650 m long and 450 m wide at its biggest section, extending to a depth of 200 m below the surface.

By steepening the pit walls without compromising safety, the expansion of the pit surface and excavation works is minimized. In the current open pit plan, the maximum pushback of the pit is around 70 m at the northeastern portion, still within the Siana property. This portion collapsed in 1989 and led to the premature closure of SURICON operations. Mining One Pty Ltd (Mining One), GRC's geotechnical consultants, attributed the failure to a mix of weak rock materials and flat, undulose west dipping structures. The pushback which results in the flattening of pit slopes is intended to

improve the ground stability. The final pit surface area is estimated at 32 ha, an 11-ha increase over the current pit area.

Additional gold resources were reported below the open pittable reserve. Based on RSG's evaluation, these resources can be extracted by underground mining method. Access is though a decline with portal at 50 m above the ultimate pit floor and 150 m below the pit crest on the main pit ramp to the eastern side. Mining is by up-hole benching or any other suitable method. The broken material is removed from the level with loaders, loaded into low profile underground trucks and hauled to the surface. For ground stability, the void is filled with a combination of waste material, mill tailings, and cement. RSG estimates that the underground operation can prolong mine life to 10 years and result in a total recovery for the open pit and underground mine of 720,000 oz Au and 1.34 million oz Ag.

Aside from economics, two factors favor the extraction of the deeper resources by underground method: lesser volume of waste materials for extraction and, if done correctly, minimal surface disturbance. More works are needed to refine the underground mining plan. These include a drilling program, development of a JORC-compliant resource model, detailed geotechnical evaluation, review of underground capital costs, and sourcing of quotations from local mining contractors.

After the selection and optimization of the mining method, the next challenge is keeping the open pit and underground workings dry. Meyer Water Environmental Solutions (MWES) estimated annual inflows to the pit at 5.9 million m^3 from groundwater and 1.1 million m^3 from rainfall. To manage these flows, GRC will install five (5) dewatering bores outside the pit perimeter and in-pit pumps. The dewatering bores will handle 3.3 million m^3 and the balance of 3.6 million m^3 is for pumping. A duplicate pumping system will be established to provide 100 % backup in case of failure.

The Siana deposit contains gold and silver. During the underground phase, significant amounts of copper, lead, and zinc will be encountered. The established gold beneficiation processes are base-metal flotation, gravity concentration, amalgamation, and cyanidation (USEPA, 1994a).

Flotation, by the addition of reagents, induces particles of a single mineral or group of minerals to adhere preferentially to air bubbles. It is chiefly used on base metal ore that is finely disseminated and generally contains small quantities of gold in association with the base metals. Gold is recovered as a by-product of the base metal recovery.

Gravity concentration techniques are used mostly on placer deposits and rely on gravitational forces to suspend and transport gangue away from the heavier valuable mineral.

In amalgamation, metallic gold is wetted with mercury to form a solution of gold in mercury which is referred to as an amalgam. The method is most effective on loose or free coarse gold particles with clean surfaces. Because of its high surface tension, mercury does not penetrate into the interstices of ore particles as sodium cyanide does. Use of amalgamation is now restricted because of its high cost, inefficiency in large-scale operations, and scarcity of suitable ores.

Cyanidation which uses solutions of sodium or potassium cyanide (NaCN or KCN) as lixiviants to extract precious metals from the ore is the predominant gold beneficiation method. It has various forms, namely, heap or valley fill leaching followed by carbon adsorption (carbon-in-column adsorption) which is suited for low-grade gold ores, agitation leaching followed by carbon-in-pulp (CIP), or agitated carbon-in-leach (CIL). As discussed in the preceding Section, in view of toxicity issues in the handling and use of cyanide (CN), researches on alternative lixiviants were undertaken. To date, however, the alternatives with less toxicity, *i.e.*, thiosulfate, thiocyanate, and malonitrile, are still inferior to cyanide in terms of availability, extraction economics and cost, recyclability, and large-scale application (Gos and Rubo, undated).

Various consultants, namely, Independent Metallurgical Laboratories, Outukumpu Technology, Orway Mineral Consultants, and Intermet Engineering, conducted metallurgical testworks on the Siana gold ore. They concluded that a CIL circuit with a gravity pre-concentration is the best processing method. The process design comprises single-stage crushing, SAG milling, gravity concentration and high-intensity cyanidation, leaching and adsorption (CIL), followed by carbon elution and electrowinning to produce combined gold and silver dore. The plant nominal throughput is 750,000

TPY of ore at an average feed grade over the life of mine of 3.35 g t^{-1} Au and 8.56 g t^{-1} Ag. The gold and silver recoveries are estimated at 85.4 % and 75.5 %, respectively.

When underground mining commences, GRC proposes to modify the process plant by installing flotation cells after the gravity circuit and treating the flotation tailings in the CIL circuit used for the open pit ore. Zinc concentrates and combined copper-lead-zinc concentrates will be thickened and filtered at site prior to transportation to the port.

The total amount of tailings to be generated from the open pit operation is about 3.1 million t. Because of the primary objective of minimizing the project's environmental impacts, the challenge is to construct the new tailings storage facility (TSF) over SURICON's original tailings ponds. Low river terraces and flood plains of Magpayang River located west of the original tailings ponds have elevations of about 40 to 45 m. The tailings elevation in the existing Tailings pond 1 varies between 43 to 45 m; at Tailings pond 2, between 47 and 48 m, and in Tailings pond 3, between 51 and 53 m. The crest elevation of Tailings dam 1 varies from 47 to 49 m, for Tailings dam 2 from 48 to 51 m, and for Tailings dam 3 at roughly 55 m.

Based on geotechnical testworks done by Mining One, Golder Associates Pty Ltd (Golder) found it feasible to build the TSF as two cells, namely, TSF3 at the southeast and TSF4 at the northwest. Prior to the plant commissioning, TSF3 will be built first over the old Tailings pond 3 to an initial stage embankment elevation of 60 m. The tailings are discharged into TSF3. The second cell, TSF4 is constructed over Tailings ponds 1 and 2 during the first year of operation to the same initial stage embankment elevation. After the TSF3 stage 1 reaches its capacity, the tailings are discharged into TSF4. TSF3 is then built up to its second stage elevation of 65 m in time for the filling up of TSF4 stage 1. The latter is built up to the same second-stage elevation in time. After completion of stage 2 for both TSFs, the crests will have a maximum height of 25 m above the Magpayang floodplains.

GHD Pty Ltd was commissioned by GRC to undertake the detailed design for the TSFs. GHD noted that TSF4 is approximately 10 m lower than TSF3. To place the storage facility in balance, GHD proposed to build TSF4 first (instead of TSF3) to the same initial stage embankment elevation. This will provide storage capacity for approximately 18 months. TSF3 is then raised in time for the filling of TSF4 to 60 m, at a storage capacity of approximately 12 months. Before TSF3 is filled up, TSF4 is raised to the final elevation of 65 m, providing storage capacity for roughly 8 months. The final lift of TSF3 to the same elevation is expected to have a storage life for 14 months. GHD's proposed TSF build-up sequence is more of an operational change than a design change.

TSF3 and TSF4 will be located close to Magpayang River and Dayano Creek. Both streams are used by the local residents for irrigation, bathing, washing, and sometimes fishing. The subsequent challenge therefore is to minimize the risks of CN releases into the streams.

Several methods are available for the detoxification of CN. One popular method is the Degussa peroxide process which uses hydrogen peroxide (H_2O_2) to oxidize free and WAD cyanides to cyanate (CNO^-). Cyanate is further hydrolyzed to biodegradable ammonium (NH_4^+) and carbonate (CO_3^{2-}). Metals complexed with CN are precipitated as hydroxides and iron cyanide complexes. Another treatment step precipitates the iron cyanide complexes by combining it with copper ion (Environment Australia, 2003).

The limitations of H_2O_2 treatment are handling and costs. Specifically, H_2O_2 is a hazardous material and expensive. Special equipment for H_2O_2 use may increase the total capital cost. The treatment process also generates ammonia which is toxic to fish (USPEPA, 1994b).

A variation of the Degussa process is peroxymonosulfuric acid (H_2SO_5) or Caro's acid which can be generated safely on site from H_2O_2 and sulfuric acid (H_2SO_4). Because Caro's acid is a stronger oxidizing agent than peroxide, the CN destruction is faster at a cost much lower compared to using H_2O_2 solely. In some applications, the levels of CN attained were lower than those of the Degussa peroxide process (FMC, undated).

Other applications, namely, the INCO SO_2-air and Noranda processes use sulfur dioxide (SO_2) or ferrous sulfate and air in the presence of copper ion to oxidize cyanide in solution to cyanate. Sulfuric acid (H_2SO_4), which is a by-product of the oxidation process, is neutralized with lime.

In the INCO process, wastewater is fed into a mixing vessel where it is reacted with SO_2 or sodium bisulfite. Air is sparged into the vessel; copper sulfate ($CuSO_4$) is added as a catalyst, and the pH is controlled by the addition of lime. Treatment may be done in a single vessel or reactor or two reactors in series. Data from bench-scale tests and actual operations indicate that a total CN concentration of 0.1 mg L^{-1} is achievable (USEPA, 1994b). The limitations of the INCO process include the slowing down of reactions at low temperatures and non-removal of thiocyanate (SCN^-), cyanate (CNO^-), or ammonia (NH_3). SCN^- and CNO^- are less toxic than free CN^-. Their median lethal concentrations (LC_{50}) for fish are 50 to 200 mg L^- and 34 to 54 mg L^{-1}, respectively against free CN's LC_{50} of 0.1 mg L^{-1} (Environment Australia, 2003).

The Noranda process is suited to ores with significant antimony (Sb) or arsenic (As) concentrations. Firstly, copper and ferrous sulfate ($FeSO_4$) is added to the cyanide effluent. In the presence of hydroxide ions, the ferrous ion is oxidized to ferric oxide while the cupric ion (Cu^{3+}) is simultaneously reduced to cuprous ions (Cu^{2+}). The Cu^{2+} removes the free CN as an insoluble precipitate, $Cu(CN)_2$. This creates a shortage of free CN^- in solution, which leads to further removal of CN through dissociation of soluble metal complexes of Cu, Zn, and Ni into simple CN and metal ions. The final removal of CN is completed by the addition of H_2O_2 at high pH in a second stage to oxidize the residual simple cyanides.

AMMTEC Ltd (AMMTEC) conducted cyanide detoxification tests on cyanide slurries generated from the Siana Project's gravity tailings. Two detoxification procedures were run and their results on achieved WAD CN levels compared.

The first procedure used the Caro's acid triple salt which contains 45 % $KHSO_5$. The $KHSO_5$ contained in the triple salt behaves functionally the same as Caro's acid produced from the reaction between H_2SO_4 and H_2O_2. The leach slurry series of tests involved dosages of 2:1, 3:1, and 4:1 of $KHSO_5$ to WAD CN on a mole for mole basis. None of the tests achieved WAD CN < 0.5 mg L^{-1}, *i.e.*, the lowest level attained was 2.3 mg L^{-1}. The results indicate that an excessive amount of reagent will be needed to achieve the target level.

The second procedure tested was the INCO process. Three (3) tests at various dosages of SO_2 to WAD CN on a gram for gram basis were run, *i.e.*, 5.39, 3.63, and 4.39. AMMTEC found the SO_2 to WAD CN of 5.39 sufficient to obtain less than 0.5 mg L^{-1} WAD CN in the treated effluent.

In view of the AMMTEC test results, GRC provided a two-reactor single stage SO_2-Air process in the plant design. Slurry will gravitate from the carbon safety screen underflow to the first of two cyanide detoxification reactors. At the reactor, the slurry will react with sodium metabisulfite and $CuSO_4$ solutions. Air is sparged into the reactor and the slurry pH maintained at 10 with the addition of lime slurry. The two reactors will provide a total of 90 minutes residence time. The aim is to reduce the WAD CN level from an anticipated level of 150 mg L^{-1} at CIL circuit discharge to less than 1 mg L^{-1} WAD CN before deposition to the tailings pond.

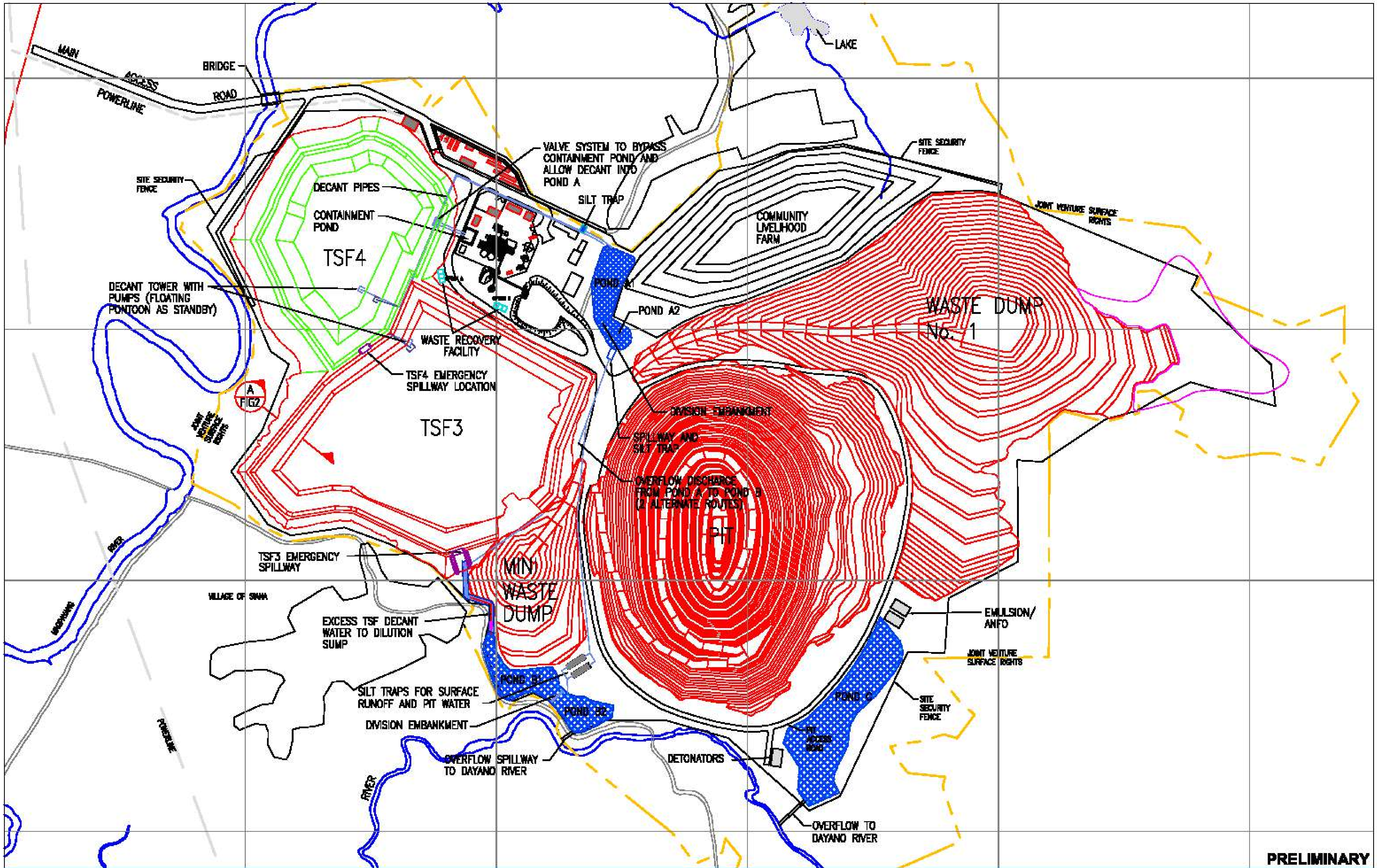
Finally, RSG estimates the total volume of waste rock materials for extraction from the redeveloped Siana pit at 8.7 million bcm. The waste rocks will go to the main dump immediately northeast of the pit, the secondary dump southwest of the pit ramp exit, and the embankment build-ups of TSF3 and TSF4.

Project Components

Figure 3-5 is the General Arrangements Map of the Siana Gold Project. The Project components or facilities and their surface areas are shown in Table 3-2.

Table 3-2. Project facilities and surface areas

Facilities	Approximate Area (m^2)
Tailings Dam	404,145
Plant Area	78,230
Main Waste Rock Dump	345,715
Secondary Waste Rock Dump	56,490


MAIN ACCESS ROAD
BRIDGE
POWERLINE
LAKE
SITE SECURITY FENCE
VALVE SYSTEM TO BYPASS CONTAINMENT POND AND ALLOW DECANT INTO POND A
DECANT PIPES
CONTAINMENT POND
SILT TRAP
COMMUNITY LIVELIHOOD FARM
JOINT VENTURE SURFACE RIGHTS
TSF4
DECANT TOWER WITH PUMPS (FLOATING PONTOON AS STANDBY)
POND A1
POND A2
WASTE DUMP No. 1
WASTE RECOVERY FACILITY
TSF4 EMERGENCY SPILLWAY LOCATION
A FIG2
TSF3
DIVISION EMBANKMENT
SPILLWAY AND SILT TRAP
OVERFLOW DISCHARGE FROM POND A TO POND B (2 ALTERNATE ROUTES)
PIT
TSF3 EMERGENCY SPILLWAY
MIN WASTE DUMP
VILLAGE OF SIANA
RIVER
EXCESS TSF DECANT WATER TO DILUTION SUMP
EMULSION/ ANFO
POND B1
POND B2
POND C
SILT TRAPS FOR SURFACE RUNOFF AND PIT WATER
DIVISION EMBANKMENT
OVERFLOW SPILLWAY TO DAYANO RIVER
DETONATORS
OVERFLOW TO DAYANO RIVER
PRELIMINARY

1	GENERAL ARRANGEMENT FOR COMMENT	JTP	AMW	26/08/08
No	Revision	Drawn	Checked	Approved	Date

0 100 200 300m
SCALE 1:10,000 AT ORIGINAL SIZE

GHD | CLIENTS | PEOPLE | PERFORMANCE
GHD GEOTECHNICS

DO NOT SCALE

Drawn JTP | Designed
Drafting Check | Design Check
Approved
Date
Scale 1:10,000

Client: RED 5 LIMITED
Project: SIANA GOLD
Title: Figure 3-5 General Arrangements Map TSF Stage 1: CREST @ RL60m)
A3 Drawing No: 61-22730-FIG01A Rev: 1

Facilities	Approximate Area (m^2)
Open Pit	325,895
Plant Area	
Accommodations area	6,550
Substation	610
Reagents Store	240
Events Pond	770
Cyanide Store	150
Lime storage	50
Workshop warehouse	350
Laboratory	360
Plant Office	225
Goldroom	80
Elution	170
MCC	65
Security office and first aid	60
Grinding	280
Cyanide Mixing	85
Potable water plant	20
Main office	650
Fuel dispensing	715
Mine fleet maintenance	1,090
Laydown area	1,730
Detoxification tank area	915
Settling pond A	18,050
ROM PAD	9,305
Access	
Access road	10,650
Causeway crossing	830
Settling pond B	14,310
Settling pond C	30,550
Geotextile tubes area	1,500
Magazines	5,610

Sources: GRC, Intermet, and GHD

DESCRIPTION OF PROJECT PHASES

The Project has two phases, namely, open pit and underground mining. The latter is expected to commence roughly two (2) years prior to the depletion of the open pittable ore reserve.

Open Pit Mining

Pre-Construction

The major pre-construction activities for the open pit mining phase are:

- Community consultations and management program – Part of the EIA is the community consultation on major community milestones, resources, sources of livelihood, organizations, and problems. Based on the results of the community consultation, GRC crafted a Community Assistance Proposal for the three (3) direct impact barangays. Most of the programs contained in the proposal were implemented by GRC since 2005.

    1. Potable water supply – The system provides 40,000 L d^{-1} potable water to the residents of Brgys. Cawilan, Siana, and Dayano. Water is pumped from the Siana pit into a holding tank. The water is sterilized with chlorine in batches; the sterilized water is then filtered to remove any suspended solids. The water is released to the community water distribution system.

    2. Elementary school education – Assistance has been provided by GRC through donation to the students of books and classroom materials and building maintenance.

    3. Public health and safety –Children's feeding programs, medical missions, establishment and manning of the GRC Clinic in Brgy. Cawilan with a Doctor and Nurse, provision of non-prescription medicines to the community, and ambulance service.

    4. Peace and order – Supply of uniform and medical kits to the Barangay Police.

    5. Road maintenance – Regular maintenance of barangay road network.

    6. Church maintenance – Partially implemented by GRC.

    7. Public infrastructures – Programmed for implementation during Project construction and operation, the assistance will cover the Barangay offices, waiting sheds, multipurpose halls, learning materials for day care centers, and new access road and causeway crossing.

    8. Agricultural support – GRC assisted the barangays in researches on high-yield rice varieties and donation of seeds for pilot test programs. The other components for implementation are provision of irrigation water during the pit dewatering, micro-loan financing for farmers, and formation of a Marketing Division as part of the SDMP.

    9. Employment policy – The employment policy for the Siana Project has been ratified by the Barangay Chairmen of the direct and indirect impact areas. The policy provides that 95 % of the unskilled workforce will come from the impact barangays. Specifically, Brgy. Cawilan will provide 25 %, Siana 23 %, Dayano 17 %, and the indirect impact barangays of Pongtud, Magpayang, and del Rosario 10 % each.

    10. Livelihood assistance – This will be implemented as part of an early SDMP, *i.e.*, the SDMP to be conducted ahead of Project operation.

    11. Disaster relief – GRC has provisions for assistance to the community during disasters.

    12. Environmental awareness – Through its floral nursery, GRC provides the community with seedlings for plantation. The company also started to integrate its solid waste management and that of the three (3) direct impact barangays with the municipal system in Timamana.

Photo 3-5. Residents of the impact barangays dig the trench for the water distribution pipeline donated by GRC.

Photo 3-6. Pipe laying by the barangay residents.

Photo 3-7. GRC staff fixes the pipe network.

Photo 3-8. The potable water treatment plant donated by GRC to the three (3) direct impact barangays.

Photo 3-9. The Siana Elementary School Reading Center Shed GRC helped to build.

Photo 3-10. GRC also funds the brushing of school permises.

Photo 3-11. The beautification of school buildings is part of GRC's community assistance program.

Photo 3-12. GRC staff donates school supplies to the children.

Photo 3-13. The children of Brgy. Dayano benefit from the company's feeding program.

Photo 3-14. GRC's feeding progam at Brgy. Siana.

Photo 3-15. The feeding program at Brgy. Cawilan.

Photo 3-16. The medical clinic and ambulance GRC provides to the direct impact barangays.

Photo 3-17. GRC's community medical clinic is equipped with a dental chair.

Photo 3-18. A barangay resident has her blood pressure read by GRC's nurse.

Photo 3-19. GRC's Clean and Green Program provides the barangays with vegetables for plantation.

Photo 3-20. GRC distributes seedlings to the students of Siana Elementary School.

Photo 3-21. Seedlings distribution at the Tubod National High School.

Photo 3-22. Tree planting along the Siana roadside.

Photo 3-23. Tree planting by members of the Union of Christian Churches of the Philippines.

Photo 3-24. One of three (3) children's playgrounds donated by GRC to the direct impact barangays.

- Exploration – Mineral exploration works conducted by GRC included review of SURICON reports and maps, geologic mapping, reverse circulation percussion, diamond drilling, sampling and analyses, orebody modeling, and ore reserve estimation.

- Environmental impact assessment and other environmental studies – The studies established the environmental and social baselines of the impact barangays. Based on the baselines, the impacts of the Project were assessed and their management plans formulated. This EIS highlights the findings and conclusions of the environmental studies.

- Geotechnical studies – Mining One undertook the geotechnical investigations for the open pit design, processing plant design, and TSF design which comprised test pitting, boreholes, and laboratory soil testing. The properties of potential foundation materials were assessed.

  Ten (10) boreholes were drilled around the existing tailings dams and at the proposed plant feed water dam site. An additional five (5) boreholes were drilled at the process plant site. The borehole depths ranged from 7.5 m to 41.6 m. Mining One collected disturbed samples generally at 1.5 m intervals using a split spoon sampler and undisturbed samples using thin wall tubes.

The boreholes were augmented by nine (9) test pits excavated around the toe of the existing tailings dams and seven (7) test pits around the proposed plant site. The maximum depth of excavation was 5 m. Dynamic cone penetrometer test and hand-held shear vane tests were conducted within the test pits.

Golder implemented a laboratory testwork program on samples of process tailings and a composite sample from Tailings dams 1 and 2. The tests included particle size distribution, Atterberg limits, soil particle density, one-dimensional consolidation, settling tests, and air-drying tests.

Seismology Research Centre (SRC) and Environmental Systems and Services Pty Ltd (ESS) conducted a seismic hazard assessment for the Project site. They recommended an operating basis earthquake (OBE) of 0.25g and maximum design earthquake (MDE) of 0.60g for the tailings dam design.

The OBE is generally considered as the earthquake with a 10 % probability of exceedance in a 50-year period which is equivalent to a recurrence period of 475 years. It is used to assess the stability of tailings storages for the operating life of the structure. On the other hand, the return period of the MDE is typically about 1 in 10,000 years. The MDE is normally used for the design of closure measures for the tailings storages (Golder, 2007).

- Geochemical tests – BMP undertook an acid-base accounting of waste rock samples obtained from the waste wall zone of the Siana deposit. Acid-base accounting is a two-part analytical procedure for determining both the acid potential and neutralizing potential of waste rocks. The test results indicate that for Domain 100 which makes up about 33 % of the total waste rocks for extraction, only 13 % of the total 15 samples is PAF. For Domain 400 which is about 27 % of the estimated waste rocks, 15 % of the total 13 samples is PAF. For Domain 600 which is roughly 16 % of the estimated waste rocks, 38 % of the total 8 samples is PAF. The rest of the samples which represent 24 % of the estimated waste rocks is NAF.

  Graeme Campbell & Associates implemented geochemical testworks on a metallurgical laboratory prepared sample of process tailings and tailings slurry water. It was concluded that the process tailings solid sample is NAF due to the strongly calcareous minerals. The tailings slurry water had concentrations of minor elements, including cyanide-complexing metals and CN forms, which were below or close to the detection limits.

- Hydrologic and hydrogeologic investigations – MWES carried out the hydrologic and hydrogeologic investigations for the Project which included the establishment of groundwater monitoring bores, streamflow measurement sites, and surface water quality monitoring sites.

- Engineering design of major structures – Golder designed the TSFs following the guidelines and recommendations of the Australian National Committee on Large Dams (ANCOLD) on factors of safety (FoS) and design storms. The FoSs are (ANCOLD, 1999):

  - Steady state static loading, no seismic, FoS = 1.5
  - OBE under pseudo-static conditions, FoS = 1.2
  - MDE, FoS = 1.0

  The ANCOLD (2000) guideline in the selection of a design storm for the TSF is a storm event between 1:10,000 years average return interval (ARI) and 1:10,000,000 years ARI as the probable maximum precipitation event (PMP).

  Golder's general design approach provides for the cyclic deposition of tailings into paddock-type tailings storage cells from the perimeter embankments. The embankments are constructed using waste rock. The TSF design consists of two cells, TSF3 and TSF4, developed in stages. At final height, the combined surface area of the TSFs is approximately 34 ha. The combined footprint is roughly 40 ha.

Golder assessed the stability of selected sections of the tailings dam design under static, OBE, and MDE earthquake loads. The material strength parameters adopted are based on the findings of the geotechnical investigations of Mining One and Golder's process tailings testworks as well as Golder's experience with similar materials. A conservative phreatic surface was assumed, *i.e.*, the surface passes through the existing embankment and the tailings remain saturated except those adjacent to the embankment.

The predicted minimum FoSs for static conditions and under OBE seismic loading exceeded ANCOLD's recommended minima of 1.5 and 1.2, *i.e.*, 2.4 to 2.1 vs. 1.5 and 1.2 to 1.1 vs. 1.2. Under MDE seismic load conditions, however, the predicted FoSs are less than ANCOLD's minimum, *i.e.*, 0.7 to 0.6 vs. 1.0. Golder stressed that an FoS less than 1.0 under earthquake loading does not necessarily imply failure of the embankment. It indicates that the embankment will undergo some permanent deformation. Following Newmark's simplified approach, Golder estimates a horizontal displacement of the potential failure mass of about 50 mm. Based on the empirical relationships developed by Swaisgood, vertical settlements of up to 1 m may be expected. To strengthen the reliability of the stability assessment, Golder recommended laboratory shear strength tests once the tailings materials become available.

For tailings water and surface runon management, Golder's design provides for decants located at the center of the cells and emergency spillways.

The decant in TSF3 is a floating pontoon mounted pump, accessed from the end of the decant causeway by a floating gantry. The decant tower for TSF4 will comprise slotted reinforced concrete sections mounted on a reinforced concrete base, founded in natural soils. The tower is surrounded with selected filter rocks to impede the inflow of tailings fines to the decant tower. Each decant installation will be supplied with power and equipped for pumping water either back to the plant circuit or to the plant feed water dam. A secondary pump for each is also provided to remove excess water in the TSF as a result of rainfall events.

As part of its detailed design works for the TSFs, GHD noted that the earth decant access platforms to the center of each TSF as proposed by Golder will reduce storage capacity and require large volumes of construction materials. GHD then proposed to locate the decant systems not at the center of the TSFs but adjacent to the dividing embankment of TSF3 and TSF4. The concrete tower, surrounded by filter materials, will be installed on stable foundation material.

Golder's design storm is a 6-hour storm event ranging from 750 mm (for the 1:10,000 years ARI) to 1,160 mm (the PMP). To discharge stormwater from rainfall in excess of the design storm, spillways with a base width of 20 m will be provided at both TSFs. The spillway for TSF4 would have discharged into the Magpayang River; the TSF3 spillway into the Dayano Creek.

GHD noted that its revised development sequence of raising TSF4 ahead of TSF3 enables the spilling of TSF4 into TSF3. It then proposed a spillway at the dividing embankment, adjacent to the decant structures. The spillway will be lined to prevent erosion or scour of the embankment during spillage.

For TSF3, GHD proposed the location of the temporary spillway along the southern perimeter which is consistent with the Golder's design. The spillway will be raised during the build-up of TSF3 and will become the permanent spillway at the end of mine life.

At a process water reticulation rate of 80 %, maintenance of a small supernatant pond size, emergency spillway depth of 1 m, and 1 m for potential deformation as a result of an MDE earthquake event, Golder recommended an operational freeboard of 3 m for each TSF.

The Main Waste Rock Dump is designed at 5-m high batters forming 30^{o} and separated by horizontal berms that vary in width from 10 m to 15 m. At a total maximum height of approximately 50 m, the overall angle of the dump is roughly 15^{o}.

Peter O'Bryan and Associates (O'Bryan) assessed the stability of the Main Waste Rock Dump using material shear strength properties that were based on information provided by Mining One, SRC, and ESS. They concluded that:

1. The location of the proposed dump immediately northeast of the open pit has a negligible effect on pit wall stability.

2. Under static and dry loading conditions, the proposed waste rock dump will be stable.

3. Under seismic and dry loading conditions, the dump will essentially remain stable, *i.e.*, some localized movement of near-surface material may occur.

4. Only a limited saturation of the dump can be tolerated. Water levels exceeding roughly 105 mRL within the dump would be expected to destabilize the slopes. An earthquake of sufficient magnitude or proximity to apply a horizontal acceleration of at least 0.25g coincidental with a water level within the dump of above 104 mRL would cause failure. O'Bryan recommended that GRC should avoid placing large "continuous" volumes of clay-rich material within the dump.

5. A worst-case situation in which earthquake-induced vibration coinciding with the presence of a substantial volume of water in the dump would be expected to cause slope instability. Slope movement would occur within the zone roughly 10 m behind or below the slope face. Breakout would occur near the toe of the slope. Consequently, some movement of waste towards the open pit is possible in the northern, northeastern, and eastern sectors. O'Bryan recommended bunding or the construction of catch fences around the pit edge to contain the material movement.

- Consultations with households at risk from the TSF3 and waste rock dumps and relocation – Based on the Project's final development plan, some 42 to 56 households within Puroks Riverside and Hilltop of Brgy. Siana and 7 to 13 households within Purok Bulawanon at Brgy. Cawilan will have to be relocated to give way to TSF3 and the Main and Secondary Waste Rock Dumps (Figure 3-4). Two (2) resettlement sites within the two (2) barangays have been selected. A resettlement action plan will be formulated in accordance with IFC Performance Standard No. 5.

- Feasibility study – This refers to the process of technical analysis to determine the viability of the Project. It has three (3) distinct phases, namely, scoping studies, prefeasibility studies, and definitive feasibility studies. As the Project advances, the project phases become more detailed and focus on a single option of developing the Project.

- Land acquisition – GRC needs to acquire land for the access road and the two (2) resettlement sites.

- Permitting – The major Government permits and approvals required prior to construction and operation are approval of the EPEP, SDMP, and FMRDP; approval of the Declaration of Mining Feasibility; conversion of MPSA exploration into MPSA for operation; registration of GRC as hazardous waste generator, wastewater discharge permit, etc.

- Detailed engineering – This covers the preparation of detailed engineering design to implement the best option determined in the definitive feasibility study.

- Procurement – All services, equipment, reagents, supplies and materials needed by the Project and identified during the detailed engineering are acquired.

Construction

- Installation of environmental and social management systems – The systems are intended to prevent or minimize adverse impacts, enhance and make more sustainable and equitable the positive impacts, monitor the impacts for continual system improvement, and manage the residual impacts. Included in the systems are the EPEP and SDMP.

- Construction of power line and substation – Power will be supplied to the Project from a SURNECO 69 kV incoming power line. SURNECO agreed to build a 69 kV substation with landing gantry, 69 kV isolators, CTs, surge diverters, and a 69 kV circuit breaker with the main plant step-down transformer. Cabling from the transformer LV terminals will supply a medium voltage switchboard from where power will be reticulated around the site to the various load centers and plant substations.

  One 750 kVA generator will be installed to provide emergency power for emergency lighting, security system, firewater system, potable water system for safety showers, all slurry agitators, detoxification and tailings pumps, process water pumps, mill inching drive, and accommodation village.

- Access road and causeway crossing construction – The Siana Project site will be accessed from the National Highway along Brgy. Del Rosario, Tubod Municipality by a newly built 16-m wide approximately 1 km long all-weather road and causeway crossing over Magpayang River (Figure 3-5). This will prevent impacts on the road networks of the barangays. The proposed road alignment is a mix of coconut land and ricefields. The area of affected ricefields is about 0.8 ha.

- Pit dewatering and development – The impounded 8.2 million m^3 of water inside the Siana pit will be pumped out into Dayano Creek. Taking into account the additional inflow of 0.6 million m^3 of rainfall and 2.8 million m^3 of groundwater during the 6-month period, the required mean pumping rate is 780 L s^{-1}. GRC proposes to use four (4) pumps, each powered by a 375 Kw electric motor governed by variable speed drives with a combined capacity of 800 L s^{-1} over a 100 m head. The pumps would be mounted on a floating pontoon and discharge into parallel 450 mm diameter HDPE pipes to be extended as the water level falls. Pipes will discharge into a settling pond which overflows into Dayano Creek.

  As soon as the pit water level has dropped to safe levels and the bearing capacity of the pit ground is confirmed to be adequate for the earthmoving equipment, pit widening works at the surface will commence. The greatest pushback will be at the northeast sector to achieve flatter slopes and the removal of weak materials.

  Slimes, currently estimated at 10 m thickness equivalent to 240,000 m^3, have accumulated at the pit bottom. During pit dewatering as the water level approaches the pit floor, a 10 m long flexible suction hose will be attached to the pump inlet. The suction hose will hang straight down and act like a dredge in sucking up slurry. During this process, the slurry density being discharged will be monitored continuously to prevent blockage. If necessary, clear water will be brought back to the pit. It will take roughly 12 months for mining to reach the level so a large quantity of the slimes can be pumped out. To complete the final clean-up, 12m deep voids will be blasted on either side of the existing pit floor. Dewatering sumps are excavated and the dewatering pump installed. The swell of the blast is dozed and side cast to mix with the slimes on the pit floor.

- Construction of tailings storage facilities and pipelines – Prior to construction of the embankment, a drainage system comprising an aggregate-filled drain and pump sumps will be constructed on the existing tailings beach adjacent to the upstream edge of existing perimeter embankments. A seepage cut-off (keyway) trench is excavated below the embankments either on natural or previously disturbed ground. On natural soil, the keyway is excavated to a minimum depth of 1 m below the natural ground level. The keyway will be backfilled with moisture-conditioned and compacted clay.

Organic rich soils located under the proposed embankments will be stripped prior to placement of fill. Where embankments are built over existing tailings beaches, the tailings shall be deep ripped and compacted prior to the placement of the embankment fill. The excess pore water pressures will be monitored during construction and appropriate measures taken to accelerate the dissipation of pore pressure if necessary. Low safety bunds will be constructed on the outer margin of the perimeter embankments and the embankment crests will be shaped with a 2% crossfall towards the upstream side of the embankment to direct incidental runoff water into the facility.

In areas of soft tailings, a high-strength geotextile will be placed over the tailings and covered with a layer of granular fill. The purpose of the geotextile is to provide tensile support to the embankment foundation during the initial placement of embankment fill. The granular layer will provide a drain for the foundation tailings.

As proposed by GHD, TSF4 will be built first on the existing Tailings dam 1 and Tailings dam 2 at an initial embankment crest elevation of 60 m and storage of roughly 8.5 ha. The tailings in said area are stronger than those in TSF3. The western and northern embankments will be built upstream of the existing embankments. To the east, it will be founded on natural ground and in places, over a thin veneer of tailings. At the initial embankment crest elevation, TSF4 will have a storage capacity of approximately 18 months.

TSF3 will cover the existing Tailings dam 3 facility and extend over previously disturbed ground to the southeast and existing embankment downstream batter slopes. It will have an initial stage 1 embankment crest height of 60 m and storage area and capacity of approximately 18 ha and 12 months, respectively. Construction will include clearing of ground to the southeast of Tailings dam 1 and stripping of vegetation from the downstream slopes of existing embankments. The northern and western embankment raises will be on top of shallow tailings deposits. No strengthening of the underlying tailings is required in said areas. At the southeast where the ground is previously disturbed, the embankments will be keyed into suitable foundation soils. At the southern part where the tailings are thick and there is an old supernatant pool, a high-strength geotextile and granular layer are proposed over the tailings beach.

TSF4 and TSF3 will both be constructed using the upstream method. Perimeter embankments will be constructed with an inner compacted clay zone (or other low-permeability material) and an outer shell of non-acid forming waste rockfill. Embankments will have a nominal downstream batter slope of 1V:3H. Internal upstream embankments for TSF4 and TSF3 and will be 1V:2.5H. Sections subject to long-term inundation will be sheeted with mine waste or granular fill as a buttress to avoid sloughing and as protection against wave erosion.

Figure 3-6 is the layout of TSF Stage 2 with embankment crest elevation of 65 m. Figure 3-7 shows typical TSF embankment sections. Figures 3-8, 3-9, and 3-10 are layouts of stage 1 and stage 2, stage 3 and stage 4, and stage 5 and stage 6 of the TSF construction, respectively.

- Construction of waste rock dump – GRC estimates the total tonnage of waste rocks for removal from the open pit at 8.7 million bcm, equivalent to 10.9 million lcm. About 1 million bcm of waste rocks will be used to construct the TSFs. GRC proposes two (2) waste rock dumps to accommodate the excess rocks. One dump located immediately northeast of the pit will have a capacity of 7.9 million bcm; another which is to the immediate southwest of the pit ramp exit will have a capacity of 0.8 million bcm.

  The dumps are designed with batter angles of 30^{o} and 10-m to 15-m berms at various vertical intervals (Figure 3-11). The overall slope angle is 15^{o}. To ensure structural stability, the placement of clay-rich materials at the dump will be staggered. Piezometers will also be installed for the regular monitoring of the phreatic surface. To protect against rain erosion, the slopes will be revegetated as soon as practical with fast growing grasses and vines. To protect personnel and equipment from waste rock dump rockfalls, bunds consisting of large boulders or catch fences will be placed near the pit edge.

MAIN ACCESS ROAD
POWERLINE
BRIDGE
LAKE
SITE SECURITY FENCE
VALVE SYSTEM TO BYPASS CONTAINMENT POND AND ALLOW DECANT INTO POND A
DECANT PIPES
SILT TRAP
CONTAINMENT POND
TSF4
COMMUNITY LIVELIHOOD FARM
JOINT VENTURE SURFACE RIGHTS
DECANT TOWER WITH PUMPS (FLOATING PONTOON AS STANDBY)
POND A1
POND A2
WASTE DUMP No. 1
WASTE RECOVERY FACILITY
TSF4 EMERGENCY SPILLWAY LOCATION
A FIG2
TSF3
DIVISION EMBANKMENT
SPILLWAY AND SILT TRAP
OVERFLOW DISCHARGE FROM POND A TO POND B (2 ALTERNATE ROUTES)
PIT
MINI WASTE DUMP
TSF3 EMERGENCY SPILLWAY
VILLAGE OF SIANA
EXCESS TSF DECANT WATER TO DILUTION SUMP
EMULSION/ ANFO
JOINT VENTURE SURFACE RIGHTS
SILT TRAPS FOR SURFACE RUNOFF AND PIT WATER
POND B1
POND B2
POND C
SITE SECURITY FENCE
PIT ACCESS ROAD
DIVISION EMBANKMENT
DETONATORS
OVERFLOW SPILLWAY TO DAYANO RIVER
OVERFLOW TO DAYANO RIVER
MAKPANG RIVER
PUMPKIN RIVER

PRELIMINARY

0 100 200 300m
SCALE 1:10,000 AT ORIGINAL SIZE

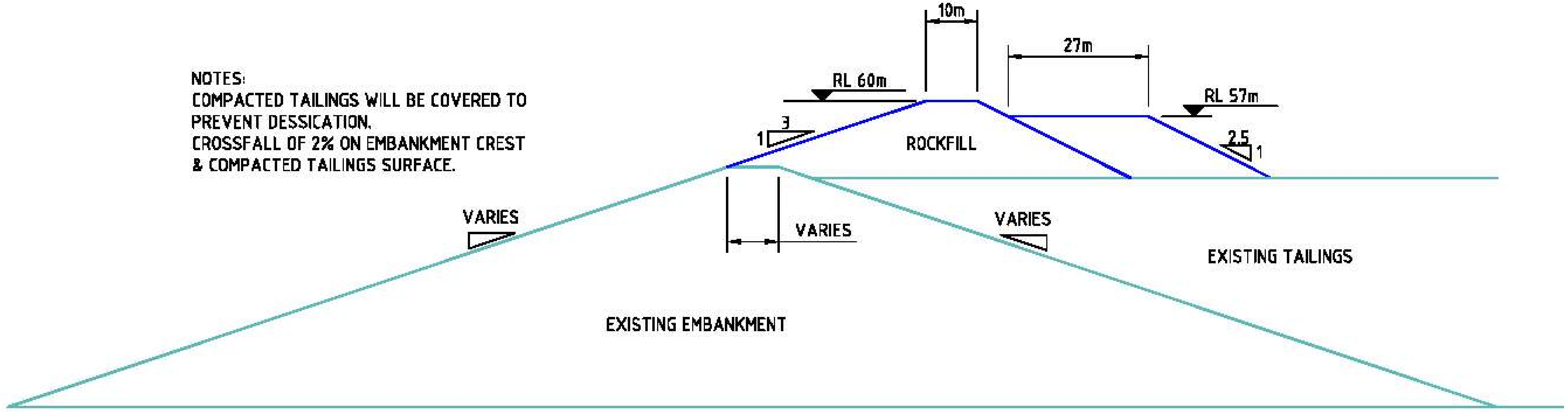
No	Revision	Drawn	Checked	Approved	Date
1	GENERAL ARRANGEMENT FOR COMMENT	JTP	ASW		26/06/08

GHD
CLIENTS | PEOPLE | PERFORMANCE
GHD GEOTECHNICS
GHD House, 239 Adelaide Tce Perth WA 6004 Australia
PO Box 1796 Perth WA 6842 Australia
T 61 8 9892 8822 F 61 8 9892 8866
E pmail@ghd.com.au W www.ghd.com.au/geotechnics

Drawn JTP | Designed
Checked | Design Check
Approved
Date
Scale 1:10,000
This Drawing must not be used for Construction unless signed as Approved

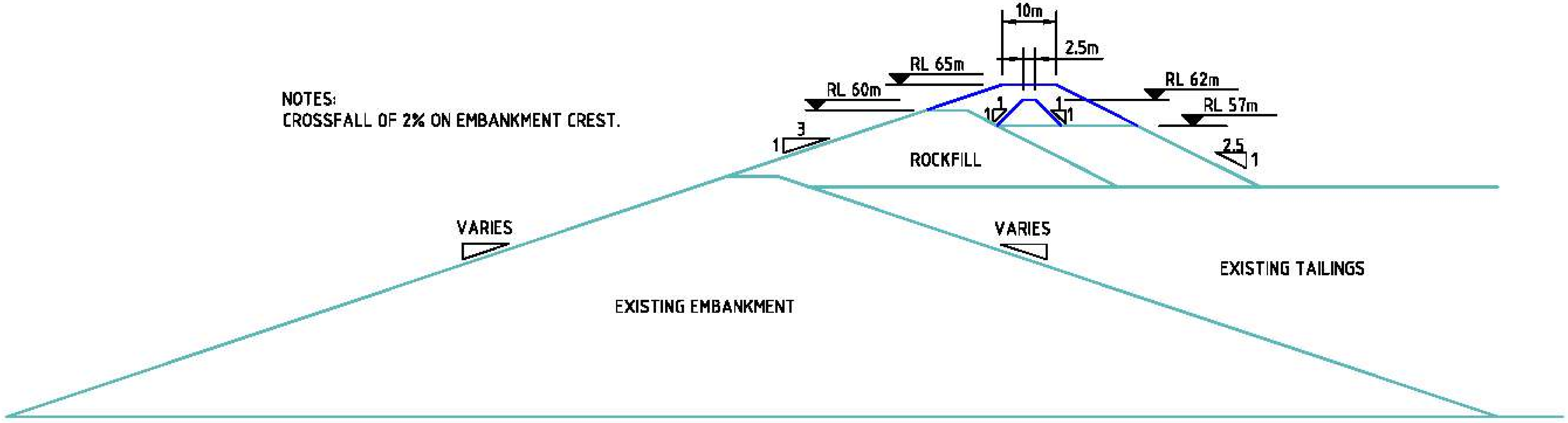
Client RED 5 LIMITED
Project SIANA GOLD
Title Figure 3-6
TSF Stage 2: CREST @ RL65m
Original Size A3
Drawing No: 61-22730-FIG01B
Rev: I

NOTES:
COMPACTED TAILINGS WILL BE COVERED TO PREVENT DESSICATION.
CROSSFALL OF 2% ON EMBANKMENT CREST & COMPACTED TAILINGS SURFACE.



PHASE
CONSTRUCTION

NOTES:
CROSSFALL OF 2% ON EMBANKMENT CREST.



PHASE
CONSTRUCTION

PRELIMINARY

No	Revision	Drawn	Checked	Approved	Date
A	ISSUE FOR CLIENT APPROVAL	JTP	ASW		

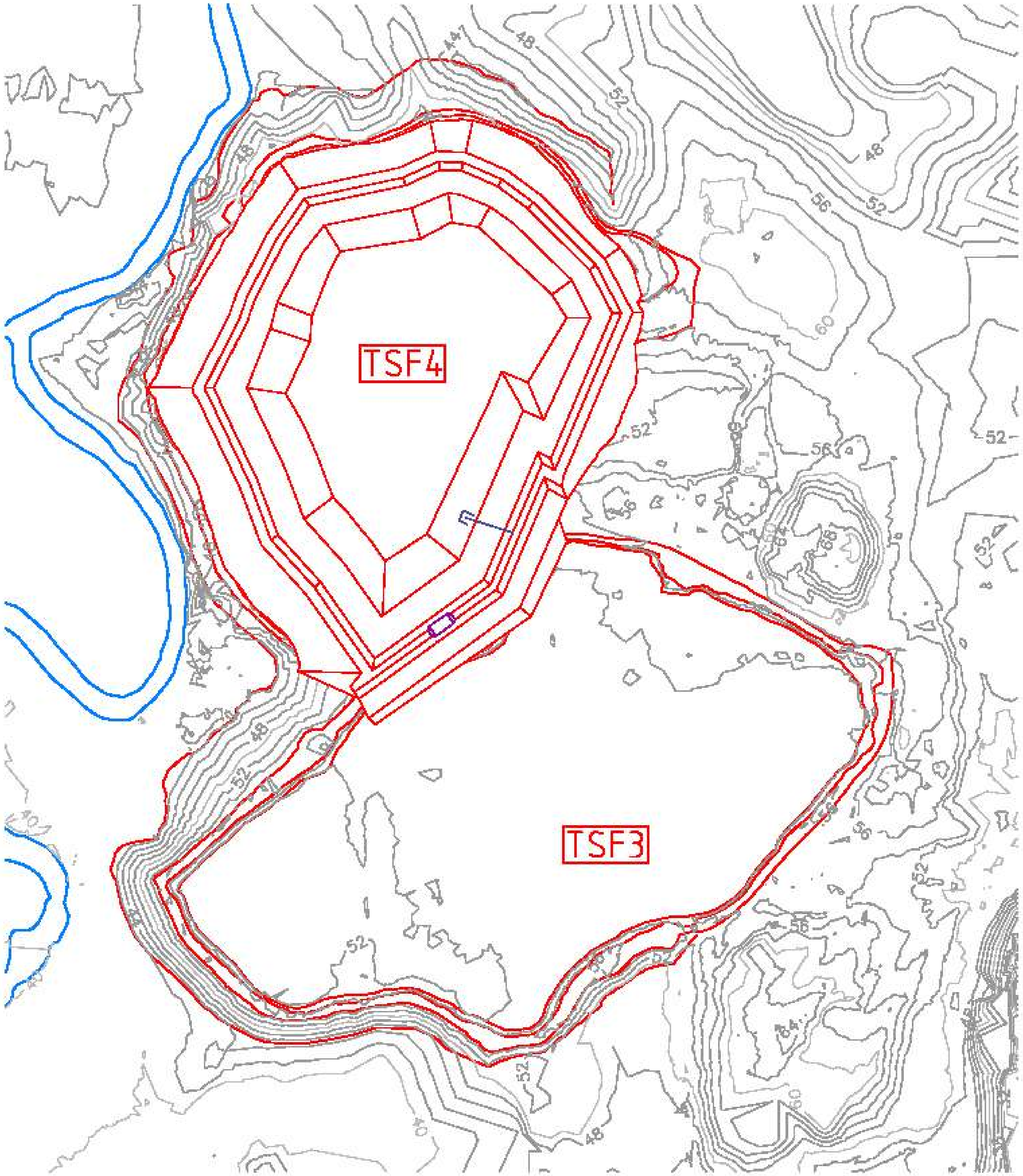
CLIENTS | PEOPLE | PERFORMANCE
GHD GEOTECHNICS

DO NOT SCALE

Drawn JTP
Designed
Drafting Check
Design Check
Approved
Date
Scale

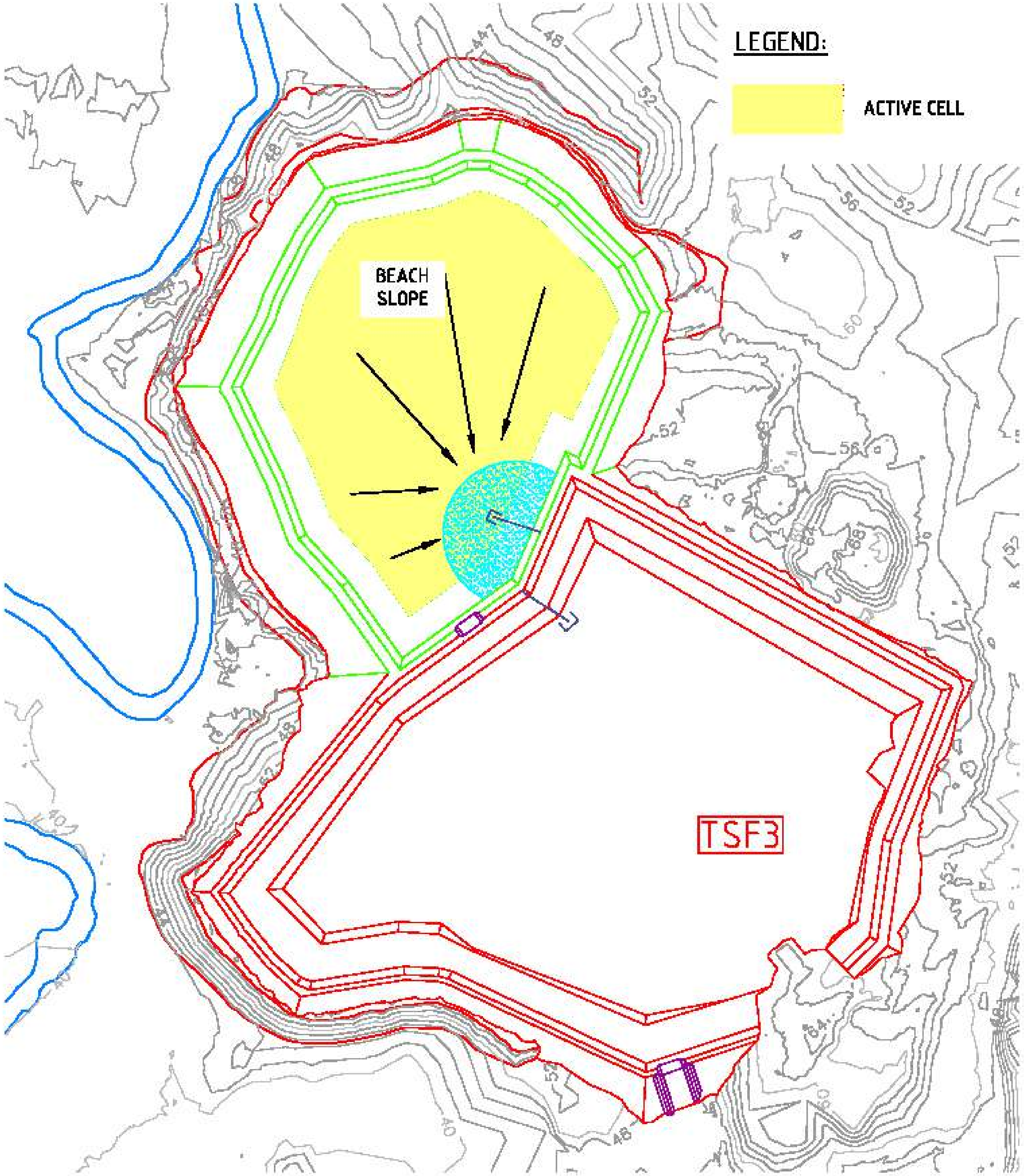
Client
Project
Title **Figure 3-7 Typical TSF Embankment Sections**

A3 Drawing No: **61-22730-FIG02** Rev: A



STAGE 1 – CONSTRUCTION OF TSF4 TO RL 60m

SCALE 1:5000



STAGE 2 – DEPOSITION IN TSF4 TO RL 57m, CONSTRUCTION OF TSF 3 TO RL 60m

SCALE 1:5000

0 50 100 150 200 250m

SCALE 1:5000 AT ORIGINAL SIZE

DO NOT SCALE	Drawn RDA OCT 2009	Designed
	Drafting Check	Design Check
	Approved	
	Date	
	Scale AS SHOWN	

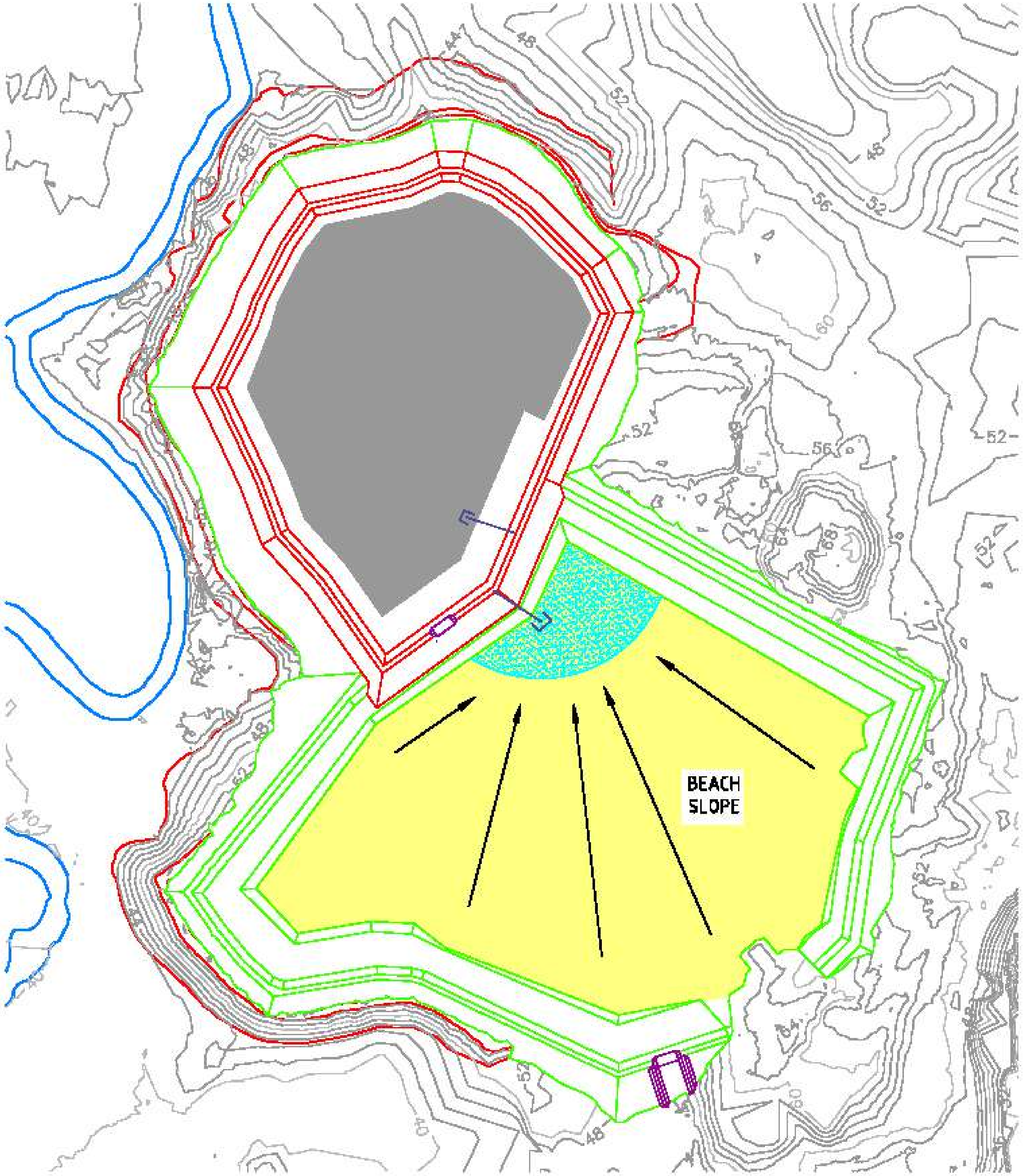
CLIENTS | PEOPLE | PERFORMANCE

Client: RED 5 LIMITED

Project: SIANA GOLD

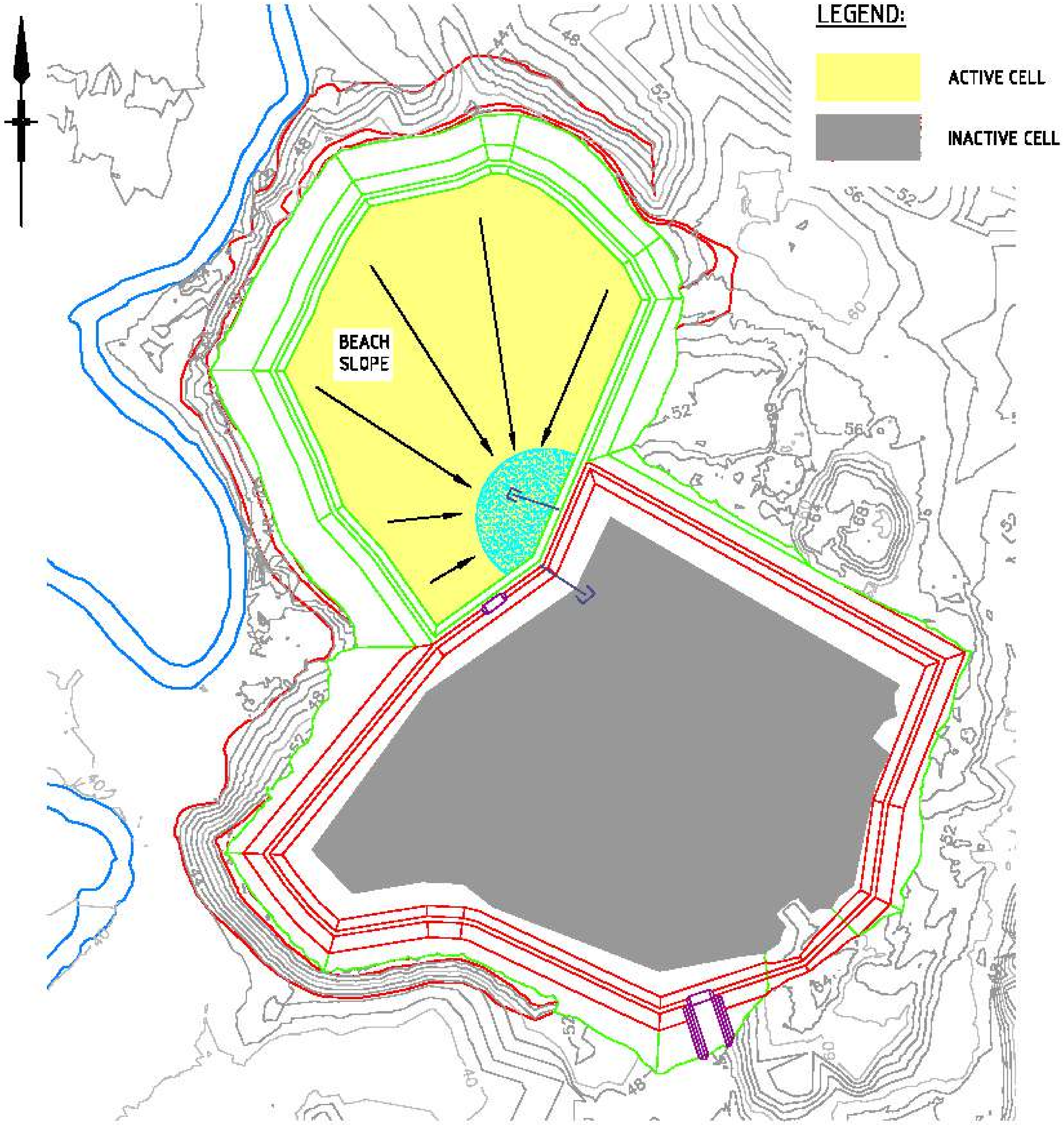
Title: Figure 3-6 TSF Construction Stage 1 and 2

A3 Drawing No: 61-22730-FIG04 Rev: A



STAGE 3 – DEPOSITION IN TSF3 TO RL 57m, CONSTRUCTION OF TSF4 TO RL 65m

SCALE 1:5000



STAGE 4 – DEPOSITION IN TSF4 TO RL 62m, CONSTRUCTION OF OF TSF3 TO RL 65m

SCALE 1:5000

0 50 100 150 200 250m

SCALE 1:5000 AT ORIGINAL SIZE

CLIENTS | PEOPLE | PERFORMANCE

DO NOT SCALE

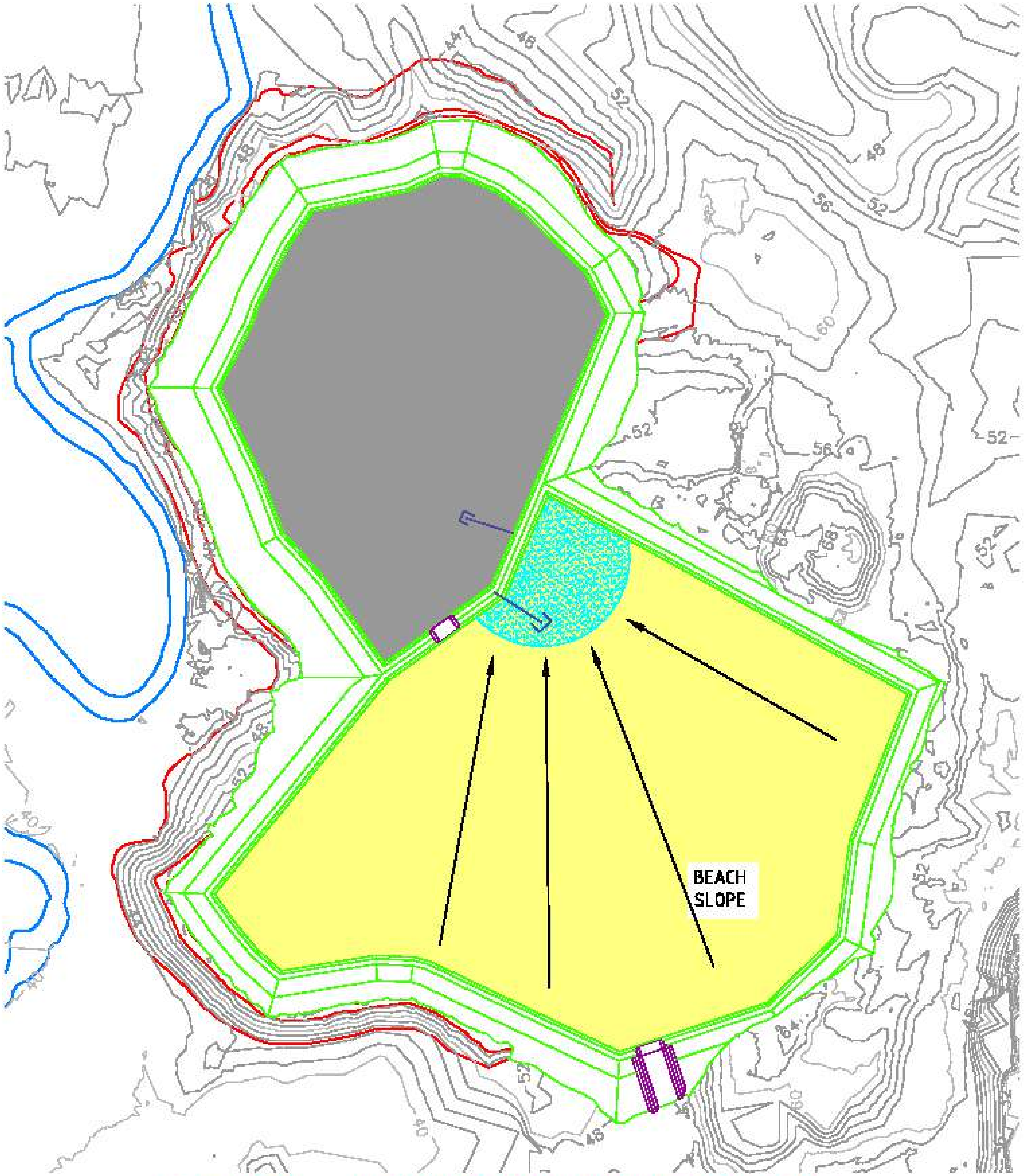
Drawn	RDA OCT 2008	Designed	
Drafting Check		Design Check	
Approved			
Date			
Scale	AS SHOWN		

Client: RED 5 LIMITED

Project: SIANA GOLD

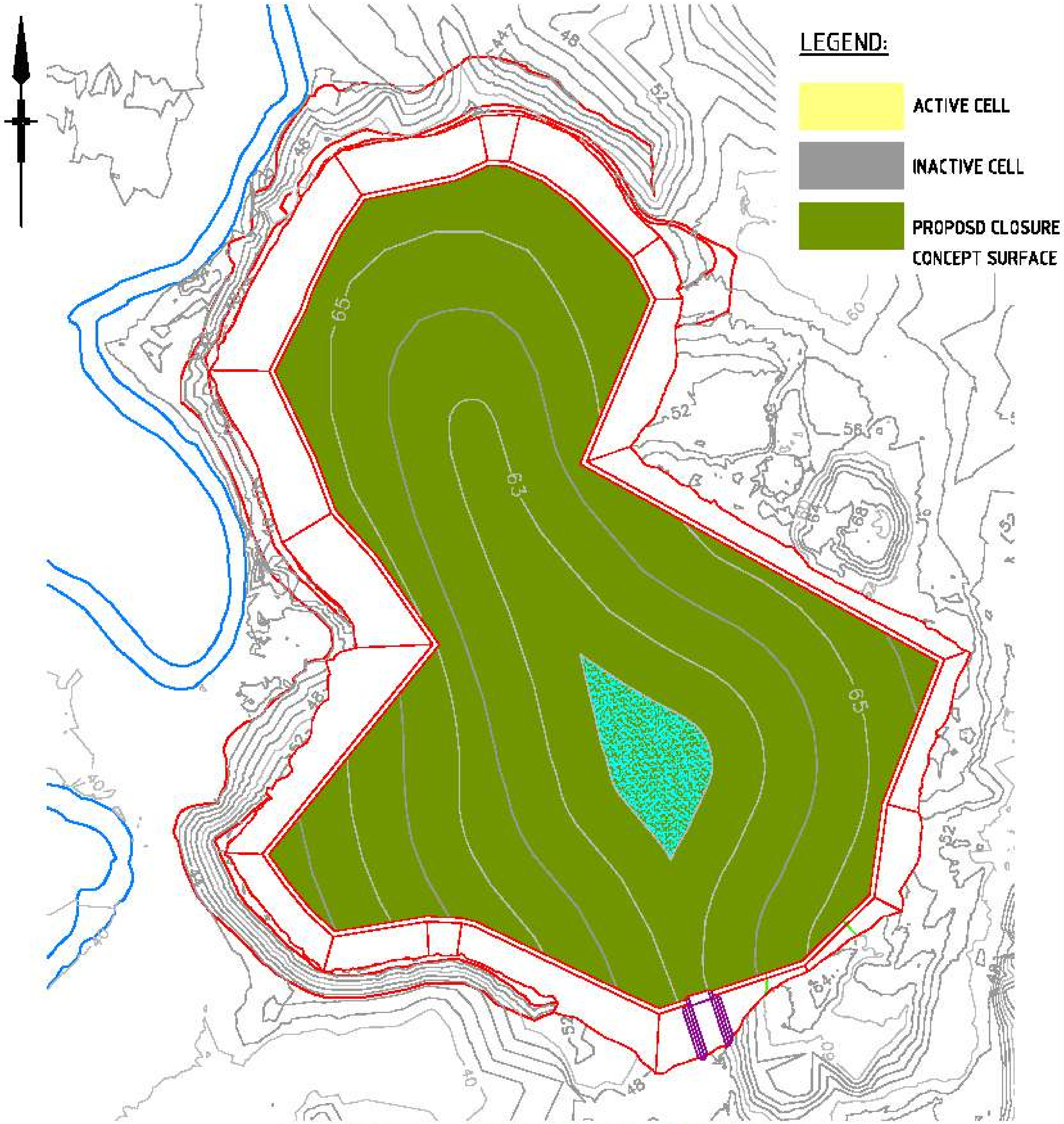
Title: Figure 3-9 TSF Construction Stage 3 and 4

Original Size: A3 Drawing No: 61-22730-FIG05 Rev: A



STAGE 5 – DEPOSITION IN TSF3 TO RL 65m

SCALE 1:5000



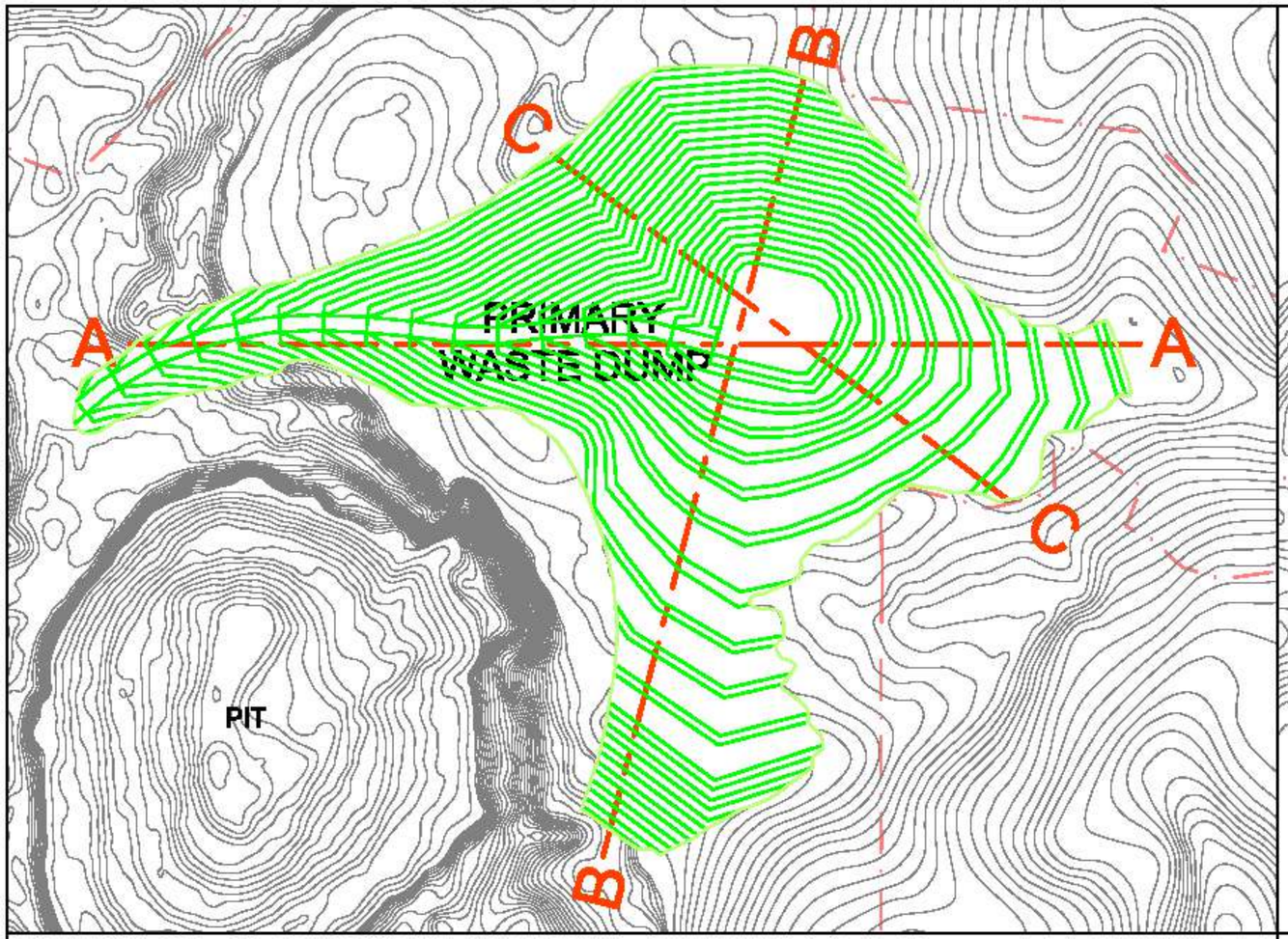
STAGE 6 – PROPOSED CLOSURE

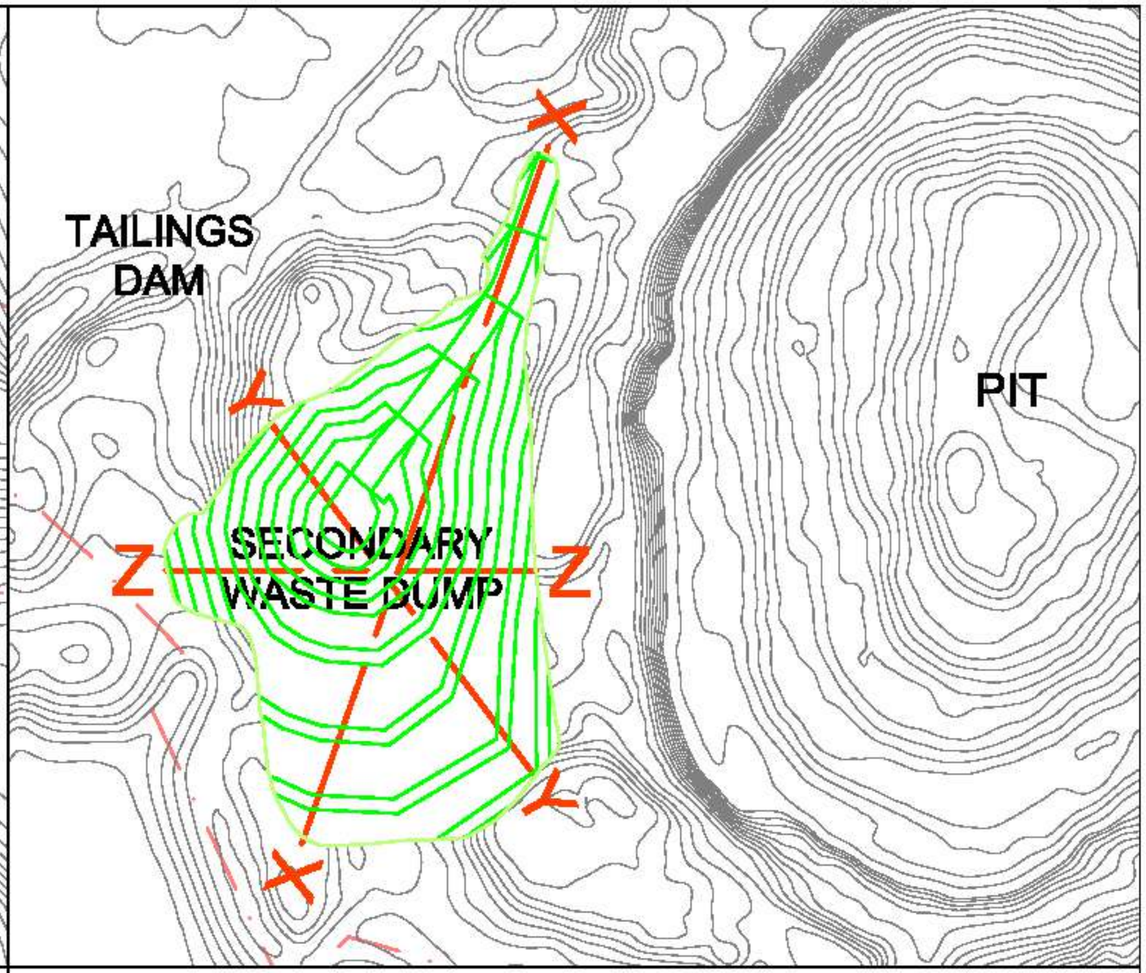
SCALE 1:5000

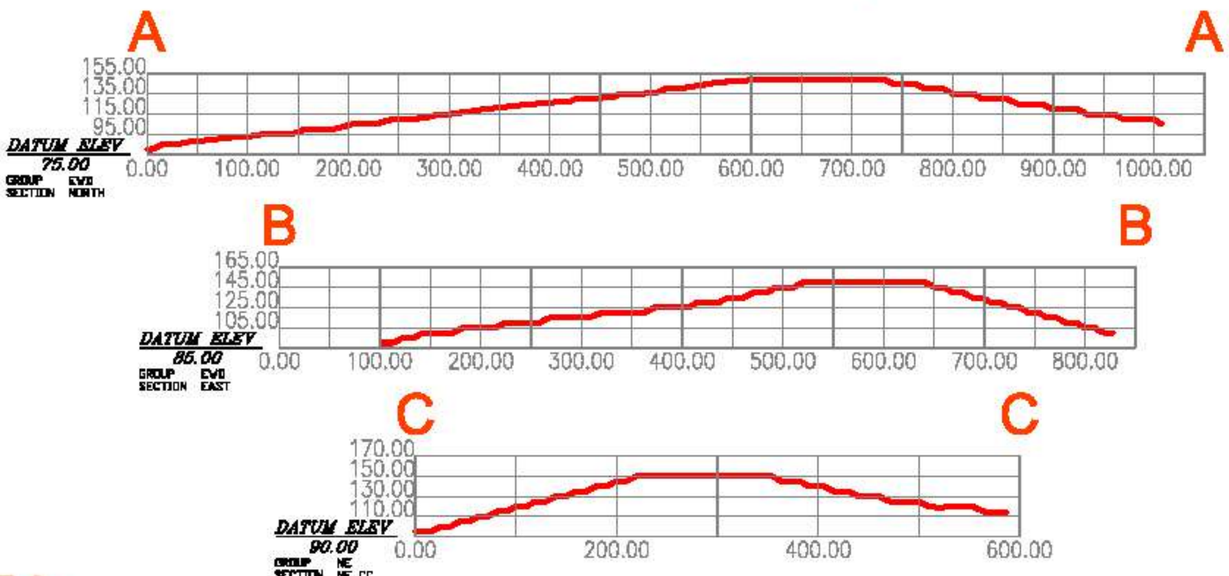
0 50 100 150 200 250m

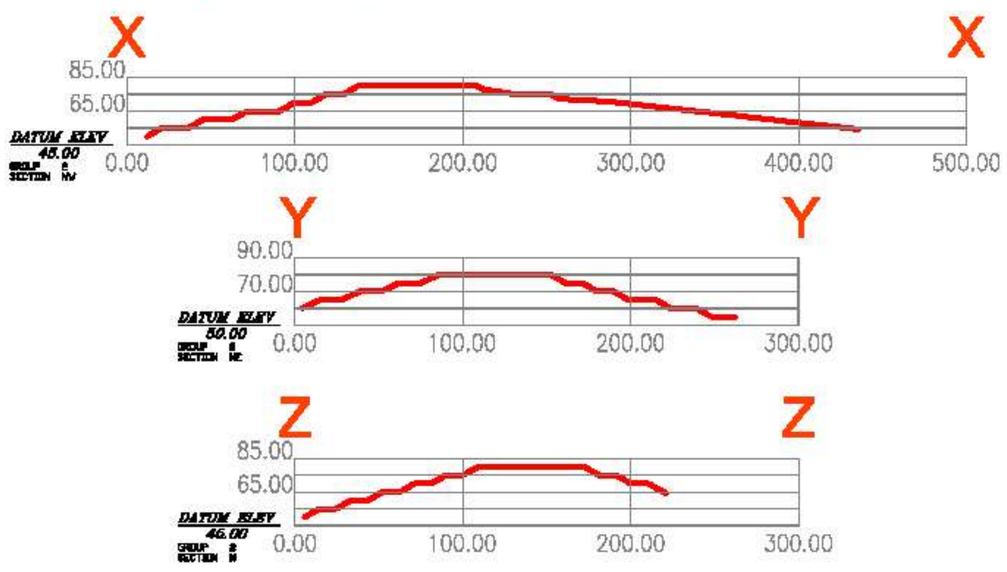
SCALE 1:5000 AT ORIGINAL SIZE

GHD — CLIENTS PEOPLE PERFORMANCE	DO NOT SCALE
Drawn	RJA OCT 2008
Scale	AS SHOWN
Client	RED 5 LIMITED
Project	SIANA GOLD
Title	Figure 3-10 TSF Construction Stage 5 and 6
Original Size	A3
Drawing No:	61-22730-FIG06
Rev:	A


A
B
C
PRIMARY
WASTE DUMP
PIT


TAILINGS
DAM
X
Y
Z
SECONDARY
WASTE DUMP
PIT


A
A
155.00
135.00
115.00
95.00
DATUM ELEV
75.00
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
900.00
1000.00
B
B
165.00
145.00
125.00
105.00
DATUM ELEV
85.00
0.00
100.00
200.00
300.00
400.00
500.00
600.00
700.00
800.00
C
C
170.00
150.00
130.00
110.00
DATUM ELEV
90.00
0.00
200.00
400.00
600.00


X
X
85.00
65.00
DATUM ELEV
45.00
0.00
100.00
200.00
300.00
400.00
500.00
Y
Y
90.00
70.00
DATUM ELEV
80.00
0.00
100.00
200.00
300.00
Z
Z
85.00
65.00
DATUM ELEV
46.00
0.00
100.00
200.00
300.00

- Construction of process plant, mine services area, and ancillaries – The process plant area is generally flat with a gentle slope to the west and vegetated with grass and saplings. Located roughly 1 km northwest of the Siana pit, it will host several structures, namely, the workshop/warehouse, laboratory, process plant and office, chemicals storage, security office, and first-aid facilities (Figures 3-11 and 3-12). The laboratory will be for mill and grade control. It consists of an office, balance room, wet chemical room, AAS room, and store room. The plant site will be cleared, grubbed, and contoured for drainage. The extension to the existing run-of-mine stockpile area will be constructed with mine waste.

  The mine services area will be located east of the process plant adjacent to the pit access road just beyond the safe blasting perimeter of the open pit. It includes the mining contractor's workshops and offices, refueling station, and mine control facilities (Figure 3-5). The site will be cleared, grubbed, and provided with pads.

  Explosives magazines will be located south of the pit (Figure 3-5).

- Construction of administration building, accommodations, and waste facilities – The administration building will be located between the process plant and mine services areas (Figure 3-5). The accommodation and messing facility is to the northwest of the plant site adjacent to the main access road. Only expatriate and senior local staff will be accommodated on a single status basis.

  For its solid waste, the Project will implement the ecological waste management. Waste will be sorted at the source into biodegradable, recyclable, and non-biodegradable. The sorted waste is delivered to a Material Recovery Facility where the final sorting of the wastes is undertaken, *i.e.*, green wastes for composting, recycled plastics, recycled bottles, non-recyclable plastics, etc (Figure 3-5). The non-recyclable, non-compostable, and non-hazardous materials such as used rubber gloves and boots, used leather shoes and harnesses, soiled rugs and towels, and worn-out wheels are stored separately for pick-up by the Mainit Municipal dumptruck once a week.

  GRC will implement an information and education program for all Project employees and contractors on the HOW, WHAT, and WHY of the proper segregation of different types of waste materials. If an additional waste facility will be required on top of the Mainit Municipal Landfill, GRC will have a small landfill, about 200 m east of the pit, built. The landfill site is constructed and maintained to ensure that watercourses and groundwater are not impacted.

  Sewage and wastewater will be treated by a bacteriological sewage treatment system. Preferably BioMAX or an approved equivalent, the system will have five (5) chambers, namely, an anaerobic chamber, aerobic chamber, clarification chamber, disinfection chamber, and pump-out chamber. Individual treatment systems will be installed at each building and sized to suit the number of occupants

- Installation of water system – Primary raw water for the process plant will be sourced from the pit dewatering bores pumped to the plant feed water pond and from the TSFs. A pump station at the plant feed water pond will convey the water to a process plant holding tank.

  For potable water, raw water will be drawn from the pit dewatering bores or pontoon pumps, then treated in the expanded potable water treatment plant for storage in the potable water tank located within the process plant area.

- Construction of stormwater and sediment control system - The objective of the Project's stormwater system is to ensure that clean water and dirty/untreated water do not mix. Thus, runoff from the eastern highlands will be diverted away from the minesite, through diversion bunds, either to the north of the proposed waste rock dump or to the south of the pit into the Dayano Creek. Dirty water from the waste rock dumps, mine workings, TSFs, and portions of the process plant area go through a series of sediment traps, settling ponds, and geotextile tubes before discharging into Dayano Creek.

NORTH

LABORATORY

PLANT OFFICE

GUARD HOUSE

WORKSHOP/
WAREHOUSE

REAGENTS STORE

REAGENTS

SECURITY OFFICE
& FIRST AID

MAIN OFFICE

FUEL STORAGE
DISPENSING
2 x 100m³

SECONDARY
CONTAINMENT
POND

GOLDROOM

ELUTION

MCC

AIR

CIL

FUTURE
GRINDING
AREA

GRINDING

PROCESS
WATER

RAW WATER

POTABLE
WATER

POTABLE
H₂O
PLANT

CYANIDE
STORAGE

FUTURE
TANKS

LIME

LIME
STORAGE

CRUSHING

MCC

ROM PAD

MINE FLEET
MAINTENANCE

SCALE OF METRES 1:500

INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION

INTERMET ENGINEERING

INTERMET ENGINEERING PTY LTD.

CLIENT: RED 5 LIMITED

CONTRACT/ENQUIRY

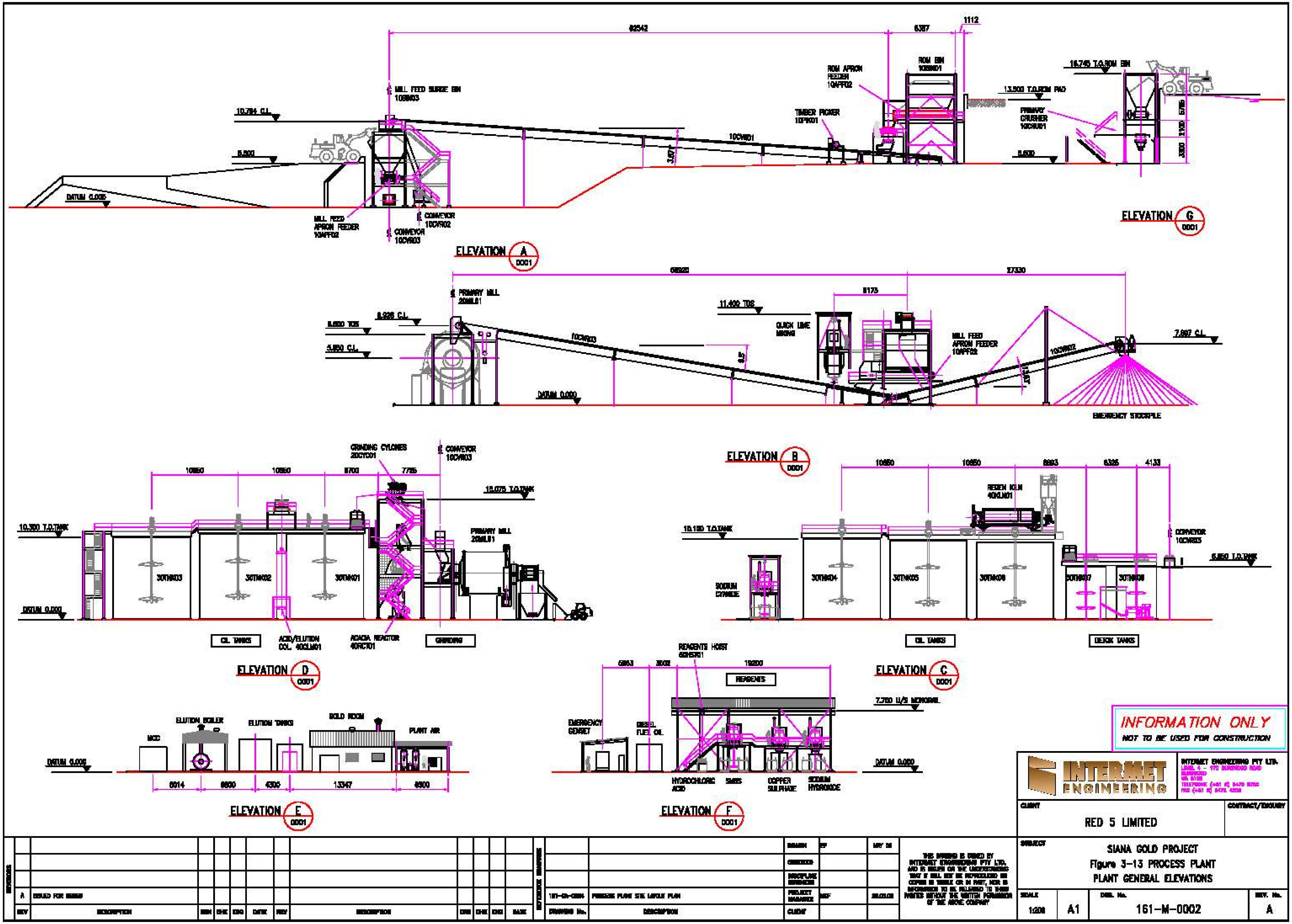
REV	DESCRIPTION	DRN	CHK	ENG	DATE
D	LABELS ADDED				
C	MCC MODIFICATION ADDED NEW CRUSHER				
B	ISSUED FOR ENVIRONMENTAL PERMIT				
A	ISSUED FOR REVIEW				

REFERENCE DRAWINGS		
161-M-0001	PROCESS PLANT LAYOUT	
DRAWING No.	DESCRIPTION	

DRAWN: EP — MAY 06
CHECKED:
DISCIPLINE CHECKED:
PROJECT MANAGER: MF — 15.05.06
CLIENT:

SUBJECT: SIANA GOLD PROJECT
Figure 3-12 PROCESS PLANT
SITE LAYOUT PLAN

SCALE	SIZE	DWG. No.	REV. No.
1:500	A1	161-M-0001	D


ELEVATION A
ELEVATION B
ELEVATION C
ELEVATION D
ELEVATION E
ELEVATION F
ELEVATION G
0001
MILL FEED SURGE BIN 10BIN03
ROM APRON FEEDER 10APF02
ROM BIN 10BIN01
TIMBER PICKER 10PIK01
PRIMARY CRUSHER 10CRU01
13.500 T.O.ROM PAD
MILL FEED APRON FEEDER 10APF02
CONVEYOR 10CVR02
CONVEYOR 10CVR03
DATUM 0.000
PRIMARY MILL 20MIL01
QUICK LIME MIXING
EMERGENCY STOCKPILE
GRINDING CYCLONES 20CYC01
CONVEYOR 10CVR03
CIL TANKS
ACID/ELUTION COL. 40CLM01
ACACIA REACTOR 40RCT01
GRINDING
REGEN KILN 40KLN01
SODIUM CYANIDE
DETOX TANKS
MCC
ELUTION BOILER
ELUTION TANKS
GOLD ROOM
PLANT AIR
REAGENTS HOIST
REAGENTS
EMERGENCY GENSET
DIESEL FUEL OIL
HYDROCHLORIC ACID
SMBS
COPPER SULPHATE
SODIUM HYDROXIDE
7.700 U/S MONORAIL
INFORMATION ONLY
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INTERMET ENGINEERING
INTERMET ENGINEERING PTY LTD.
CLIENT
RED 5 LIMITED
SUBJECT
SIANA GOLD PROJECT
Figure 3-13 PROCESS PLANT
PLANT GENERAL ELEVATIONS
SCALE 1:200
A1
DWG. No. 161-M-0002
REV. No. A
A ISSUED FOR REVIEW
REV DESCRIPTION
DRAWING No. DESCRIPTION

Figure 3-14 is theProject's stormwater drainage design. As shown, there are three (3) settling ponds.

- Pond A, to be constructed between the process plant and the main waste rock dump, will collect runoff and settle the suspended sediments from the waste dump and portions of the process plant area. The pond will also store decant water from the TSF. It will have a spillway and sediment trap along the southern perimeter from where excess overflow will discharge to Pond B. For added safety, Pond A can be divided into two compartments – one compartment to receive TSF decant water that may be contaminated with CN and the other compartment to receive surface runoff.

- Pond B will be located southeast of TSF3. Just like Pond A, it can be divided into two compartments. One compartment will receive potentially contaminated TSF decant water; the other will receive surface runoff and water pumped out from the open pit. Pond B will have a spillway to release excessive inflow into the Dayano Creek.

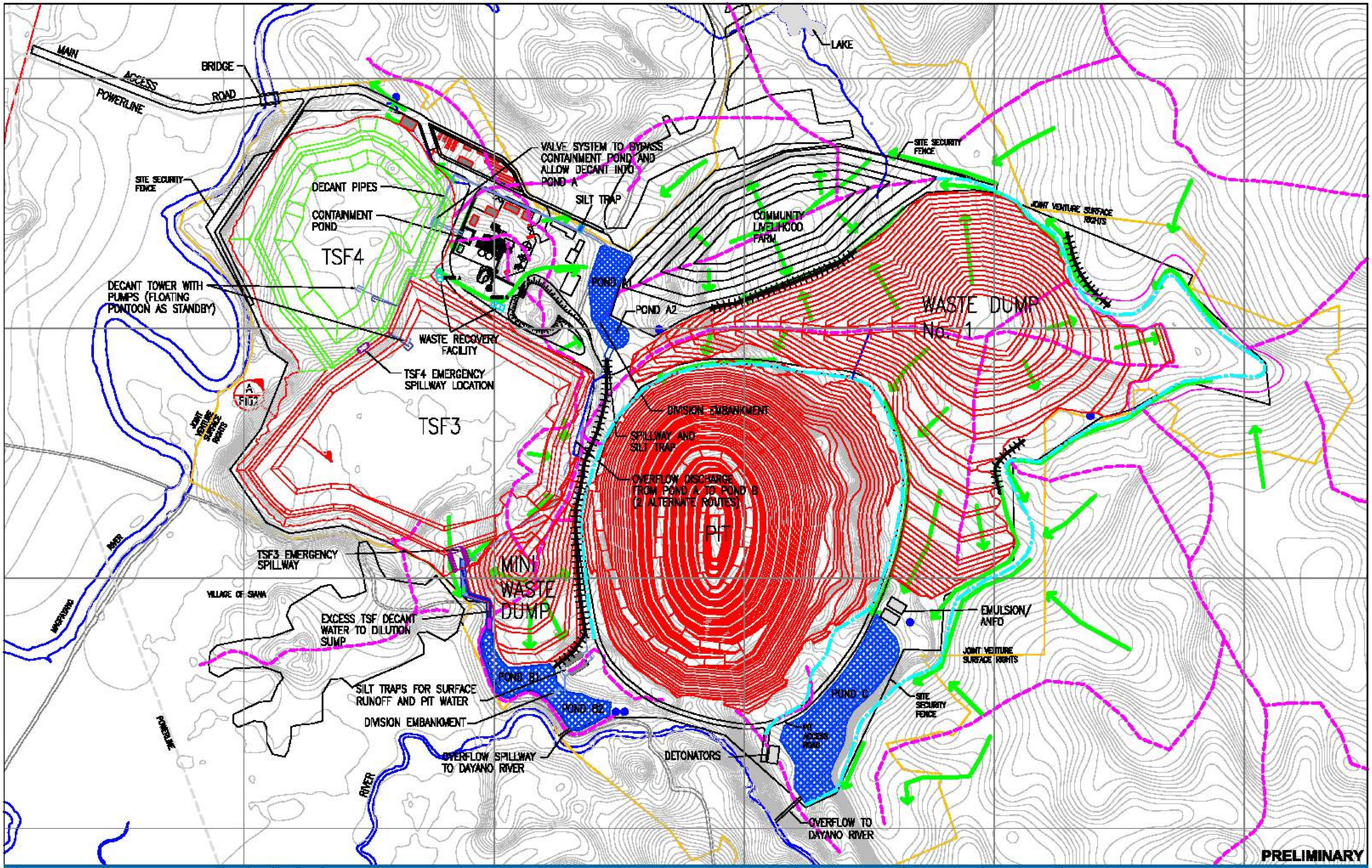
- Pond C, to be built southeast of the open pit, will contain runoff from the eastern side of the pit and from the main waste rock dump. It will be provided with sediment traps upstream and with a spillway into the Dayano Creek.

Supernatant water from the TSF will be pumped either to the process plant, Pond A or Pond B. From Pond A or Pond B, excess decant water will flow into the Dayano Creek. Testworks indicate that the process tailings are fine-grained with approximately 30 % to 37 % of the sample as clay (finer than 2µm), 60 to 65% as silt (2 to 75 µm), and 2 to 5 % sand fraction. The problem with clay and the fine silt is that they will not settle to the pond bottom. Thus, they will remain suspended in the supernatant water and likely flow out into Dayano Creek.

One control measure successfully applied to the filtration of waste materials with high water content and high percentage of fine particles passing 74 µm is the geotextile tube. A geotextile tube is constructed by sewing one or more layers of permeable but soiltight geotextiles together to form a container that will retain a saturated material. The material may come from a variety of sources such as mining operations, waterway dredging, wastewater treatment facilities, paper mills, and agricultural and industrial sites. During filling, the geotextile tube is pressurized with the soil-water mixture, allowing discharge of the liquid through the fabric pores but retaining the solid particles. The result is a "soil sausage" with lower water content and high percent solids. The shear strength of the solids will increase with time making them suitable for use as a construction material (Moo-Young *et al.*, undated).

Photo 3-25. A typical layout of geotextile tubes in a construction site.

To evaluate factors affecting the filtration and dewatering capacity of geotextile tubes, Moo-Young *et al.* (undated) conducted pressure filtration tests on five (5) different types of high-water content materials. The tests results showed filtration efficiencies in excess of 90 %. Thus, although most of the solid particles in the



No	Revision	Drawn	Checked	Approved	Date
I	GENERAL ARRANGEMENT FOR COMMENT	JTP	ABW		25/08/08

0 100 200 300m
SCALE 1:10,000 AT ORIGINAL SIZE

GHD
CLIENTS | PEOPLE | PERFORMANCE
GHD GEOTECHNICS

DO NOT SCALE

Drawn: JTP

Scale: 1:10,000

Client: RED 5 LIMITED
Project: SIANA GOLD
Title: Figure 3-14 Stormwater drainage design

Original Size: A3 — Drawing No: 61-22730-FIG01A — Rev: I

materials have a grain size much smaller than the apparent opening size of the geotextiles, the geotextiles still retain a very high percentage of the solids. The workers concluded that the mechanism of filtration depended on the porous structure of the geotextile and the formation of a filter cake inside the geotextile. In turn, the latter depended on sludge properties such as porosity, viscosity, and specific gravity; geotextile hydraulic properties; flow condition, and filtration pressure.

Apart from filtration efficiencies, the other advantages of geotextile tubes are:

- They are not a mechanical device. Hence, they will not break down or malfunction like a centrifuge, belt press, or vacuum or drum filter.
- Tubes can be used for short-term or permanent containment.
- They can be stacked to minimize space requirements and maximize storage capacity.

Geotextile tubes should be installed downslope of Pond B, immediately prior to the Dayano Creek discharge.

- Process plant commissioning – This entails a series of test runs and instrumentation checks within the gold process plant to ensure physical integrity, optimality of operating parameters, and smooth functioning of the various plan components. Figures 3-15 and 3-16 are the gold cyanidation flowsheet and piping and instrumentation diagram for the CN detoxification, respectively. The chemicals to be used are lime, hydrochloric acid (HCl), sodium hydroxide (NaOH), sodium cyanide (NaCN), copper sulfate ($CuSO_4$), sodium metabisulfite (SMBS), and activated carbon. Of these chemicals, five (5) have significant hazard ratings.

Table 3-3. Chemicals with significant hazard ratings

Chemical	NFPA Hazard Ratings			
	Health	Flammability	Reactivity	Contact
$CuSO_4$	2	0	0	---
NaCN	3	0	2	3
NaOH	3	0	1	3
HCl	3	0	2	3
SMBS	2	0	1	3

Notes: NFPA is National Fire Protection Association. A hazard rating of "0" means no hazard; a rating of "4" means extreme hazard.
Sources: MSDS of chemicals.

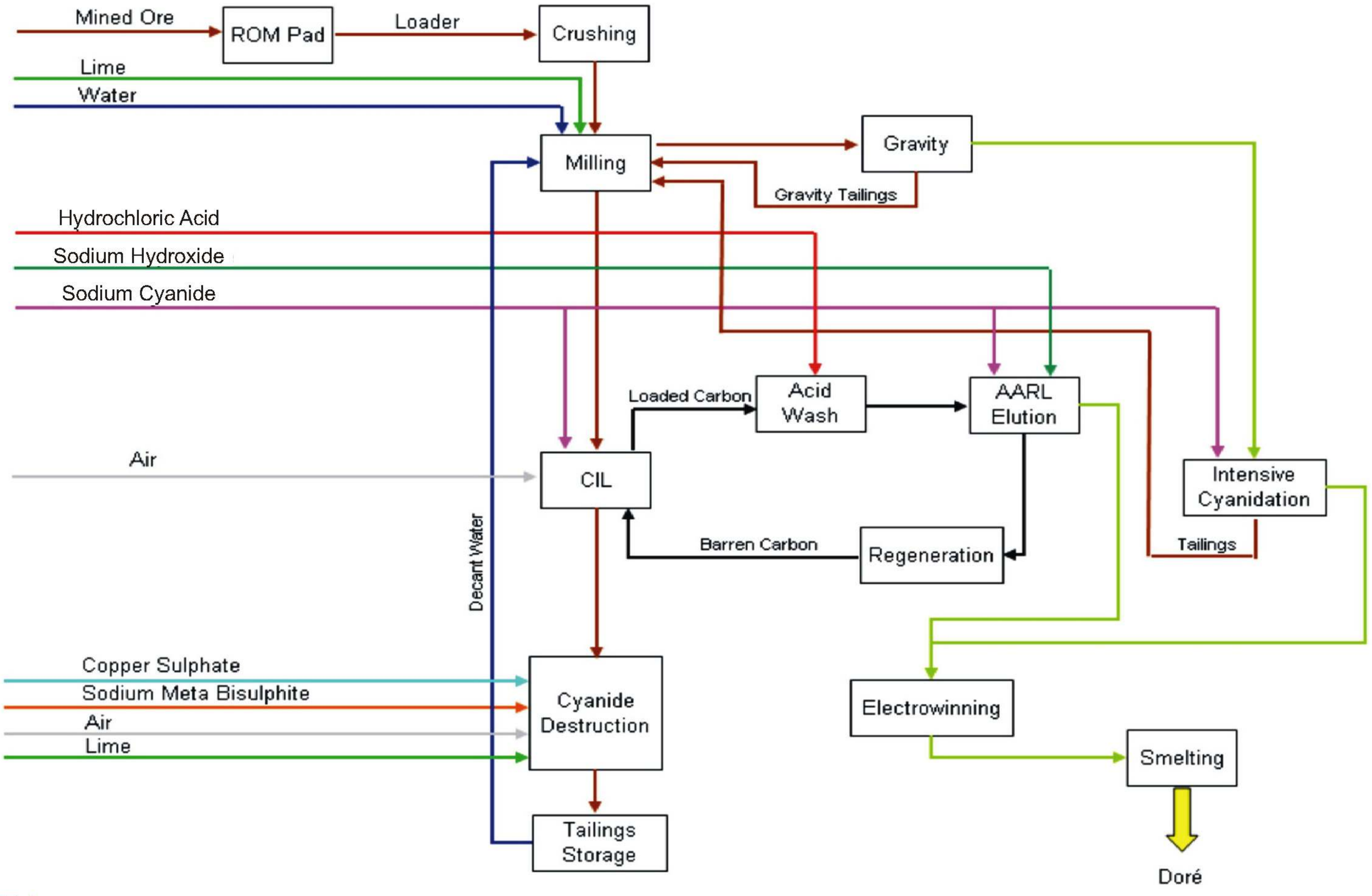
Figure 3-17 is the Gantt chart of Project construction activities.

Operation

- Open pit mining – RSG's pit development plan provides for batter angles of 55.5° to 63° for the east wall and 63° to 63.5° for all other walls. The overall angles are 40° for the north wall, 44° for the east wall, 41° for the south wall, and 44° for the west wall. The basic sequence of mining involves drilling for blast holes, blasting, loading, and hauling.

  Diesel hydraulic rigs will drill 6m deep 89 to 102-mm diameter holes at grids of 4 m by 4 m. Blasting will use ammonium nitrate mixed with fuel oil. For watery holes, waterproof explosives such as emulsion are used. Blasting is in 5-m lifts and excavation is in 2.5-m intervals using hydraulic backhoes.

  Diesel hydraulic backhoes with a bucket size of 5.7 lcm will load the waste and ore into articulated trucks. The trucks will bring the ore to the ROM pad beside the process plant.



Source : Intermet Engineering

REAGENTS 1
161-PI-301

OIL TAIL
30-SCR-07
161-PI-301

SMBS
30-PMP-17/18

XXX-SD-PES-25-XXX

COPPER SULPHATE
30-PMP-14/15

XXX-CU-PES-25-XXX

LIME
30-PMP-11/12

XXX-SL-SC1-25-XXX

XXX-SM-PES-50-XXX

XXX-SD-SR1-300-XXX

XXX-SD-SR1-300-XXX

XXX-SD-SR1-250-XXX

XXX-SD-SR1-200-XXX

XXX-SD-SR1-200-XXX

TSF

XXX-SD-SR1-150-XXX

XXX-SD-SR1-150-XXX

XXX-SL-SC1-XXB-XXX

XXX-SL-SC1-XXB-XXX

XXX-MG-SC1-15-XXX

XXX-MG-SC1-15-XXX

XXX-MG-SC1-25-XXX

PLANT SPILLAGE POND

30-PMP-14

30-PMP-13

30-PMP-09

30-PMP-10

30-CMP-01

30-CMP-02

PANEL

VENDOR PACKAGE

GLAND WATER
60-PMP-04/05

LAH
LAL
LAHL
LIT
LE
LIC
AIT
AE
SH/L
FAL
FAH
FIC
FIT
FE
FV
SI
M
V/S

25BA1.XX
15BH1.XX
25DI5

INTERNET ENGINEERING

INTERNET ENGINEERING PTY LTD.
LEVEL 4 – 170 BURSWOOD ROAD
BURSWOOD
WA 6100
TELEPHONE (0481 4) 9472 6700
FAX (0481 4) 9472 4699

CLIENT: RED 5 LIMITED

CONTRACT/ENQUIRY: 161

SUBJECT:
SIANA GOLD
Figure 3-16 DETOX
PIPING & INSTRUMENTATION DIAGRAM

SCALE: A1

DRG. No.: 161-PI-302

REV. No.: A

REVISIONS													REFERENCE DRAWINGS				
REV	DESCRIPTION	DRN	CHK	ENG	DATE	REV	DESCRIPTION	DRN	CHK	ENG	DATE		DRAWING No.	DESCRIPTION			
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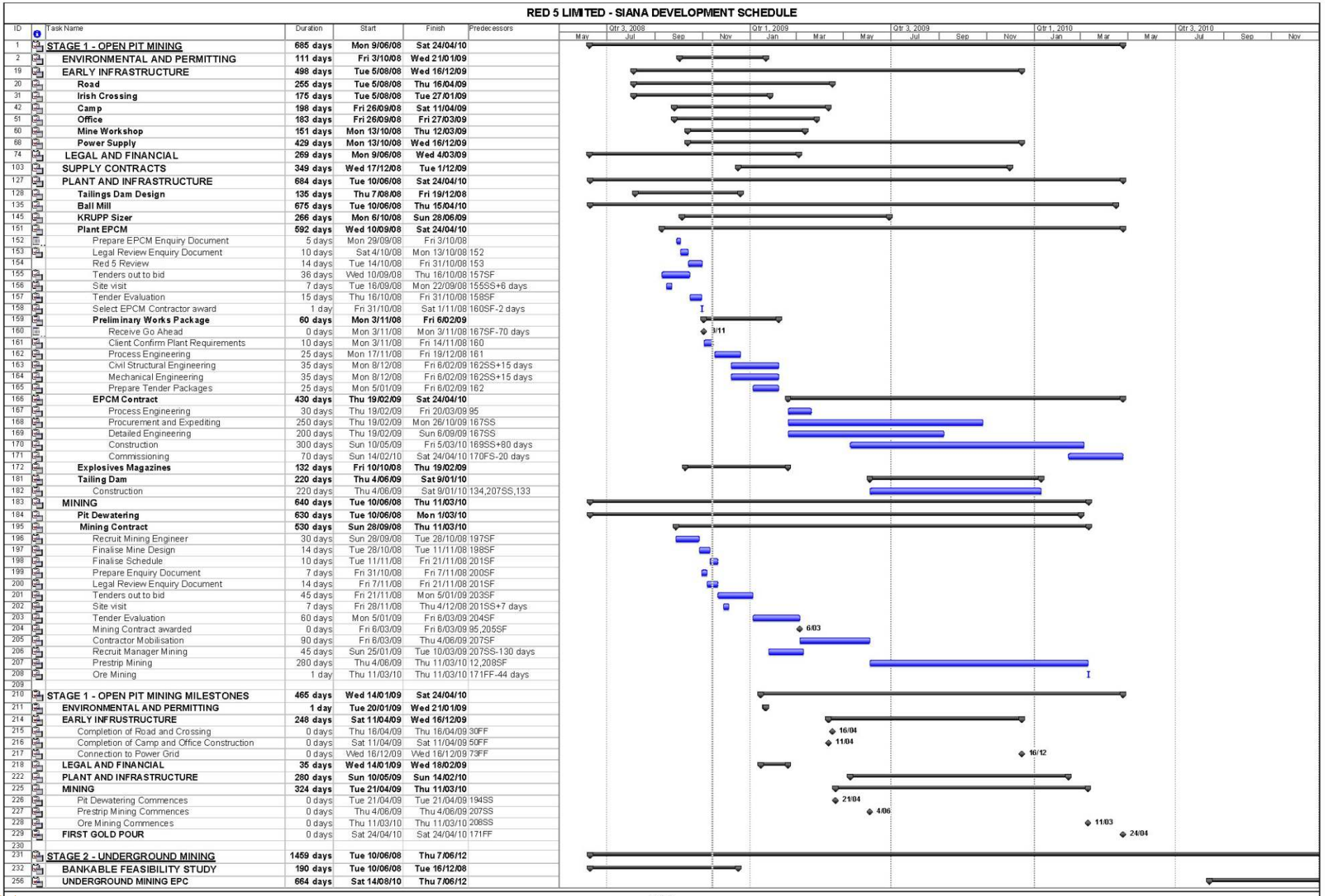
															CHECKED		
															DISCIPLINE SUPERVISOR		
															PROJECT MANAGER		
															CLIENT		



ID	Task Name	Duration	Start	Finish	Predecessors
1	**STAGE 1 - OPEN PIT MINING**	**685 days**	**Mon 9/06/08**	**Sat 24/04/10**	
2	**ENVIRONMENTAL AND PERMITTING**	**111 days**	**Fri 3/10/08**	**Wed 21/01/09**	
19	**EARLY INFRASTRUCTURE**	**498 days**	**Tue 5/08/08**	**Wed 16/12/09**	
20	**Road**	**255 days**	**Tue 5/08/08**	**Thu 16/04/09**	
31	**Irish Crossing**	**175 days**	**Tue 5/08/08**	**Tue 27/01/09**	
42	**Camp**	**198 days**	**Fri 26/09/08**	**Sat 11/04/09**	
51	**Office**	**183 days**	**Fri 26/09/08**	**Fri 27/03/09**	
60	**Mine Workshop**	**151 days**	**Mon 13/10/08**	**Thu 12/03/09**	
68	**Power Supply**	**429 days**	**Mon 13/10/08**	**Wed 16/12/09**	
74	**LEGAL AND FINANCIAL**	**269 days**	**Mon 9/06/08**	**Wed 4/03/09**	
103	**SUPPLY CONTRACTS**	**349 days**	**Wed 17/12/08**	**Tue 1/12/09**	
127	**PLANT AND INFRASTRUCTURE**	**684 days**	**Tue 10/06/08**	**Sat 24/04/10**	
128	**Tailings Dam Design**	**135 days**	**Thu 7/08/08**	**Fri 19/12/08**	
135	**Ball Mill**	**675 days**	**Tue 10/06/08**	**Thu 15/04/10**	
145	**KRUPP Sizer**	**266 days**	**Mon 6/10/08**	**Sun 28/06/09**	
151	**Plant EPCM**	**592 days**	**Wed 10/09/08**	**Sat 24/04/10**	
152	Prepare EPCM Enquiry Document	5 days	Mon 29/09/08	Fri 3/10/08	
153	Legal Review Enquiry Document	10 days	Sat 4/10/08	Mon 13/10/08	152
154	Red 5 Review	14 days	Tue 14/10/08	Fri 31/10/08	153
155	Tenders out to bid	36 days	Wed 10/09/08	Thu 16/10/08	157SF
156	Site visit	7 days	Tue 16/09/08	Mon 22/09/08	155SS+6 days
157	Tender Evaluation	15 days	Thu 16/10/08	Fri 31/10/08	158SF
158	Select EPCM Contractor award	1 day	Fri 31/10/08	Sat 1/11/08	160SF-2 days
159	**Preliminary Works Package**	**60 days**	**Mon 3/11/08**	**Fri 6/02/09**	
160	Receive Go Ahead	0 days	Mon 3/11/08	Mon 3/11/08	167SF-70 days
161	Client Confirm Plant Requirements	10 days	Mon 3/11/08	Fri 14/11/08	160
162	Process Engineering	25 days	Mon 17/11/08	Fri 19/12/08	161
163	Civil Structural Engineering	35 days	Mon 8/12/08	Fri 6/02/09	162SS+15 days
164	Mechanical Engineering	35 days	Mon 8/12/08	Fri 6/02/09	162SS+15 days
165	Prepare Tender Packages	25 days	Mon 5/01/09	Fri 6/02/09	162
166	**EPCM Contract**	**430 days**	**Thu 19/02/09**	**Sat 24/04/10**	
167	Process Engineering	30 days	Thu 19/02/09	Fri 20/03/09	95
168	Procurement and Expediting	250 days	Thu 19/02/09	Mon 26/10/09	167SS
169	Detailed Engineering	200 days	Thu 19/02/09	Sun 6/09/09	167SS
170	Construction	300 days	Sun 10/05/09	Fri 5/03/10	169SS+80 days
171	Commissioning	70 days	Sun 14/02/10	Sat 24/04/10	170FS-20 days
172	**Explosives Magazines**	**132 days**	**Fri 10/10/08**	**Thu 19/02/09**	
181	**Tailing Dam**	**220 days**	**Thu 4/06/09**	**Sat 9/01/10**	
182	Construction	220 days	Thu 4/06/09	Sat 9/01/10	134,207SS,133
183	**MINING**	**640 days**	**Tue 10/06/08**	**Thu 11/03/10**	
184	**Pit Dewatering**	**630 days**	**Tue 10/06/08**	**Mon 1/03/10**	
195	**Mining Contract**	**530 days**	**Sun 28/09/08**	**Thu 11/03/10**	
196	Recruit Mining Engineer	30 days	Sun 28/09/08	Tue 28/10/08	197SF
197	Finalise Mine Design	14 days	Tue 28/10/08	Tue 11/11/08	198SF
198	Finalise Schedule	10 days	Tue 11/11/08	Fri 21/11/08	201SF
199	Prepare Enquiry Document	7 days	Fri 31/10/08	Fri 7/11/08	200SF
200	Legal Review Enquiry Document	14 days	Fri 7/11/08	Fri 21/11/08	201SF
201	Tenders out to bid	45 days	Fri 21/11/08	Mon 5/01/09	203SF
202	Site visit	7 days	Fri 28/11/08	Thu 4/12/08	201SS+7 days
203	Tender Evaluation	60 days	Mon 5/01/09	Fri 6/03/09	204SF
204	Mining Contract awarded	0 days	Fri 6/03/09	Fri 6/03/09	95,205SF
205	Contractor Mobilisation	90 days	Fri 6/03/09	Thu 4/06/09	207SF
206	Recruit Manager Mining	45 days	Sun 25/01/09	Tue 10/03/09	207SS-130 days
207	Prestrip Mining	280 days	Thu 4/06/09	Thu 11/03/10	12,208SF
208	Ore Mining	1 day	Thu 11/03/10	Thu 11/03/10	171FF-44 days
209					
210	**STAGE 1 - OPEN PIT MINING MILESTONES**	**465 days**	**Wed 14/01/09**	**Sat 24/04/10**	
211	**ENVIRONMENTAL AND PERMITTING**	**1 day**	**Tue 20/01/09**	**Wed 21/01/09**	
214	**EARLY INFRUSTRUCTURE**	**248 days**	**Sat 11/04/09**	**Wed 16/12/09**	
215	Completion of Road and Crossing	0 days	Thu 16/04/09	Thu 16/04/09	30FF
216	Completion of Camp and Office Construction	0 days	Sat 11/04/09	Sat 11/04/09	50FF
217	Connection to Power Grid	0 days	Wed 16/12/09	Wed 16/12/09	73FF
218	**LEGAL AND FINANCIAL**	**35 days**	**Wed 14/01/09**	**Wed 18/02/09**	
222	**PLANT AND INFRASTRUCTURE**	**280 days**	**Sun 10/05/09**	**Sun 14/02/10**	
225	**MINING**	**324 days**	**Tue 21/04/09**	**Thu 11/03/10**	
226	Pit Dewatering Commences	0 days	Tue 21/04/09	Tue 21/04/09	194SS
227	Prestrip Mining Commences	0 days	Thu 4/06/09	Thu 4/06/09	207SS
228	Ore Mining Commences	0 days	Thu 11/03/10	Thu 11/03/10	208SS
229	**FIRST GOLD POUR**	0 days	Sat 24/04/10	Sat 24/04/10	171FF
230					
231	**STAGE 2 - UNDERGROUND MINING**	**1459 days**	**Tue 10/06/08**	**Thu 7/06/12**	
232	**BANKABLE FEASIBILITY STUDY**	**190 days**	**Tue 10/06/08**	**Tue 16/12/08**	
256	**UNDERGROUND MINING EPC**	**664 days**	**Sat 14/08/10**	**Thu 7/06/12**	

Source : GRC

Gantt chart of Project construction activities

Table 3-3 shows the planned material movements at the open pit. Figure 3-18 is the annual pit cross-sections.

Table 3-4. Planned open pit material movements

Mined	Unit	Total	-1	1	2	3	4	5
Waste	Kbcm	9,034	3,991	3,347	835	1,551	233	277
Ore	Kbcm	1,288	3	231	317	306	297	135
LG	Kbcm	1						
Total	Kbcm	10,322	3,993	3,578	1,152	857	530	212
Waste	Kt	22,600	10,052	8,476	2,012	1,317	561	181
Total	Kt	25,710	10,059	9,053	2,775	2,049	1,276	498
Ore	Kt	3,110	7	577	763	731	716	317
Ore	Au g t^{-1}	3.41	2.64	3.12	3.48	3.53	3.64	2.96
Ore	Ag g t^{-1}	8.71	13.96	15.78	9.6	6.09	6.52	5.53
LG	Kt	1		1	1			
LG	Au g t^{-1}	1.22		1.19	1.23			
LG	Ag g t^{-1}	24.2		30.11	22.4			

Source: RSG

Notes:

1. The numbers in the column headings are in years.
2. LG is low-grade ore recovered from SURICON's low grade stockpiles.

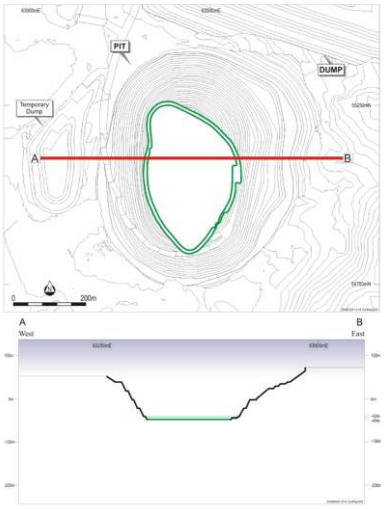
- Pit water management – During pit operation, groundwater inflows into the pit, estimated at 5.9 GL annually, and pressures on the pit walls have to be managed. GRC will install five (5) dewatering bores outside of the pit perimeter to the east. Two (2) bores are sited in the southeast through the karstic limestone, three (3) bores are in the eastern pit wall. The limestone bores are equipped with 50 L s^{-1} submersible pump each; the eastern bores with 17 L s^{-1} submersible pump each. Siting of the boreholes was based on the open fractures or cavities inferred from core images, geotechnical logs, and lithology logs.

  Apart from the groundwater inflows, 1.06 GL of rainfall is expected annually. Most of the rainfall occurs between November and March. GRC's pit water management plan provides for the pump-out of rainwater over a 3-month period at 0.6 GL monthly which is equivalent to a minimum of 230 L s^{-1}. For the remaining nine (9) months, the pumping rate is a minimum of 115 L s^{-1}. GRC will put up a static booster slurry pump at -50 RL to receive pit water from a pontoon mounted slurry pump. A duplicate system will provide 100 % back up in case of failure. Sumps will be established in the waste in the pit floor as mining progresses deeper to provide surge capacity. The two (2) pumps in series will be linked telemetrically.

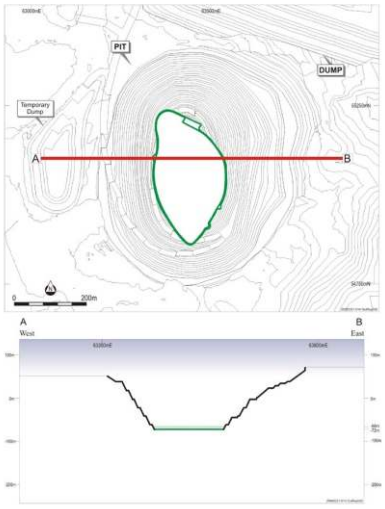
- Gold cyanidation - The main steps of the process are crushing, grinding, gravity concentration, CIL, carbon elution, carbon regeneration, and gold recovery (Figure 3-15).

  Ore from the ROM pad is reclaimed by a front-end loader and fed to a 70-t ROM bin. The bin has a grizzly with 700 mm opening and provided with a variable speed apron feeder. From the crusher, the ore goes to the semi-autogenous grinding (SAG) mill and then through a cyclone.

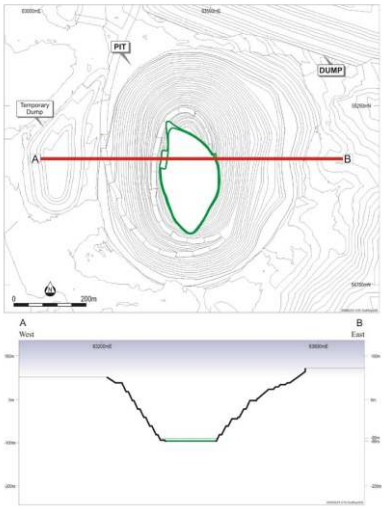
  The cyclone overflow passes through a screen for removal of the coarse particles. Spray water is applied to the screen deck. The screen underflow gravitates to a centrifugal concentrator for recovery of the coarse free gold particles. The concentrator tails and screen overflow are returned to the mill feed chute.



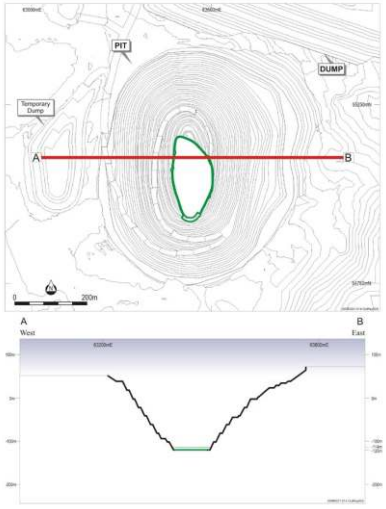
Pit cross section, west to east - Year 1



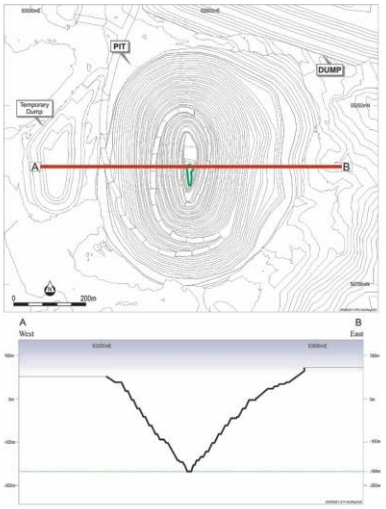
Pit cross section, west to east - Year 2



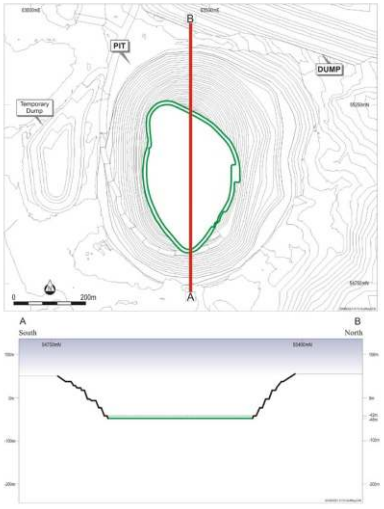
Pit cross section, west to east - Year 3



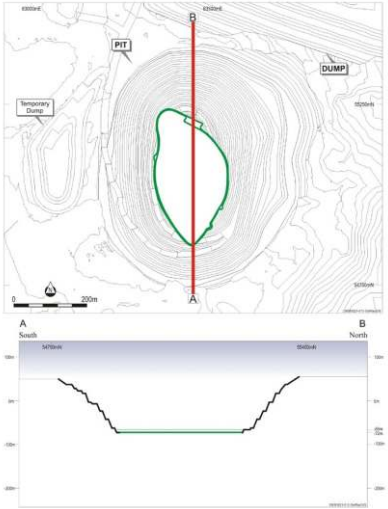
Pit cross section, west to east - Year 4



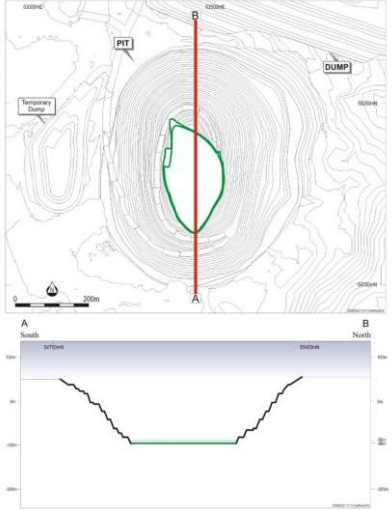
Pit cross section, west to east - Year 5



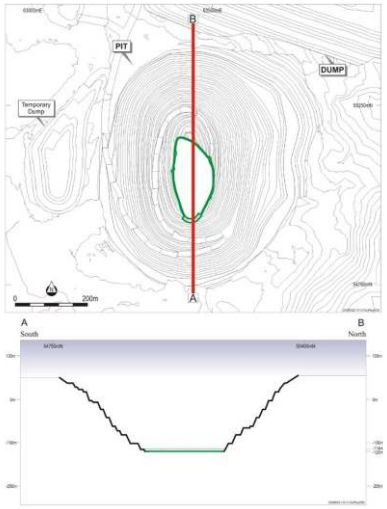
Pit cross section, south to north - Year 1



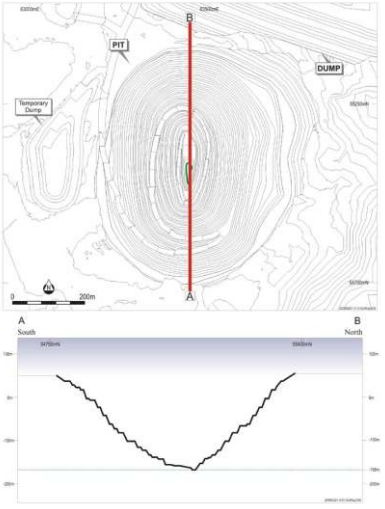
Pit cross section, south to north - Year 2



Pit cross section, south to north - Year 3



Pit cross section, south to north - Year 4



Pit cross section, south to north - Year 5

Source : RSG

Annual pit cross sections

At the CIL section, gold and other precious metals from the ore are dissolved, collected, and separated for purification. The cyclone overflow gravitates to one of six (6) agitated CIL tanks. Flow is sequential through the six (6) tanks with the cyanide solution in contact with the counter-current flowing activated carbon stream.

The carbon, which is called "loaded carbon" because it is laden with gold and silver values, is collected through screens. Using diluted sodium hydroxide and cyanide, the loaded carbon is stripped of its values. The pregnant solution passes through electrowinning cells where the metallic elements adhere as precipitate. The stripped carbon is activated in a kiln.

Photo 3-26. A cyanide SO_2-air detoxification circuit (AM King Industries, Inc.)

- Cyanide detoxification using a two-reactor single stage SO_2-Air process - The carbon safety screen underflow, *i.e.*, tailings, will report to the first of two cyanide detoxification reactors. At the reactor, the slurry will react with sodium metabisulfite and $CuSO_4$ solutions. Air is sparged into the reactor and the slurry pH maintained at 10 with the addition of lime slurry. Figure 3-16 is the piping and instrumentation diagram of the cyanide detoxification circuit.

- Operation and maintenance of TSF and waste rock dump - During the normal operation of the TSFs, tailings will discharge via HDPE delivery pipelines at a nominal solids content of 32.5 % by mass from the perimeter embankment. A beach surface that grades downward towards the center of the facility will be formed. Supernatant water will be collected from the TSFs by decants located near the dividing embankment and pumped either to the process plant, Pond A or Pond B.

- Implementation of EPEP and SDMP.

- Periodic review of the FMRDP.

Underground Mining

Pre-construction

- Exploration – This will involve the driving of additional diamond drill holes within the target stoping block down to -400 m RL for detailed ore reserve assessment following the JORC code.

- Detailed hydrogeology and geotechnical studies – These studies will focus on the target blocks and the overlying rocks, particularly, with respect to faulting, weathering, groundwater, hydrothermal alterations, and intrusions by dikes, stocks, and sills. The objectives are prediction of subsidence and hydrological impacts and formulation of control measures.

- Feasibility study – The ore reserve assessment, hydrogeology, and geotechnical studies will determine the mining plan. Based on the plan, the capital and operating requirements and costs over the mine life are estimated. The feasibility of the operating scenario in terms of net present value and discounted cash flow rate of return on investment is computed.

- Detailed engineering - This covers the preparation of detailed engineering design to implement the best option determined in the definitive feasibility study.

- Procurement – All services, equipment, reagents, supplies and materials needed by the underground mine and identified during the detailed engineering are acquired.

Construction

- Development of portal and declines – Based on RSG's initial plan, access to the underground workings is through a 1V:7H decline with portal at -100 m RL, *i.e.*, 50 m above the ultimate pit floor and 150 m below the pit crest on the main pit ramp to the eastern side (Figure 3-19). The opening is 4.5 m x 4.5 m to accommodate articulated trucks.

- Installation of electrical substation – The substation will power the lighting, ventilation, and other requirements of the underground mine.

- Driving of waste and ore levels and ventilation raises – RSG's initial mining plan is for stoping blocks at 10 m interval on strike and on 25-m sublevels to achieve a minimum annual production rate of 300,000 t. For smooth operations, waste and ore levels and ventilation raises need to be driven.

- Construction of fill batch plant – RSG proposes filling of the stoping voids with a combination of waste material, mill tailings, and cement. A fill batch plant may have to be installed near the underground workings.

- Installation of flotation circuits at process plant – To recover the copper (Cu), lead (Pb), and zinc (Zn) in the deeply-seated ore, two (2) flotation circuits will be installed in series after the gravity circuit (Figure 3-20).

  The first circuit, a Cu-Pb flotation circuit, will use SMBS and zinc sulfate ($ZnSO_4$) to depress the Zn minerals. Gold in the Cu-Pb concentrate will be dissolved using intensive cyanidation and extracted from solution in the gold room. The Cu-Pb concentrate is sold to smelters.

  The second circuit, Zn flotation, will accept the Cu-Pb flotation tailings. The Zn minerals are activated using $CuSO_4$. The Zn concentrate containing 53 % Zn and 7 % Fe will be sold to an overseas smelter. The Zn flotation tailings will flow to the CIL circuit used for the treatment of open pit ores.

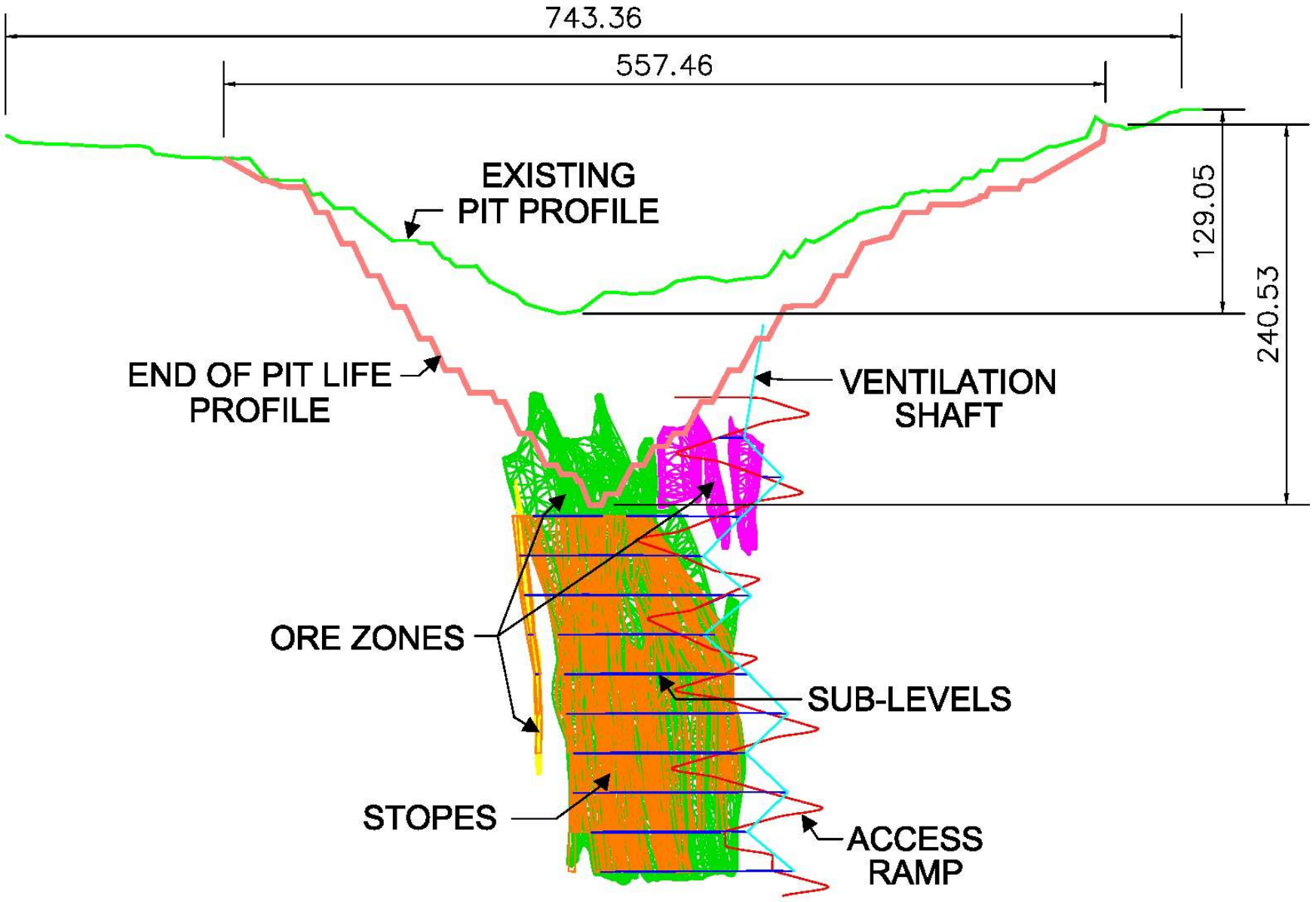
  Table 3-5 lists the flotation chemicals with significant hazard ratings.

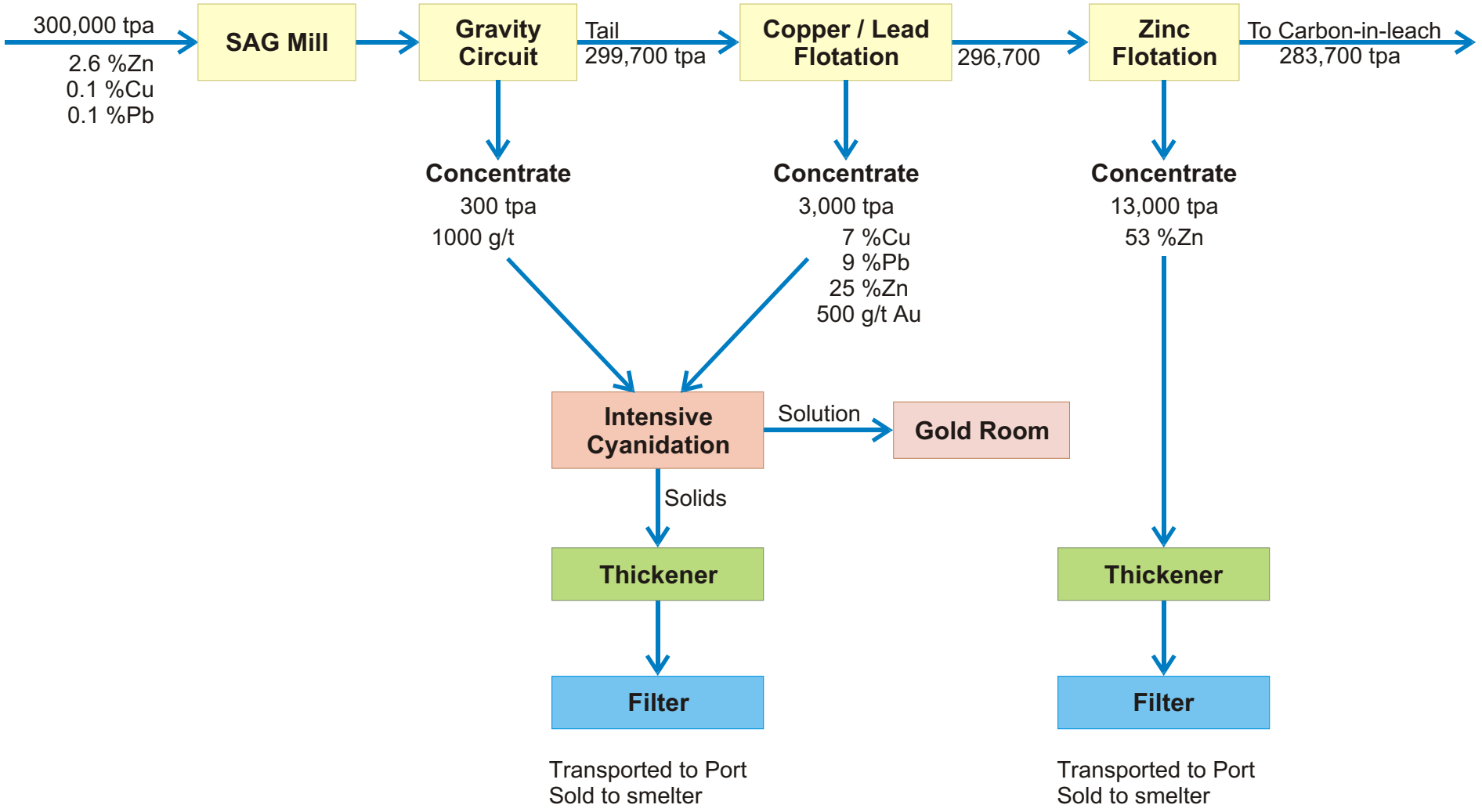
Table 3-5. Chemicals with significant hazard ratings

Chemical	NFPA Hazard Ratings			
	Health	Flammability	Reactivity	Contact
Aerophie 3418A Promoter	2	1	0	0
MIBC Frother	2	2	0	0
$ZnSO_4$	1	0	1	2

Notes: NFPA is National Fire Protection Association. A hazard rating of "0" means no hazard; a rating of "4" means extreme hazard.

Sources: MSDS of chemicals


743.36
557.46
EXISTING
PIT PROFILE
129.05
240.53
END OF PIT LIFE
PROFILE
VENTILATION
SHAFT
ORE ZONES
SUB-LEVELS
STOPES
ACCESS
RAMP



Source : GRC

Additional Cu-Pb and Zn flotation circuit

- Implementation of the EPEP and SDMP.

Operation

- Mining by up-hole benching or other suitable technique – Up-hole benching involves the development of strike drives to the extent of mineralization, then retreating back to a central pillar by drilling and blasting up holes between levels. Mineralization that is not easily recovered by remote loading on the level is exposed on the level below as mining progresses downwards. In narrow areas of the orebody, hand-held stoping methods may be employed. The feasibility study will finalize the underground mining method.

- Void filling – GRC is evaluating two (2) options for void filling – cemented hydraulic fill or paste fill. Cemented hydraulic fill has the advantage of less cement than paste fill but it needs time to drain water and cure and requires pumping capacity. Paste fill uses more cement and is expensive; however, it requires no drainage and cures quickly in 30 days.

- Flotation and gold cyanidation.

- Cyanide detoxification.

- Implementation of EPEP and SDMP.

- Periodic review of the FMRDP.

Abandonment

The activities spelled out in the FMRDP will be implemented at this stage. These include:

- Removal of unused reagents and wastes – This will involve the haul out of unused reagents in the reagent storage and process plant areas, oil and chemical spills, and wastes.

- Dismantling of plant structures – Plant structures that will not fit the post-mining land use and those that will not be needed by the barangays will be dismantled. The associated cables, pipes, concrete masonry, storage tanks, equipment and structures are removed as well.

- Re-flooding of pit and underground workings and drying of TSFs – During mine closure, the pit and underground workings will accumulate water. This will benefit the Philippine Duck reproduction. For long-term stability, the TSFs will be dried.

- Recontouring and drainage works – Consistent with the post-mining land use, the cleared mining areas, including the dried tailings, will be recontoured. Subsequently, a new sustainable drainage network is established and the hardstands deep ripped. The slope, surface, and drainage modifications must suit the minimum FoSs and design rainfall during closure.

- Spread of topsoil or soil reconditioning and revegetation – Available topsoil will be spread over the recontoured surfaces. Alternatively, subsoil reconditioned with compost or any other suitable materials established during the field revegetation trials may be used. Endemic floral species are planted.

- Retrenchment package and labor support programs – These comprise the employee benefits and programs which GRC will provide during or before mine closure. The labor support programs include job search, employee re-training, and entrepreneurial skills development.

- Transfer of social assets – The social assets which may be transferred by GRC to the community, subject to future discussions, include water supply and electricity.

Wastes, Issues, and Control Measures

Table 3-6. Wastes, issues, and control measures by Project phase

Project Phase	Activities/Environmental Aspects	Associated Wastes			Environmental/Social Issues or Risks	Pollution Control Measures
		Type	Generation Rate	Estimated Volume		
All phases	Maintenance of accommodations, mess hall, and offices	Domestic solid waste	0.5 kg person-day^{-1}	91 t pa for 500 people 57 t pa for 312 people	Visual aesthetics and foul smell	• Waste segregation • Composting • Landfill east of the open pit near the waste rock dump
		Sewage (construction)	75,000 m^3 pa	75,000 m^3	Visual aesthetics, foul smell, water-borne diseases	Bacteriological sewage treatment system, preferably BioMAX
		Sewage (operations)	48,300 m^3 pa	240,000 m^3		
	Ground clearings, excavations, and grading at the process plant area, mine services area, access and haul roads, open pit, waste rock dump, and TSFs	Surface runoff and suspended sediments	2.5 m rainfall excess pa	6 million m^3 surface runoff pa	Turbidity of washing, bathing, and irrigation water Flooding Sedimentation of ricefields Effects on fishes	Stormwater and sediment control system consisting of: • Diversion bunds to convey runoff from the eastern highlands away from the minesite either to the north of the waste rock dump or to the south of the pit into Dayano Creek. • Drainage channels, sediment traps, settling ponds, and geotextile tubes for the dirty water from the waste rock dumps, mine workings, and process plant area
		Dust	To be estimated in the air quality impacts modeling		Nuisance Respiratory diseases	• Water sprays • Enclosures, barriers, and buffer zones
		Noise	To be estimated in the noise impacts modeling		Nuisance	• Enclosures, barriers, and buffer zones • Less noisy and shielded equipment
	Operation and maintenance of plant and equipment	Used oil (construction)	91 m^3 pa	91 m^3	Visual aesthetics Non-suitability of water for washing and bathing Destruction of aquatic habitats	• Oil-water separator at mine fleet maintenance area • Oil drip trays at fuel storage and dispensation • Used oil collection, storage, and disposition
		Used oil (operations)	52.4 to 1.7 m^3 pa	106 m^3		

Project Phase	Activities/Environmental Aspects	Associated Wastes			Environmental/Social Issues or Risks	Pollution Control Measures
		Type	Generation Rate	Estimated Volume		
Construction	Pit dewatering	Pumped out water and suspended sediments	780 L s^{-1} over 6 months	11.6 million m^3 of water	Turbidity of washing, bathing, and irrigation water Flooding Sedimentation of ricefields Effects on fishes	• Controlled discharge to a maximum of 780 L s^{-1} • Monitoring and control of pumping and discharge during high rainfall periods • Sediment trap, settling pond, and geotextile tubes • Opening of irrigation dam
	Pit development and build-up of waste rock dump and TSFs	Waste rocks – NAF and minor PAF	4.1 million bcm pa	4.1 million bcm	Visual aesthetics Space to accommodate waste rock dumps Physical stability of waste rock dump	• The main waste rock dump northeast of the pit with capacity of 9.6 million lcm • Waste rock dump southwest of the pit ramp exit with a capacity of 0.3 million lcm • Both dumps designed with batter angles of 30° and 10-m to 15-m berms at varying vertical intervals. • 1 million bcm of waste rocks to be used as borrow materials for the TSFs • Classification of waste rocks into PAF and NAF and placement of materials in a manner to prevent acid generation • Staggered placement of clay-rich materials into the main waste rock dump
		Pit, waste rock dump, and TSF runon and suspended sediments	2.5 m excess rainfall pa	2.6 million m^3 pa	Turbidity of washing, bathing, and irrigation water AMD Flooding Sedimentation of ricefields Effects on fishes	• Diversion bunds for clean water from the eastern highlands • Pit dewatering bores and pumping • Drainage channels, sediment traps, settling ponds, and geotextile tubes for the dirty water • Regular monitoring of Pond A and B TSF decant water quality prior to discharge and pH treatment at the pond if required

Project Phase	Activities/Environmental Aspects	Associated Wastes			Environmental/Social Issues or Risks	Pollution Control Measures
		Type	Generation Rate	Estimated Volume		
	Plant commissioning	Reagent spills – $CuSO_4$, NaCN, NaOH, HCL, SMBS, Aerophine, MIBC, $ZnSO_4$	Should be insignificant		The eight (8) listed chemicals have significant hazard ratings with respect to health, flammability, reactivity, and contact.	The Project will employ a physical system that will prevent and fully contain the escape of chemicals to the environment from their delivery to site down to the disposition of wastes or residues: • Sturdy packaging and bulk containers • Delivery by experienced and well-equipped personnel • Under-cover, well-placarded, and bunded storage areas with a holding capacity equal to 100 % of the aggregate storage capacity • Storage areas are segregated considering the incompatibilities of the various chemicals.[1] • Events pond to contain chemical spills
		Tailings	40,000 t	40,000 t	Physical and chemical degradation of streams, ricefields, and lake Human health and safety	• Tailings will go through a CN detoxification circuit prior to discharge to the TSF • TSF is engineered for seismic and hydrometeorological risks
	Underground development works	Groundwater inflow and suspended sediments	Volume of water for handling to be estimated during the hydrogeology and geotechnical studies for underground mining		Turbidity of washing, bathing, and irrigation water AMD Flooding Effects on fishes	• Diversion bunds for clean water from the eastern highlands • Pit dewatering bores and pumping • Drainage channels, sediment traps, settling ponds, and geotextile tubes for the dirty water • Regular monitoring of Pond A and B TSF decant water quality prior to discharge and pH treatment at the pond if required

Project Phase	Activities/Environmental Aspects	Associated Wastes			Environmental/Social Issues or Risks	Pollution Control Measures
		Type	Generation Rate	Estimated Volume		
Operations	Open pit/underground mining and waste rock dump build-up	Waste rocks – NAF and minor PAF – from the open pit	2.2 million to 0.06 million bcm pa	4.6 million bcm	Visual aesthetics Space to accommodate waste rock dumps Physical stability of waste rock dump	• The main waste rock dump northeast of the pit with capacity of 7.9 million bcm • Waste rock dump southwest of the pit ramp exit with a capacity of 0.8 million bcm • 1 million bcm of waste rocks to be used as borrow materials for the TSFs • Classification of waste rocks into PAF and NAF and placement of materials in a manner to prevent acid generation • Staggered placement of clay-rich materials at the main waste rock dump
		Waste rocks from underground	Volume is much smaller compared to that of the open pit. Volume to be estimated during the feasibility study for underground mining			Use of waste rocks to fill stoping voids. The storage of any excess waste rocks to be finalized during the feasibility study.
		Pit and waste rock dump runon and suspended sediments	2.5 m excess rainfall pa	1.6 million m^3 pa	Turbidity of washing, bathing, and irrigation water AMD Flooding Sedimentation of ricefields	• Diversion bunds for clean water from the eastern highlands • Drainage channels, sediment traps, settling ponds, and geotextile tubes for the dirty water • Regular monitoring of plant feed water pond quality prior to discharge and pH treatment at the pond if required
		Groundwater inflow and suspended solids	To be estimated during the hydrogeology and geotechnical studies for underground mining		Turbidity of washing, bathing, and irrigation water AMD Flooding Sedimentation of ricefields	Pit dewatering, pumping, and treatment of water in the plant feed water pond. The scheme will be finalized during the feasibility study for underground mining.

Project Phase	Activities/Environmental Aspects	Associated Wastes			Environmental/Social Issues or Risks	Pollution Control Measures
		Type	Generation Rate	Estimated Volume		
	Operation of gold cyanidation plant (combined with flotation plant subsequently)	Reagent spills – NaOH, $CuSO_4$, HCl, diesel, NaCN	Should be insignificant		The five (5) listed chemicals have significant hazard ratings with respect to health, flammability, reactivity, and contact.	Project's physical system for chemicals
	Operation and maintenance of TSFs	Tailings from open pit	750,000 t to 82,000 t pa	3 million t	Physical and chemical degradation of streams, ricefields, and lake Human health and safety	• Tailings will go through a CN detoxification circuit prior to discharge to the TSF • TSF is engineered for seismic and hydrometeoro-logical risks
		Tailings from underground	300,000 t pa	Roughly 1.5 million t		TSF for underground mining operations will be designed during the feasibility study.
		TSF supernatant water during open pit mining	For TSF3, 295,250 m^3 pa to Pond B For TSF4, 122,710 m^3 pa to Pond A The total volume of supernatant recovered by the process plant is 1.25 million m^3 pa.		Turbidity of washing, bathing, and irrigation water Heavy metals in suspended clays of supernatant water	• Supernatant water will be collected from the TSFs by decants supplied with power and pump to deliver the water either to the process plant or Ponds A and B • For seepage and stability control, water held on storage in the TSFs is kept to a minimum. • Geotextile tubes filter the supernatant before discharge to Dayano Creek.
Abandonment	Closure of operations	Wastes, structures and ancillaries that do not fit with the post-mining land use	To be estimated during the preparation of the Final Mine Rehabilitation and Decommissioning Plan (FMRDP)		Wastes Non-blending of structures with background Turbidity of washing, bathing, and irrigation water Nuisance dust and respiratory ailments	• Haul out of wastes and unnecessary structures, equipment, and ancillaries • Drying of tailings pond • Consistent with the post-mining land use, recontouring, deep ripping, soil conditioning, and revegetation
		Surface runoff and suspended sediment				
		Dust				

Notes:

1. NaCN and SMBS are incompatible with acids and oxidizers. Thus, HCl needs to be stored farther away. HCl is also incompatible with NaOH. Thus, it is stored separately from the acid and two different collecting sumps are maintained for the two chemicals. $ZnSO_4$ is incompatible with calcium and hydroxides. Hence, these substances are separated by a distance in the storage area.

MANPOWER REQUIREMENTS

Based on the agreement among the Barangay Captains, 95 % of total unskilled employment generated by the Project will come from the six (6) direct and indirect impact barangays. The indirect impact barangays of Magpayang, del Rosario, and Pongtud will provide 10 % each. The direct impact barangays of Dayano, Siana, and Cawilan will get 18 %, 23 %, and 25 % of the total employment, respectively.

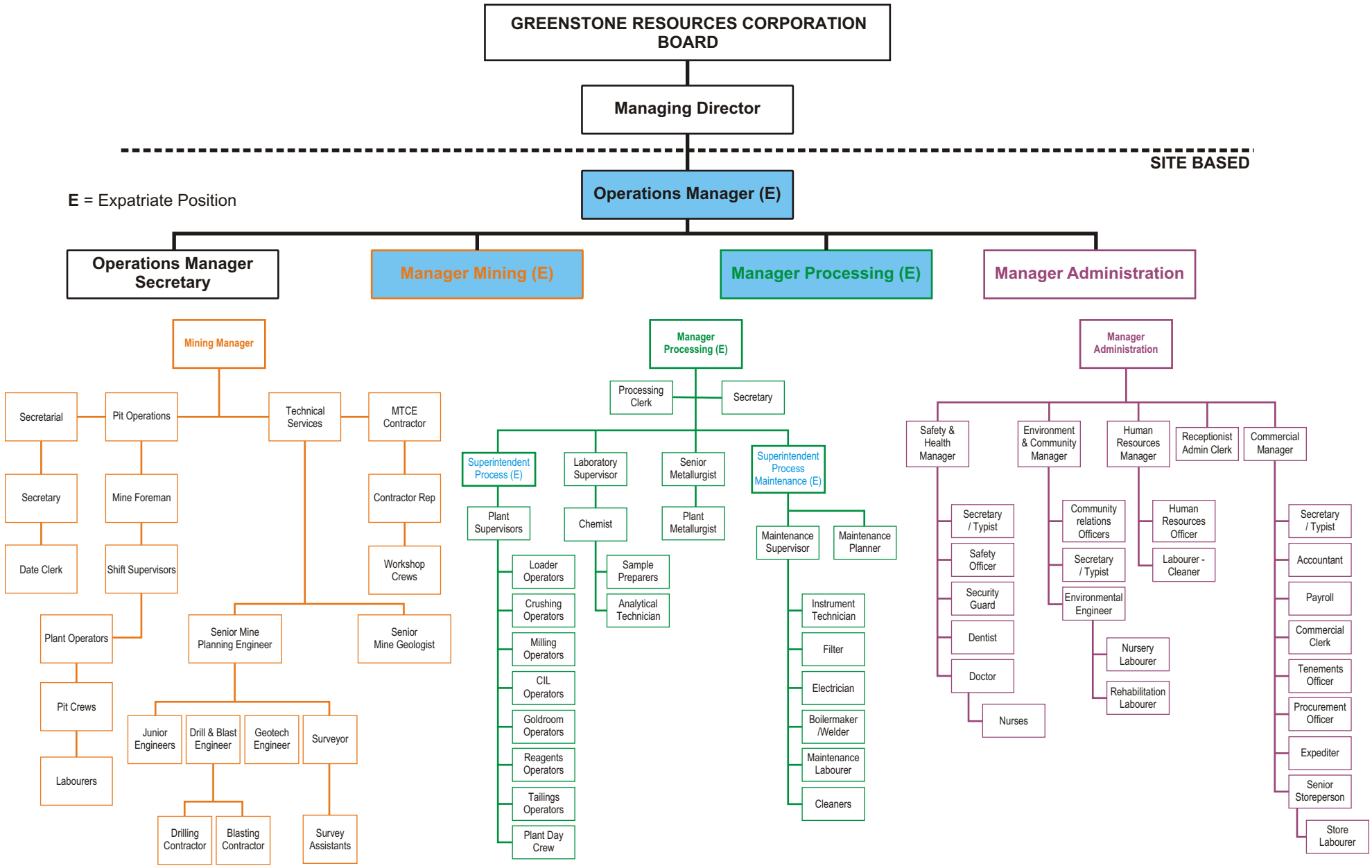
During construction, it is expected that about 700 employees, both GRC-hired and contractor-based, will be required. The number of GRC-hired employees will build up to about 350 during the latter part of the construction. During operations, the total number of GRC employees is estimated at 500.

As shown in Figure 3-21, the Operations Manager will be responsible for all Project site activities. He will be assisted by a Manager for Mining, Manager for Processing, and Manager for Administration. An Environment and Community Manager will be responsible for the Project's environmental and community commitments. He will be assisted by an Environmental Engineer who will also act as the Project's Pollution Control Officer (PCO). The Project's safety and health concerns will be handled by a Safety and Health Manager. The Environment and Community Manager and Safety and Health Manager will report to the Manager for Administration.

Table 3-7 lists the various positions required by the Project excluding exploration and additional laborers.

Table 3-7. GRC's manpower requirements

Division/Position	Development	Operation
Operations manager	1	1
Secretary	1	1
Receptionist	1	1
Administration Clerk	2	2
Health and safety manager	1	1
Secretary – Health and safety	1	1
Safety officer	1	1
Security guards	40	40
Doctor	1	1
Dentist	1	1
Nurses	3	3
Environment and community manager	1	1
Secretary – Environment and community	1	1
Environmental engineer and PCO	1	1
Community relations officer	4	4
Nursery labourer	4	4
Rehabilitation labourer	4	4
Human resources manager	1	1
Human resources officer	1	1
Laborer – Cleaner	6	6
Commercial manager	1	1
Secretary – Commercial	1	1
Accountant	2	2


GREENSTONE RESOURCES CORPORATION BOARD
Managing Director
SITE BASED
E = Expatriate Position
Operations Manager (E)
Operations Manager Secretary
Manager Mining (E)
Manager Processing (E)
Manager Administration
Mining Manager
Secretarial
Pit Operations
Technical Services
MTCE Contractor
Secretary
Mine Foreman
Contractor Rep
Date Clerk
Shift Supervisors
Workshop Crews
Plant Operators
Senior Mine Planning Engineer
Senior Mine Geologist
Pit Crews
Junior Engineers
Drill & Blast Engineer
Geotech Engineer
Surveyor
Labourers
Drilling Contractor
Blasting Contractor
Survey Assistants
Manager Processing (E)
Processing Clerk
Secretary
Superintendent Process (E)
Laboratory Supervisor
Senior Metallurgist
Superintendent Process Maintenance (E)
Plant Supervisors
Chemist
Plant Metallurgist
Maintenance Supervisor
Maintenance Planner
Loader Operators
Crushing Operators
Milling Operators
CIL Operators
Goldroom Operators
Reagents Operators
Tailings Operators
Plant Day Crew
Sample Preparers
Analytical Technician
Instrument Technician
Filter
Electrician
Boilermaker /Welder
Maintenance Labourer
Cleaners
Manager Administration
Safety & Health Manager
Environment & Community Manager
Human Resources Manager
Receptionist Admin Clerk
Commercial Manager
Secretary / Typist
Safety Officer
Security Guard
Dentist
Doctor
Nurses
Community relations Officers
Secretary / Typist
Environmental Engineer
Nursery Labourer
Rehabilitation Labourer
Human Resources Officer
Labourer - Cleaner
Secretary / Typist
Accountant
Payroll
Commercial Clerk
Tenements Officer
Procurement Officer
Expediter
Senior Storeperson
Store Labourer

Division/Position	Development	Operation
Payroll	1	1
Commercial clerk	3	3
Tenements officer	1	1
Procurement officer	2	2
Officer – expediter	1	1
Senior Storeperson	1	1
Stores labourer	6	6
Total Administration	95	95
Mining manager	1	1
Secretary	1	1
Data clerk	2	2
Mine foreman	1	1
Senior mine geologist	1	1
Mine geologist	3	3
Senior planning engineer	1	1
Geotechnical engineer	1	1
Drill and blast engineer	1	1
Senior surveyor	1	1
Surveyor	1	1
Survey assistants	6	6
Junior geologists	4	4
Junior engineers	4	4
Sampler/spotter	12	12
Shift supervisor	3	3
Excavator operator	6	6
Truck operator	36	36
Dozer operator	6	6
Grader operator	3	3
Water truck operator	3	3
Pump crew	10	10
Service crew	6	6
General labor / timber pickers	14	14
Maintenance tyres	4	4
Crane operator	3	3
Total Mining	134	134
Processing manager	1	1
Secretary/receptionist	1	1
Clerk	1	1
Senior metallurgist	1	1
Metallurgist	1	1

Division/Position	Development	Operation
Process superintendent	1	1
Plant supervisor	1	4
Loader operators	1	4
Crusher operators	2	8
Mill operators	2	8
CIL operators	2	8
Goldroom operators	2	2
Reagent operators	2	2
Tailings operators	1	4
Day crew	1	4
Chemist	1	4
Laboratory supervisor	1	1
Analytical technician	1	1
Sample preparation	1	4
Process maintenance superintendent	1	1
Maintenance supervisor	1	2
Planner maintenance	1	1
Instrument technician	1	1
Fitters	1	4
Electricians	1	4
Boilermaker/welder	1	3
Maintenance labourer	1	4
Maintenance cleaner	1	3
Total Processing	33	83

Source: GRC and Intermet

PROJECT COST

The Project's total capital cost, excluding underground mining and the flotation circuits, is estimated at US $ 60 million. Table 3-8 breaks down the capital cost estimate.

Table 3-8. Capital cost estimate for the Siana Gold Project

Particulars	US $	PhP (at PhP 45 = US$ 1)
Plant and Infrastructures		
Process plant	17,255,534	776,499,030
Buildings	1,477,077	66,468,465
Mobile equipment	566,000	25,470,000
Site earthworks	388,547	17,484,615
Tailings dam (geotextile and liner)	400,000	18,000,000

Particulars	US $	PhP (at PhP 45 = US$ 1)
Transportation	524,400	23,598,000
Site cost	499,747	22,488,615
Sub-total	**21,111,304**	**950,008,680**
Indirect Costs	**10,067,105**	**453,019,725**
Pre-Production		
Mining capital (including TSF construction)	5,713,932	257,126,940
Mining pre-production	11,573,162	520,792,290
Plant pre-production labor and administration	766,330	34,484,850
Owner costs	2,199,000	98,955,000
Working capital	969,570	43,630,650
Miscellaneous capital	2,020,754	90,933,930
Sub-total	**23,242,748**	**1,045,923,660**
Project Contingency	**5,442,116**	**244,895,220**
Total Project Capital Cost	**59,863,274**	**2,693,847,330**

Source: GRC and Intermet

The Mining capital cost included under Pre-production covers the following:

- Pre-mining labor to set up pit operations valued at US $ 225,874 (PhP 10,164,330)
- Fleet-related purchases (excluding leased equipment) at $ 3,584,450 (PhP 161,300,250)
- Dewatering of flooded pit at $ 426,886 (PhP 19,209,870)
- TSF3 stage 1 construction at $ 1,099,910 (PhP 49,495,950)
- Sub-contractor establishment at $ 350,000 (PhP 15,750,000)
- Diversion channels at $ 26,832 (PhP 1,207,440).

Owner costs include costs for project management, engineering consultants, site administration, and equipment needs during final design phase and construction:

- TSF at US $ 255,000 (PhP 11,475,000)
- Environmental reviews at $ 56,000 (PhP 2,520,000)
- Financial, tax, and corporate expenses at $ 75,000 (PhP 3,375,000)
- Mine final design at $ 90,000 (PhP 4,050,000)
- Engineering and construction project management at $ 1,040,900 (PhP 46,840,500)
- Project services at Perth and site at $ 184,100 (PhP 8,284,500)
- Operations computing hardware and software at $ 110,000 (PhP 4,950,000)

- Workshop tools and benches at $ 150,000 (PhP 6,750,000)
- Training hardware and construction first aid at $ 100,000 (PhP 4,500,000)
- Vendor representatives commissioning at $ 50,000 (PhP 2,250,000) and
- Miscellaneous minor items at $ 88,000 (PhP 3,960,000).

Miscellaneous capital covers the following:

- Major legal costs that include financing of due diligence studies and documentation, purchase of access road and resettlement land, permitting costs, and disbursements such as Philippine and Australian stamp duty on bank loan agreements valued at US $ 1,079,232 (PhP 48,565,440). $ 40,850 (PhP 1,838,250) and $ 16,700 (PhP 751,500) are for the purchase of access road and resettlement land, respectively.
- Environment and community cost at $ 268,532 (PhP 12,083,940) for new housing for families for resettlement.
- Geology cost at $ 20,663 (PhP 929,835).
- Geotechnical cost for instrumentation for stability monitoring at $ 287,719 (PhP 12,947,355).
- Hydrogeology cost at $ 22,209 (PhP 999,405).
- Financial costs for bank review of feasibility study and engineering, procurement, and construction monitoring at $ 229,443 (PhP 10,324,935)
- Opportunities and threats at $ 112,957 (PhP 5,083,065) for additional risk assessment, security matters, and insurance at $ 112,957 (PhP 5,083,065).

The total Project capital cost of US $ 59,863,274 (PhP 2,693,847,330) excludes subsequent capital expenditures which total US$ 3,092,200 (PhP 139,149,000) detailed in Table 3-9.

Table 3-9. Post-commissioning capital estimates

Capital Cost	Total	Year 1	Year 2	Year 3	Year 4	Year 5
Sustaining	US $235,000 PhP 10,575,000	45,000 2,025,000	60,000 2,700,000	60,000 2,700,000	60,000 2,700,000	10,000 4,500,000
Replacement	496,000 22,320,000	124,000 5,580,000	124,000 5,580,000	124,000 5,580,000	124,000 5,580,000	
TSF	1,861,200 83,754,000		723,800 32,571,000	1,137,400 51,183,000		
Decommissioning	200,000 9,000,000					200,000 9,000,000
Rehabilitation	300,000 13,500,000					300,000 13,500,000
Total	3,092,200 139,149,000	169,000 7,605,000	907,800 40,851,000	1,321,400 59,463,000	184,000 8,280,000	510,000 22,950,000

Source: GRC and Intermet

PROJECT DURATION AND SCHEDULE

As discussed previously, the Project has four (4) phases, namely, pre-construction, construction, operation, and closure and a total life of 12 years. The specific activities required for each phase are as follows:

Pre-Construction and Construction

The activities for this phase are:

- Environmental approvals and permitting – This covers, among others, the lodging and review of the Project's EIS by the EMB and DENR; issuance of an ECC by the DENR; preparation and submission of an EPEP, SDMP, and FMRDP to the MGB; preparation and submission of a Project Feasibility Study to the MGB; approval by the MGB of the EPEP, SDMP, FMRDP, and Project Feasibility Study; conversion of the MPSA for exploration to MPSA for operation; and issuance by the EMB of chemicals permit, wastewater discharge permit, and permit to construct and operate air pollution sources.
- Detailed engineering
- Procurement and
- Construction – The major activities are pit dewatering; roads, buildings, and earthworks; open pit development works; build-up of waste rock dumps and TSFs; and process plant commissioning

This phase is expected to last for one and a half (1.5) years.

Operations

The open pit and underground mining operations will last for ten (10) years.

The estimated life of the open pittable mineral resource is five (5) years. On the third year of open pit operations, construction works for the underground mining will commence. Prior to commencement, GRC will have completed the pre-construction works for the underground operations which include:

- Exploration and ore reserve evaluation
- Hydrogeology and geotechnical studies
- Project feasibility study
- Detailed engineering and
- Procurement.

Based on an initial assessment by RSG, the underground operations will lengthen the total project life to ten (10) years.

Closure

After the depletion of the underground reserve, GRC will implement the FMRDP. Mine closure activities are expected to consume a half year.

4 BASELINE ENVIRONMENTAL CONDITIONS, IMPACT ASSESSMENT AND MITIGATION

THE LAND

Land Classification and Use

Methodology

This entailed mainly the use of secondary data listed in Table 2-4 and complemented by a site assessment in January 2005 and April 2008.

Baseline Conditions

Figure 4-1 shows the land classification of the Siana Project site and vicinities based on NAMRIA's Land Classification Map Nos. 689 and 1224. Superimposed on the land classification are the proposed facilities of the Project. As shown, the whole Project site together with the adjoining lands to the west is classified as alienable and disposable (A&D). Thus, claims or titles may be applied by private individuals over these lands for settlement, agricultural, and other production purposes except mining.

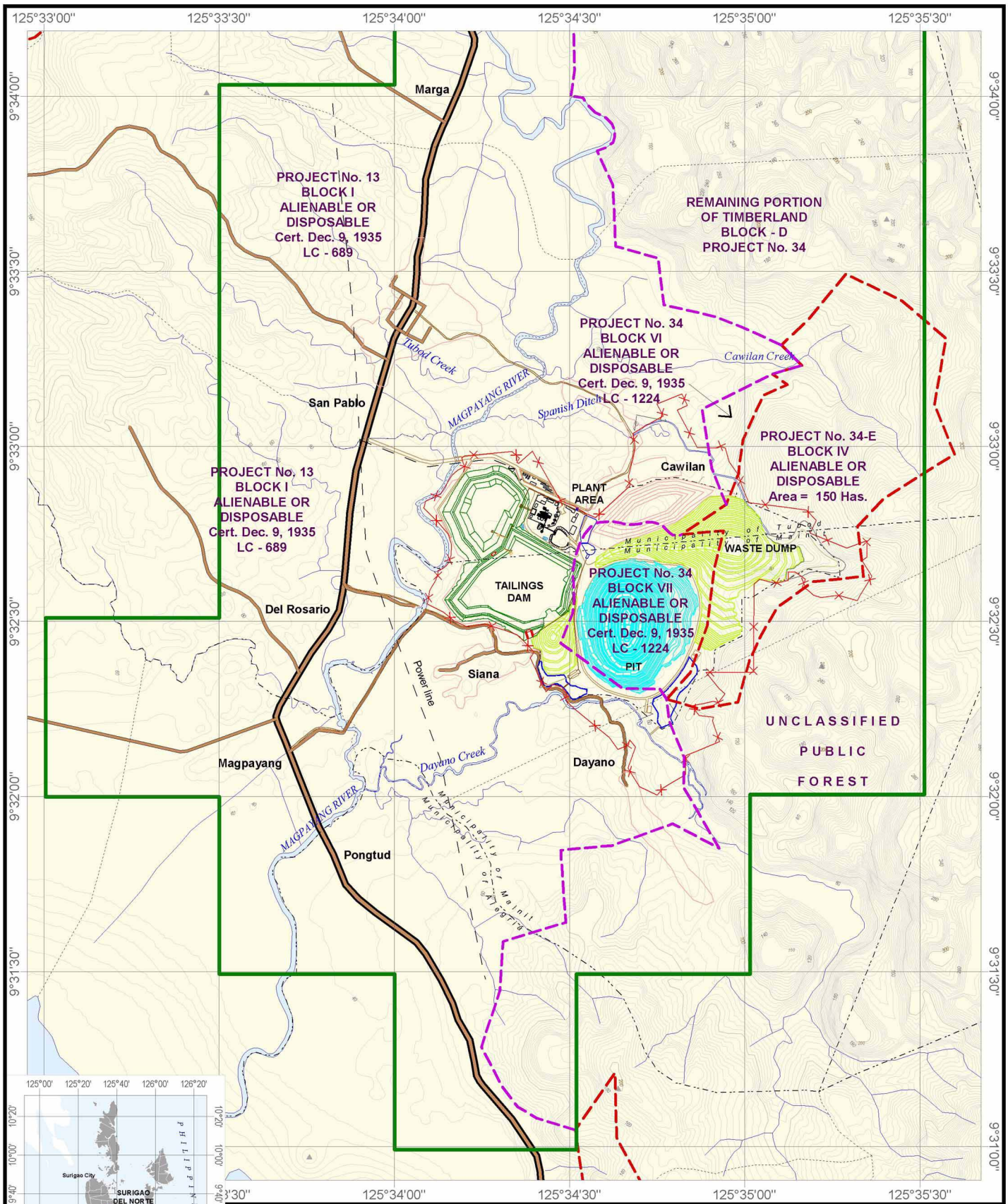
Figure 4-1 also shows the extent of land owned by Merrill Crowe Corporation (MCC). Except for some sections of the proposed main access road, chiefly from the National Highway to Magpayang River the proposed Project facilities fall inside MCC land.

Lands far north of the Project are classified as part of Timberland Block D. Lands far south and to the southeast are "Unclassified Public Forest". Presidential Decree No. (PD) 705 provides that no private claims for surface ownership may be made over these lands. Eastern portions of the MCC property but outside of the proposed Project site fall inside the unclassified public forest.

The Project site and surroundings are inside the 2,024-ha northern block of MPSA No. 184-2002-XIII which has been transferred to MCC. Through an Agreement dated 19 August 2005, MCC will transfer the MPSA to a Project company which will be owned 60 % by GRC.

Figure 4-2 is the actual land use of the Magpayang River catchment which includes the Project site as inferred from the Ikonos 2005 satellite image. The land use within the Project site and surroundings, roughly 0.5 km from the property line, shown in the Figure has been verified through a rapid field mapping in April 2008. The Project site is predominantly grassland. The minor exceptions are the ricelands west of the site and along the Magpayang River banks, the forests at the Timamana highlands to the east, and the coconut lands southeast of the property.

Figure 4-2 also shows the households of Brgy. Cawilan which are located inside or immediately adjacent to the MCC property, specifically SURICON's main waste rock dump to the north, and the Brgy. Siana households southwest of the property and adjacent to Tailings dam 3. Gold small-scale mining without permits is active at the waste rock dump and tailings pond areas. During the less rainy period, the number of small-scale miners is usually less than ten (10). The number can double or triple during the rainy days. Near the southeastern end of Tailings dam 3, a gold CIL plant, non-existent in 2005, operates without a permit.



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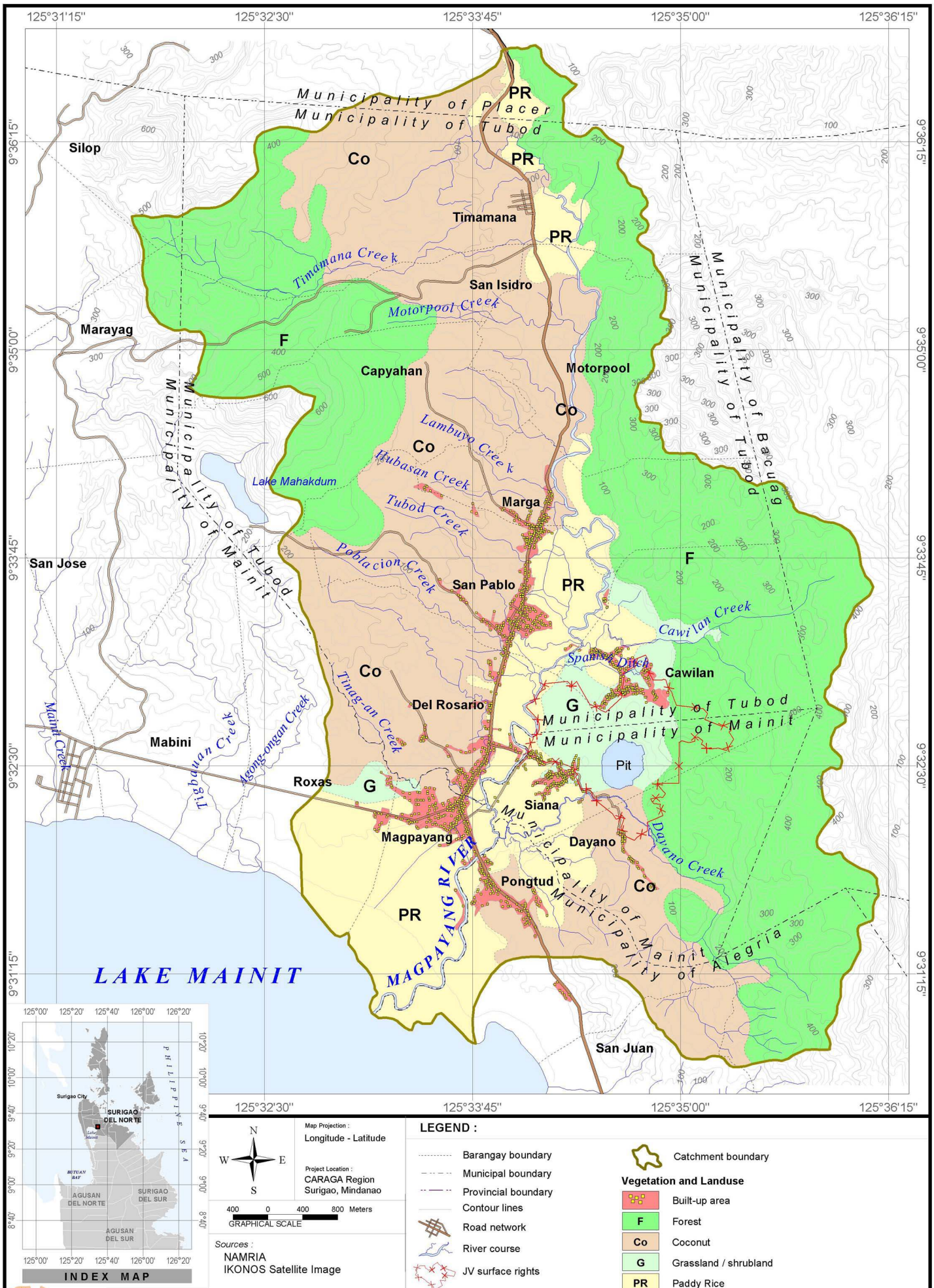
Land classification map

EIS of the Siana Gold Project

Figure No. 4-1



Land use map of the Magpayang River catchment

EIS of the Siana Gold Project

Figure No. 4-2

Photo 4-1. Materials at the waste rock dump are mined, crushed, and the heavy fines recovered in the sluice box and placed in sacks.

Photo 4-2. The gold CIL plant southeast of Tailings dam 3.

There are no protected areas or sites of ecological, cultural, historic, and recreational significance within the Project site and immediate vicinities. About 6 km downslope of the site is Lake Mainit. Though not a protected area, the lake is rated very high in the Philippine Biodiversity Conservation Priorities (Ong *et al.*, 2002). It is an important source of fisheries for the Municipalities of Mainit, Alegria, Kitcharao, and Jabongga.

Impacts

As shown in Figure 3-1, portions of the Project site fall within Brgy. Cawilan, Tubod Municipality and Brgys. Siana and Dayano of Mainit Municipality. In Tubod's 1999 Municipal Comprehensive Land Use Plan (MCLUP) and Mainit's 2001 MCLUP, the approved use of the Project site is industrial. This is consistent with the proposed re-development of the site for mining.

Tubod presently classifies the proposed access road as agricultural. About 0.8 ha of the road alignment is planted to rice. After an ECC is issued to the Project, agricultural lands within the road right of way need to be reclassified for infrastructure use.

Geology and Geomorphology

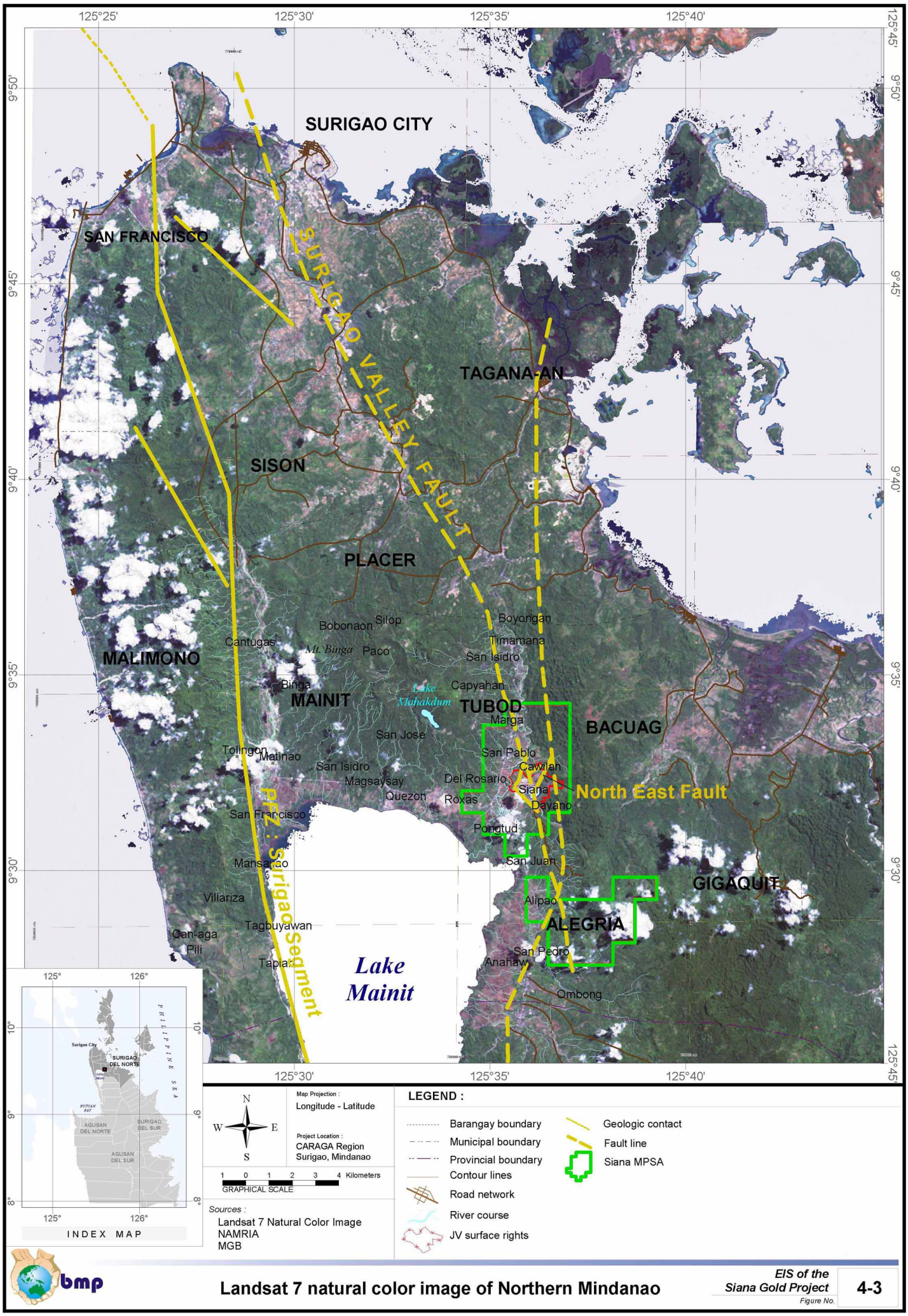
Methodology

The assessment relied largely on secondary data listed in Table 2-4. The data were complemented by field mapping, interviews, and community timelining by the residents of the impact barangays.

Baseline Conditions

Geomorphology – Figure 4-3 is the Landsat 7 Natural Color Image of Northern Mindanao. For the Project site and vicinities, there are three (3) main physiographic features:

- NNW-SSE trending predominantly andesitic ridge that parallels and is adjacent to the west coast of the Surigao Peninsula. Characterized by steep hillsides and narrow valleys, the peak is Mt. Malimono at the north with an elevation of 900 masl. Geomorphologically, this is a structural landform created by massive earth movements due to plate tectonics. The Philippine Fault Zone Surigao Segment marks the eastern edge of the landform.



Landsat 7 natural color image of Northern Mindanao

EIS of the Siana Gold Project

Figure No. 4-3

- Central portion marked by clusters of volcanic peaks and conical hills, some reaching 600 masl at the north, and the Lake Mainit basin down south. The deepest portion of the lake is at 219 mbsl. Geomorpologically, this is another structural landform.

  The Paco area northwest of the Project site, with a 2-km diameter crater-like depression, resembles a large conical volcanic edifice. Three (3) other depressions are discernible, namely, one in Capayahan and two others, which are probably explosion craters previously, are Lake Mahukdam and the small lake of Brgy. Silop. Mt. Binga, a prominent peak adjacent to Brgy. Binga, is a volcanic plug with slopes covered by coconut trees. Aligned with this plug in a roughly northwest direction are Masapelid Hill and Mt. Maragon-ong.

- Eastern portion which forms the northern extremity of the East Mindanao Ridge. The ridge is marked by gentle to moderate slopes on the western peripheries abruptly interrupted on the east by numerous irregular depressions typical of limestone areas. The maximum elevation is about 1600 masl at the south.

The highlands north of the Lake Mainit catchment are separated by two (2) distinct narrow N-S trending lowlands of the Mayag River valley to the west and Magpayang River valley to the east. Both are depositional landforms formed from the deposition of surface materials weathered and eroded from the limestone and andesitic ridges. The most productive agricultural lands in the area, they consist of the alluvial floodplains and the transitional upland fringe. The floodplains, which are areas on one or both sides of the stream channel that are inundated by floodwaters at some time, are planted to rice. The transitional upland fringe, a portion of the upland on one or both sides of the floodplain that serves as transitional zone or edge between the floodplain and the surrounding landscape, is planted to coconuts.

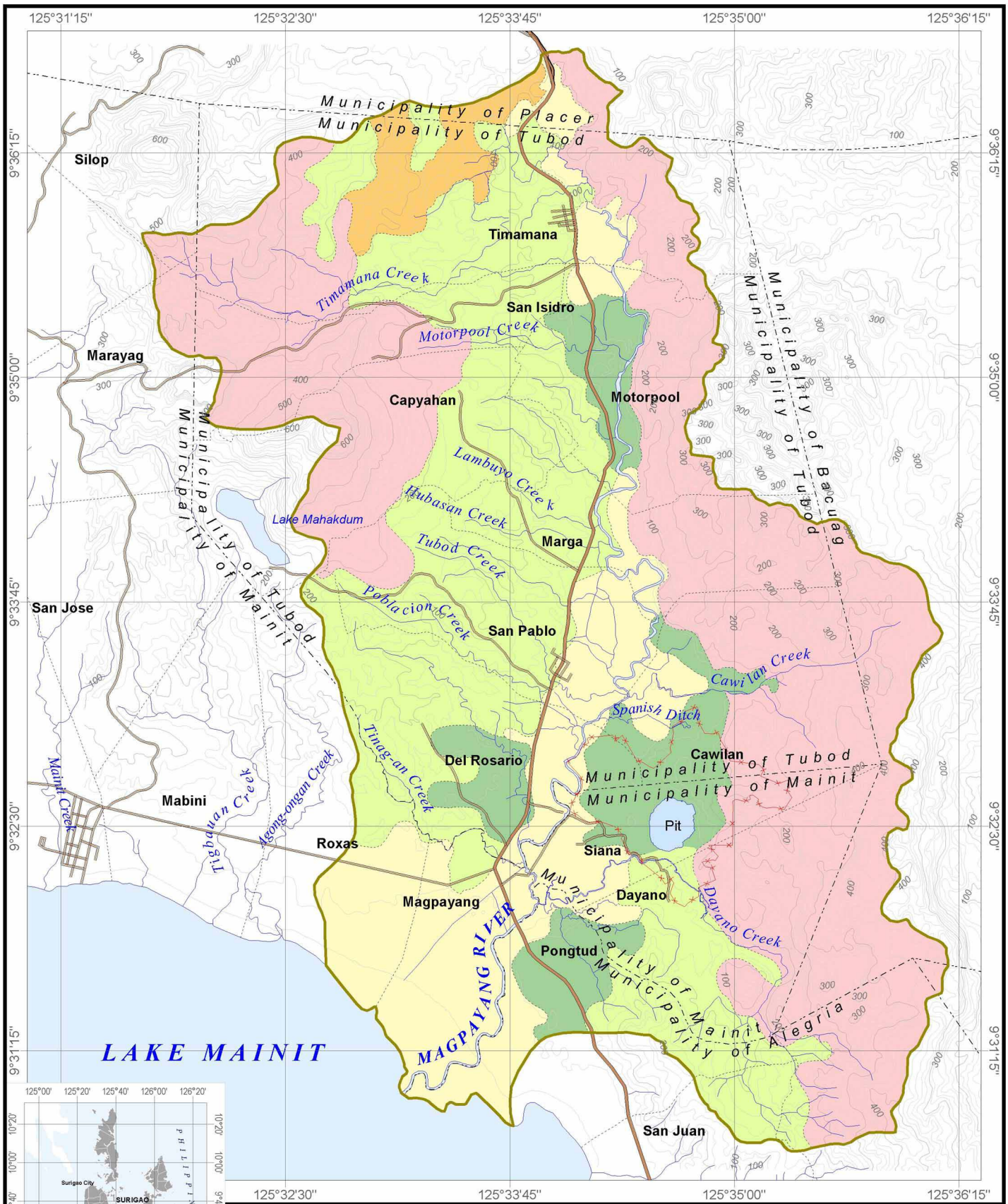
The Project site is southeast of the Magpayang River catchment. As shown in Figure 4-4, the Project site is bounded to the north and west by the low river terraces and floodplains of the Magpayang River. The western river terraces have an elevation of 40 to 45 masl and slope of 0 to 3 %. Eastward are the Timamana limestone hills with a local peak elevation of 400 masl and slopes in excess of 50 %. South of the site are the alluvial floodplains of the Magpayang River and Dayano Creek. Magpayang River and Dayano Creek are both meandering streams. Mining One (2007) believes that, based on the drillhole results, both streams are highly likely to have once passed the TSF western embankment and proposed Pond B footprint.

The Project site, which is generally part of the transitional upland fringe, has a mean elevation of 50 masl and slopes of 8 to 18 %. The tailings elevation in the existing Tailings dam 1 varies between 43 to 45 masl, at Tailings dam 2 between 47 and 48 m, and at Tailings dam 3 between 51 and 53 m. The crest elevation of Tailings dam 1 varies from 47 to 49 masl; for Tailings dam 2, from 48 to 51 masl; and for Tailings dam 3, at roughly 55 masl. The old waste rock dumps adjacent to the open pit have elevations of 55 to 60 masl.

Figure 4-5 is the geomorphological map of the Magpayang River catchment.

Regional Geology and Stratigraphy – Figure 4-6 is the regional geology of northern Surigao. Figure 4-7 is the stratigraphy inferred by the Bureau of Mines and Geosciences (1981).

GRC's geological mapping indicates that the site is a mixed bedrock lithological package including interbedded coarse grained pebbly polymictic epiclastics, laminated algal limestones, semi-massive to karstic limestones, sandstones, siltstones, mudstones, thin coal seams, and basalts. Mining One's geotechnical investigation inferred the near surface deposits to be interbedded fluvial, alluvial and colluvial deposits overlying residual bedrock. The depth and sequence of the deposits vary considerably.



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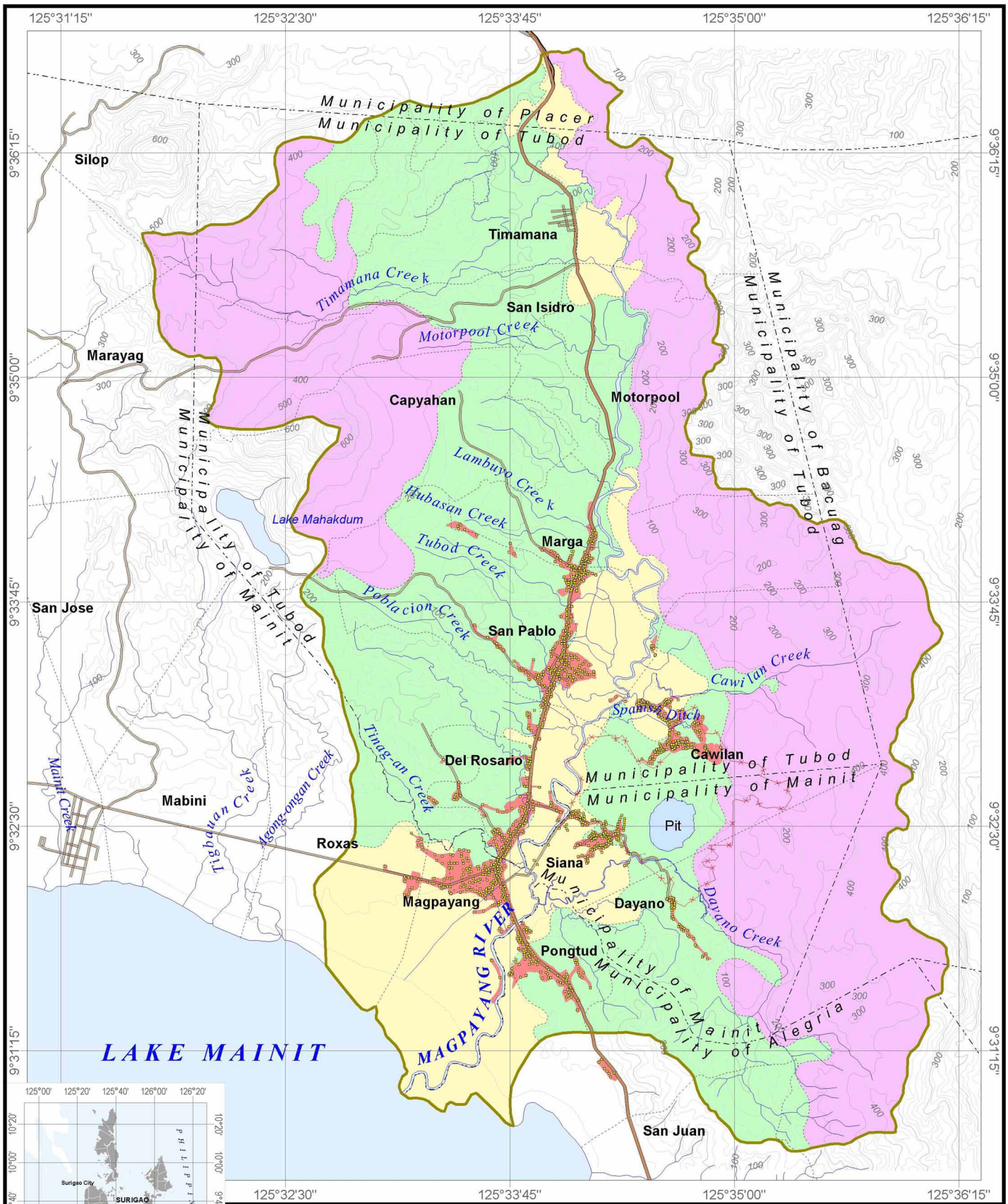
Slope map of Magpayang River catchment

EIS of the Siana Gold Project

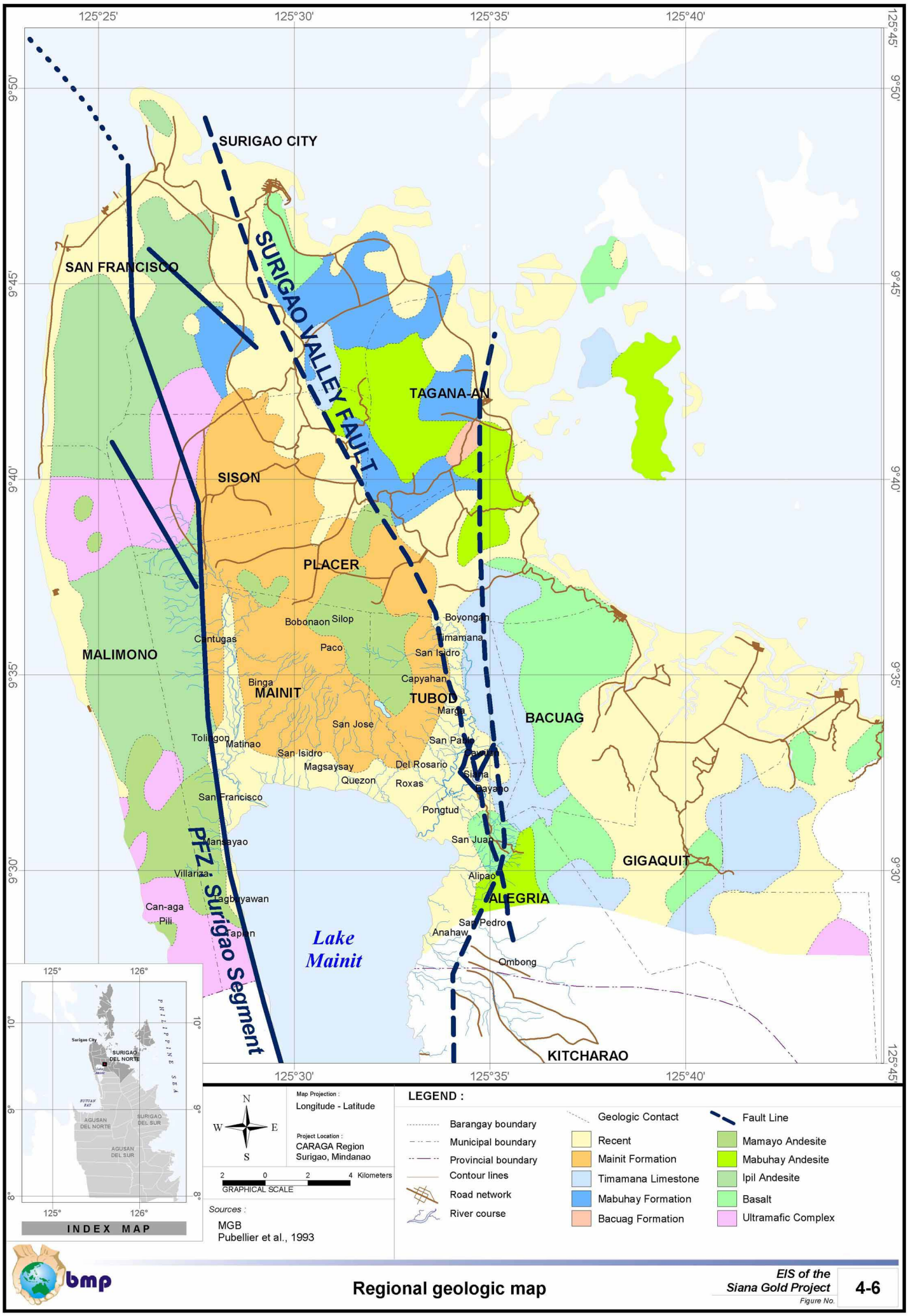
Figure No. 4-4



Geomorphological map of the Magpayang River catchment

EIS of the Siana Gold Project

Figure No. 4-5



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Regional geologic map

EIS of the Siana Gold Project

Figure No. 4-6

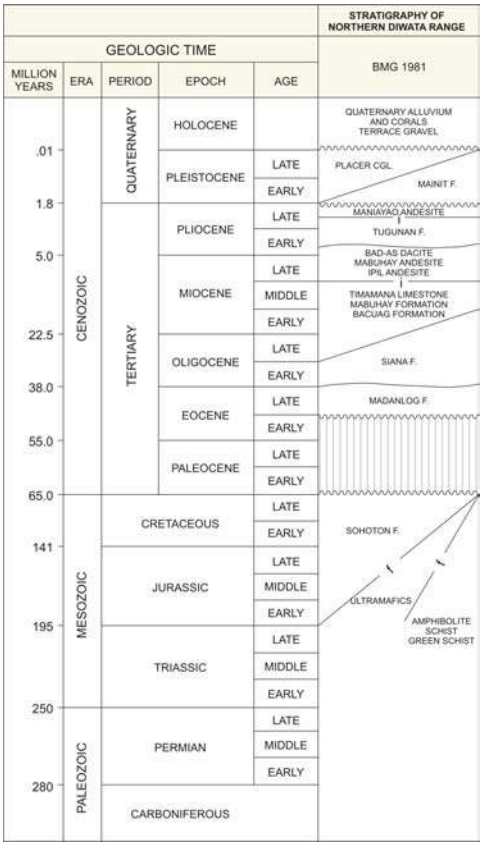


Figure 4-7. Regional stratigraphy

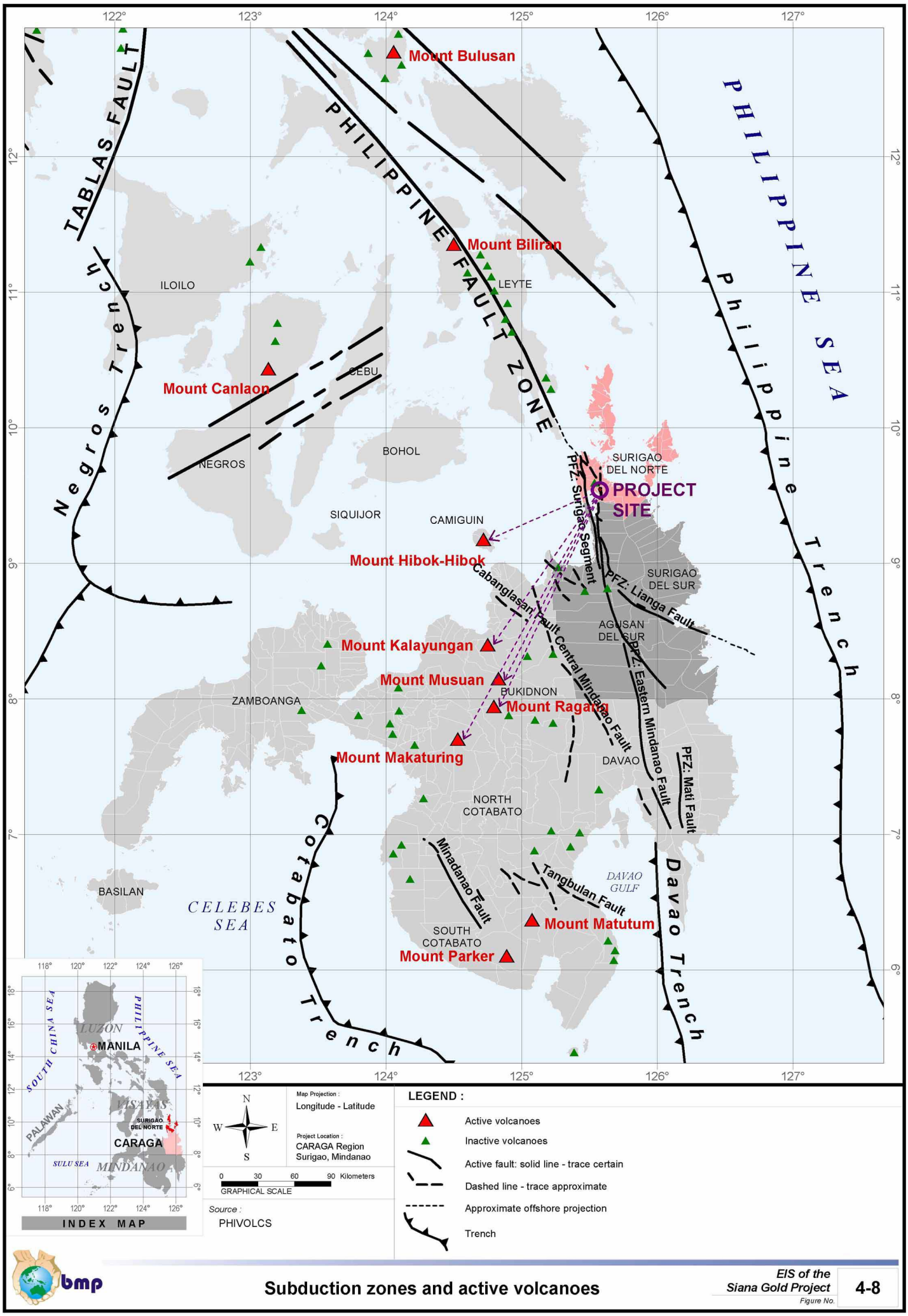
Where SURICON had its facilities, a highly variable fill material is encountered. The material ranged from moderately dense gravel with varying quantities of cobbles, sands, silts, and firm to very stiff clays; tailings; stiff to very stiff clay with sand/silt and trace cobbles (fluvial sediments); alluvial/colluvial sediments; carbonaceous muds; residual soils; and extremely weathered volcanic rock, siltstone/sandstone, and moderately weathered to slightly weathered limestone.

Structures and Geohazards – The Project site occurs in a complex tectonic region. As shown in Figure 4-8, about 25 km west of the Project site is the Philippine Fault Zone (PFZ). The PFZ is a predominantly strike-slip fault which oftentimes displays components of normal and thrust type of faulting. It is about 1600 km long, extending from the Lingayen Gulf in Western Luzon and through the offshore Pujada Peninsula in southeastern Mindanao. It has been the site of many large historical earthquakes, *i.e.*, M_s larger than 5, and more numerous moderate to small events. The 1879 Surigao earthquake with magnitude M_s of 7.4 was attributed to the fault zone (Rimando, 1994).

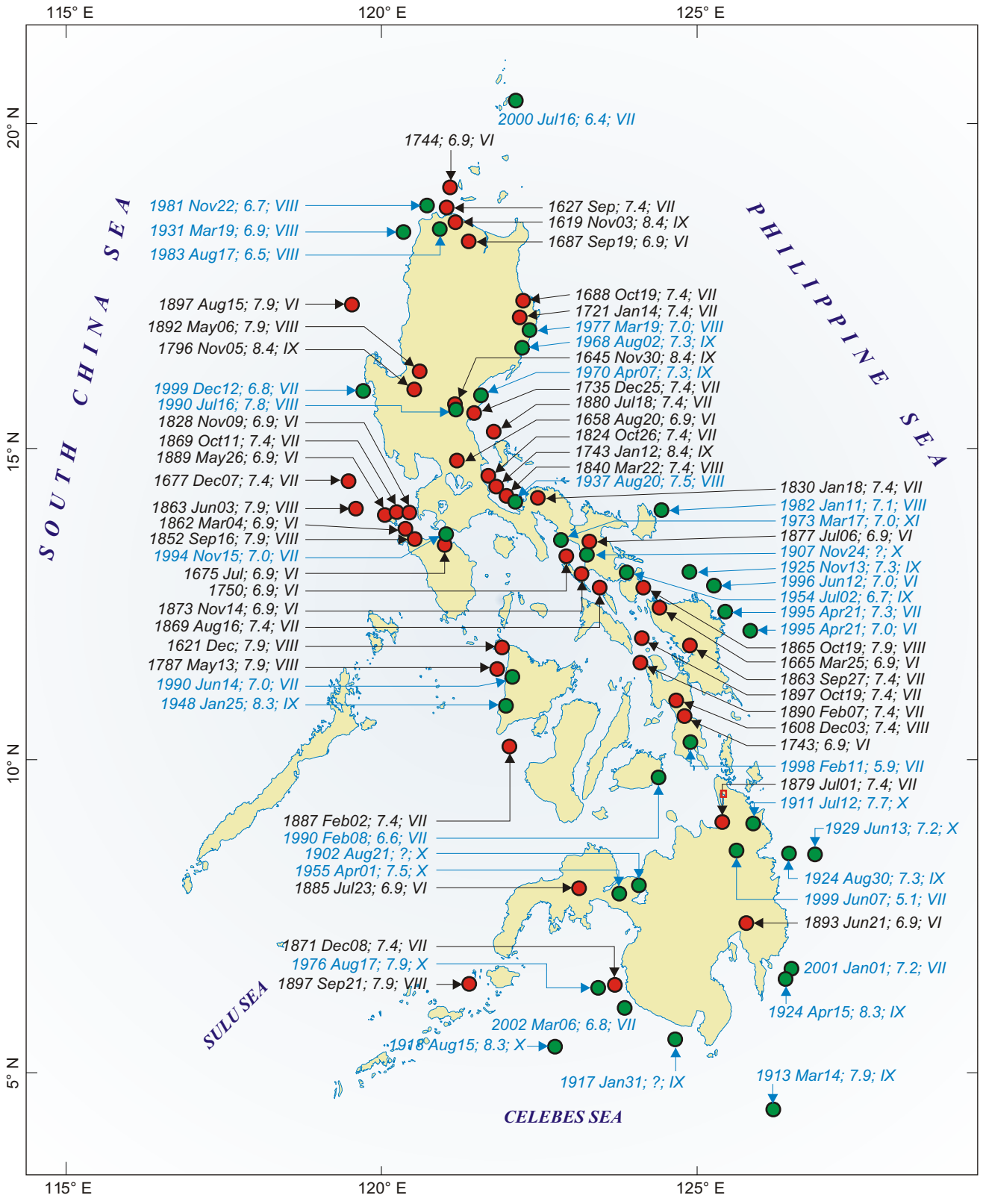
Roughly 135 km eastward of the site is the Philippine Trench where the Philippine Sea Plate is being subducted. On the far west side, about 405 km, the seafloor of the Sulu Plate subducts along the Sulu Trench near the northwest side of Zamboanga Peninsula and Sulu Archipelago. Southwest of the site, the Celebes Sea Plate subducts near the west side of Central Mindanao along the Cotabato Trench and in Davao Gulf along the Davao Trench (Punongbayan, 1994).

The major converging subduction zones framing Mindanao such as the Philippine Trench, Sulu Trench, and Cotabato Trench led to the formation of volcanic centers and complexes. Five (5) active volcanoes are within 200 km from the Project site. The most active, Mt. Hibok-Hibok in Camiguin Island, is about 103 km west of the Project site (Martinez, 1994). Considering the distance, a Mt. Hibok-Hibok eruption can bring ash fall to the Project site.

Figure 4-9 locates the epicenters of destructive earthquakes from 1608 to 2002. It also indicates the dates of occurrence, magnitude, and maximum intensity of the earthquakes. Within a 300-km distance from the Project site, the earthquake with the strongest magnitude is the earthquake of 12 July 1911 with M_s of 7.7 and epicentre 67 km SE



Subduction zones and active volcanoes



N
W E
S
100 0 100
kilometers

Map Projection:
Longitude - Latitude

Source :
PHIVOLCS 2002

LEGEND

- Historical Earthquake
- Instrumental Earthquake
- *1897 Sep21* Date of Occurrence
- *8.4* Magnitude
- *IX* Maximum Intensity
- Project site

Philippine significant earthquakes 1608 - 2002

of the site. The earthquake wrought great havoc in many parts of Mindanao. It destroyed houses and felled many big trees. It caused massive landslides and tsunami which penetrated far inland (Mangao *et al.*, 1994).

Thenhaus *et al.* (1994) developed a probabilistic ground-motion hazard model for the Philippines. Through this model, peak horizontal ground accelerations (PGA) that have a 10 % probability of being exceeded in 50 years have been estimated for rock, medium soil, and soft soil. From Figure 4-10, the estimated peak ground accelerations for northern Mindanao range from 0.25 to 0.29g for rock, from 0.40 to 0.56 for medium soil, and from 0.70 to 0.80g for soft soil.

SRC and ESS conducted a seismic hazard assessment specific to bedrocks at the Project site in 2006. They used seismicity data and geology to partition the study area into seismotectonic area source zones. Seven (7) source zones were modelled, namely, Philippine Trench mid, Philippine Trench south, Samar, Philippine Fault mid, Philippine Fault south, Negros-Cebu, and Cotabato. Within each zone, earthquakes were assumed to be distributed uniformly with depth, up to 20 km for crustal earthquakes and up to 300 km for subduction zones. The long-term level of earthquake activity was assumed to be uniform. A rate of activity was assigned to each zone based on the Gutenberg-Richter seismicity recurrence equation. SRC and ESS then used the Atkinson and Boore (2003) attenuation function to estimate the PGA recurrence and uniform probability response spectral recurrence. The PGA for an OBE at a 1:500 year return period is estimated at 0.25g; the PGA for an MDE at a 1:10,000 year return period is 0.60g.

Golder (2007) conducted a preliminary assessment of the liquefaction potential of the existing tailings and prepared process tailings sample using Fell *et al.*'s (2005) simplified model. They found that:

- Existing tailings have a moderate to high in-situ density and they will not liquefy.
- Proposed tailings are susceptible to liquefaction, with the most recently placed (surficial) tailings at greatest risk.
- Because of their high density and clay content, the foundation soils and embankment materials will not liquefy due to seismic loads.

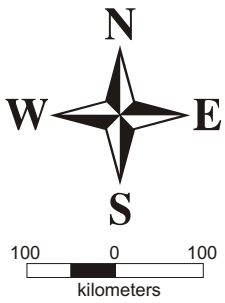
The NE corner of SURICON's open pit failed in 1989. RSG (2007) attributes this to a combination of flat west dipping structures which daylighted in the slope, in conjunction with steep dipping cross cutting structures that transect the Siana orebody. The steep structures acted as release mechanisms for the failure and most probably as conduits for groundwater. Available evidence suggests that the flat west dipping structures are present throughout the east basalt. SURICON's east wall did not fail due to the absence of release structures.

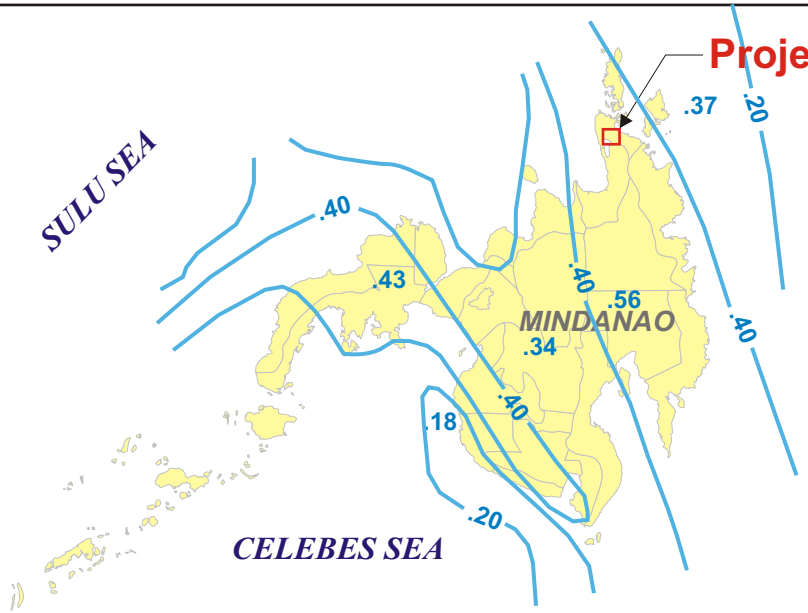
Geochemistry - Chemical analyses for heavy metals were undertaken on the waste rocks and process tailings and tailings slurry water samples through various sampling episodes. Table 4-1 summarizes the results. The individual readings are shown in Table 8-1.

Table 4-1. Chemical analyses of waste rocks and tailings

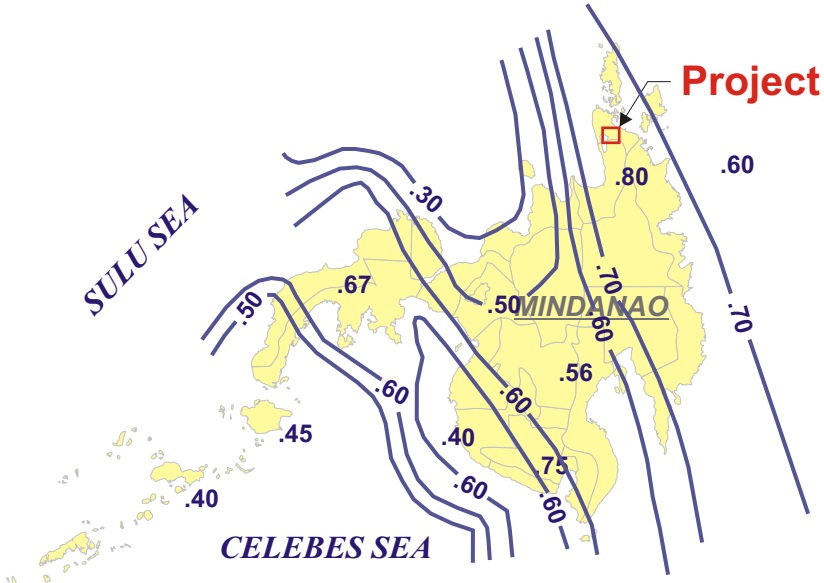
Sample	Episode	As	Cd	Cr	Cu	Hg	Pb	Zn
Waste rocks	Tetra Tech 2003	20 - 51	BDL	---	62 – 152	0.34 – 0.71	43 - 142	108 - 208
Waste rocks	GRC various	1 - 558	---	---	6 – 1249	---	2.5 – 779	10 – 1114
Tailings	Tetra Tech 2003	233 - 264	1 - 3		184 - 224	5.83 – 19.49	425 – 1525	754 - 1371
Prepared process tailings solids	GCA 2006	131	7	197	272	0.70	1126	1629
Prepared tailings slurry water	GCA 2006	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Note: All metal readings are in mg kg^{-1}.

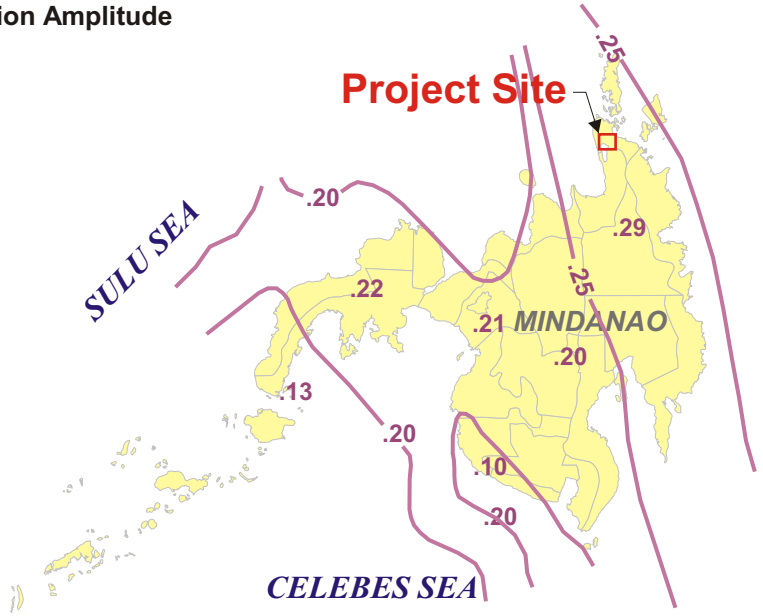




Peak Horizontal Ground Acceleration Amplitude
for Medium Soil



Peak Horizontal Acceleration Amplitude
for Soft Soil



Peak Horizontal Ground Acceleration Amplitude
for Rock

Source: Thenhaus et al., 1994

bmp

Peak horizontal ground acceleration amplitudes for Northern Mindanao

Apart from the chemical analyses, acid-base accounting of waste rock samples and laboratory prepared sample of process tailings and tailings slurry water was conducted.

The waste rock tests found that for the major waste rocks, *i.e.*, Domains 100 and 400, which comprise 60 %, only 13 to 15 % of the samples are PAF. For samples from Domain 600 which makes up 27 % of the waste rocks for extraction, 38 % of the samples are PAF. The rest of the samples which represent 24 % of the estimated waste rocks is NAF (BMP, 2007).

The prepared sample of process tailings was found to be NAF due to the strongly calcareous materials (GCA, 2006).

Impacts

Figure 4-11 is a perspective view of the proposed Project facilities.

From the standpoint of geology and geomorphology, the potential impacts of or to the Project are:

1. Ground shaking and liquefaction of tailings from strong earthquakes can cause failure of proposed Project structures, especially the TSF and waste rock dumps. The impacts of a structural failure are physical impacts like burial, inundation, or habitat smothering and chemical impacts due to heavy metals in the tailings.

   The TSFs are paddock-style facilities; hence, the impact areas of a dam breach or tailings release depend on the location of the breach. The potential impact areas may be the open pit, Brgy. Siana, Dayano Creek, Magpayang River, process plant and mine service areas, or Brgy. Cawilan. The potential impact areas of a waste rock dump failure are the open pit, process plant and mine service areas, or Brgy. Cawilan.

2. The location of the TSF, especially the western side, and Pond B embankment on highly permeable soil foundation may lead to uncontrolled underseepage and erosion.

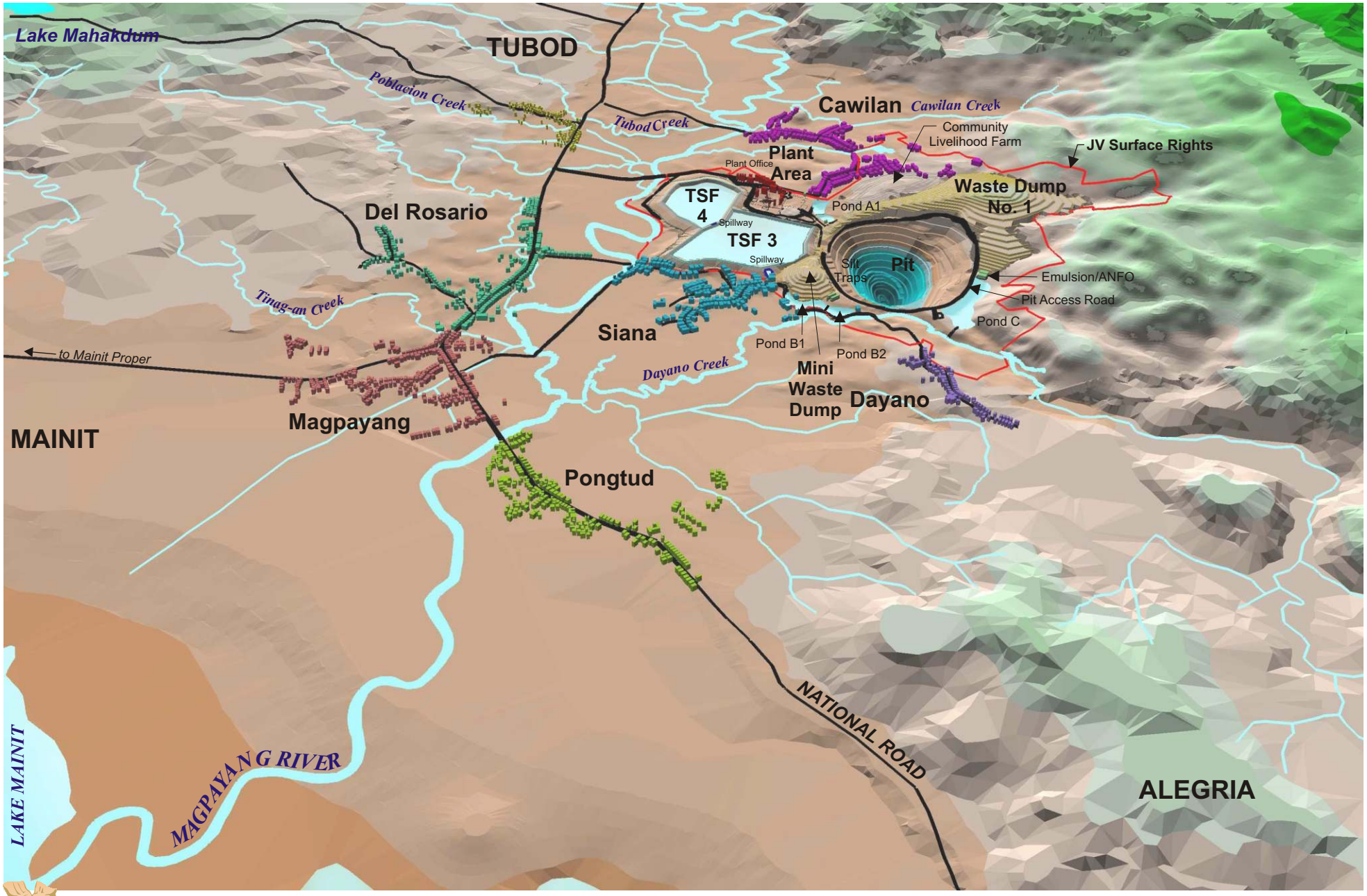
3. Open pit mining can cause ground instability or failure of the pit wall. The impacts will be confined to Project personnel, structures, and equipment.

4. Underground mine development or operation can cause a pit wall failure or ground subsidence.

GRC will prevent or manage the impacts through the following:

- Geotechnical site investigation
- Engineering design prior to earthworks
- Implementation of design with strict quality control
- Regular stability inspection and monitoring
- Observance of a buffer or exclusion zone from the edge of the TSF embankment and waste rock dump
- Staggered placement of clay-rich materials at the waste rock dump
- Emergency planning and testing.

The TSF and waste rock dumps are major risk sources. To reduce the risks, the MGB prescribes certain policy guidelines and standards for mine wastes and mill tailings management which are contained in DENR Memorandum Order (MO) No. 99-32. Table 4-2 summarizes the Project's compliance with the MO.



Perspective view of the Proposed Project Facilities

Table 4-2. Project compliance with DENR MO No. 99-32

DENR MO Section	Guidelines on Site Selection and Design	Project Compliance
Waste rock dump		
Sec. 8 a	Waste storage shall be located far from old growth or virgin forest, proclaimed watershed forest reserves, wilderness areas, mangrove forests, national parks, greenbelts, game refuge, bird sanctuaries and areas proclaimed as marine reserves/marine parks, and tourist zones	There are no old-growth or virgin forests or any of the sensitive sites listed in Sec. 8a in the vicinity of the Project site.
8 b	Waste storage shall be located away from water bodies	The nearest distance from the main waste rock dump and secondary dump to Dayano Creek is roughly 900 m and 150 m, respectively.
8 c	Waste storage close to the coast shall be above the maximum storm surge level and a buffer of not less than 500 m from the mean low tide level along the coast.	Not applicable to the Project.
8 d	Waste storage shall consider the expected life of the mine, geology, hydrology, geochemistry, ecology, land use, topography, possible mineralization of site area and climate.	All enumerated factors were considered in the dump design.
8 e	Mine waste storage as much as possible shall accommodate mine waste produced from the entire life of mine operation	The total tonnes of waste rocks for removal from the open pit are estimated at 8.7 million BCM. About 1 million tonnes BCM of waste rocks will be used to build the TSF leaving a waste surplus of 7.7 million BCM. GRC proposes two waste rock dumps with individual capacities of 7.9 million BCM and 0.8 million BCM.
8 f	Mine waste storage shall not be located on areas that might promote the generation of ARD.	The waste storage site is confirmed not to generate ARD.
8 g	Mine waste storage shall be designed and constructed above the maximum flood level.	The storage site is not flood-prone.
8 h	In-pit dumping of mine waste shall be used whenever applicable.	The option of in-pit dumping is not available to the Project.
Sec. 9 a	The expected life of the mine, geology, local and regional seismicities, hydrology, geochemistry, ecology, land use, topography, climate, area of land available, vegetation of the site shall be considered in the design of waste dumps.	The Project has considered all the factors in the design.
9 b	Drainage system shall be constructed to handle heavy rainfall event. A 50-year flood shall be used for minimum design purposes.	Figure 3-14 is the Project's stormwater drainage design. The details of the drainage channel and culvert sizes to accommodate the design flood at a minimum return period of 50 years will be estimated during the detailed design and engineering for the Project.
9 c	ARD potential of mine wastes for impoundment shall be established.	GRC commissioned an acid-base accounting of waste rock samples obtained from the

DENR MO Section	Guidelines on Site Selection and Design	Project Compliance
		waste wall of the Siana deposit. The results are discussed on page 3-16 of the EIS.
Tailings storage facility		
Sec. 13 a	TSFs shall be located far from declared watershed areas and free from spillage, slides and washing away of tailings by surface runoff during heavy rains into adjacent areas and natural drainage systems.	The Project has complied with this.
13 b	Impoundment in valleys shall be designed and constructed above the maximum flood level.	The TSF is a paddock-style of embankment.
13 c	Placement of tailings solids into mined-out areas, whether on the surface or underground shall be carried out whenever this is both proven safe and practicable.	This is not applicable to the Project.
Sec. 15 a	Impoundment close to the coast shall be above the maximum storm surge level.	This is not applicable to the Project.
15 b	Seismic consideration in the design of impoundment shall not be less than 0.15 and 0.25 g under an operation basis earthquake (OBE) and maximum credible earthquake (MCE), respectively.	As discussed on pages 3-16 and 4-5 of the EIS, the peak ground acceleration adopted by the Project designers for the OBE and MCE are 0.25g and 0.60g, respectively.
15 c	Ground/impoundment foundation shall be thoroughly analyzed to include drilling with water pressure test (WPT), rock quality designation (RQD), unconfined/uniaxial compressive strength (UCS), permeability (K), direct shear test, and rock mass rating (RMR)	As discussed on pages 3-15 and 3-16 of the EIS, foundation testworks consisted of borehole coring and test pits. For the boreholes, standard penetration tests (SPTs) and on-site geotechnical logging were undertaken. Piezometers were installed in several boreholes for groundwater measurements. For the test pits, on-site geotechnical logging and dynamic cone penetrometer tests were performed. Disturbed and undisturbed samples collected from the boreholes and test pits were subjected to laboratory tests. The tests determined moisture content, unit weight, Atterberg limits (i.e., liquid limit, plastic limit, plasticity index, linear shrinkage), particle size distribution (i.e., % gravel, % sand, % silt, % clay, % passing 0.075 mm sieve), consolidation, CU triaxial, UU triaxial, and permeability.
	Impoundments formed of earth or earth and rock materials shall be designed and constructed with a factor of safety against failure of at least 1.2 under static loading and at least 0.98 – 1.2 under maximum probable earthquake loading conditions.	The stability of selected sections of the tailings dam design under static, OBE, and MDE earthquake loads was assessed. The results are presented on pages 3-16 and 3-17 of the EIS. The predicted minimum FOSs for static conditions were 2.4 to 2.1 vs. the MO's 1.2. For MDE seismic loading, the minimum FOSs were 0.7 to 0.6 vs. MO's 0.98 to 1.2. The designer stressed that an FOS less than 1 under earthquake loading does not imply failure of the embankment. It indicates that the embankment will undergo

DENR MO Section	Guidelines on Site Selection and Design	Project Compliance
		some permanent deformation. The designer estimated a horizontal displacement of the potential failure mass of about 50 mm and vertical settlements of up to 1 m. They recommended Cone Penetrometer Testing with pore water pressure measurements (CPTu) during detailed design. A CPTu investigation of tailings was also recommended for better understanding of the liquefaction potential of the material.
	Materials to be used for embankment shall also be analyzed as to its gradation, Atterberg limits, Unified soil classification system (USCS), consolidation, optimum moisture content, unconfined/uniaxial compressive strength (UCS) on remolded sample, and direct shear test.	Geotechnical testworks were conducted on samples representing all lithological domains within the proposed open pit. The tests included densities, UCS, triaxial, and direct shear.
	Embankments shall be compacted to no less than 90 % of proctor density	This is one of the assumptions of the geotechnical stability analysis. Detailed design works for the TSF are ongoing.
	Filter/drain zone shall always be provided along the entire length of the embankment. Provision of key (width = 0.25H), buttress, grout curtain, apron, etc. shall be implemented whenever necessary.	Filters and keys are provided in the current TSF design. Detailed design works for the TSF are ongoing.

During closure, the TSF and waste rock dumps will be vulnerable to slope failure and wind- and rainfall-driven erosion. The FMRDP will implement slope, surface, and drainage modifications to suit minimum factors of safety (FoSs) and design rainfall at closure, drying of tailings pond, and consistent with the post-mining land use, deep ripping of hardstands and recontouring of surfaces and slopes to blend structures with the natural background.

Pedology

Methodology

Secondary information on soil of the project area was gathered from the 1984 Soil map of Surigao del Norte Province. The 2005 colored Ikonos imagery of the project area was used to observe the geomorphological features/processes and land cover and to determine the representative soil observation sites. Two (2) broad soil groups were apparent: soils of the alluvial plain and upland soils. Seven (7) auger borings, broken down into four (4) bores for the alluvial plain and three (3) for the upland soils, were conducted from 15 to 17 January 2005 to characterize the soil profiles using the FAO guidelines for soil description and the Maunsell soil color chart. Slopes in the observation sites were determined using the abney hand level. Disturbed soil samples were collected for physico-chemical analyses at the soils laboratory of the BSWM. The auger boring observations are shown in Table 8-2. The observations of 2005 remain valid to the present time.

Baseline Conditions

Soil Types – Table 8-3 presents the results of the physico-chemical analyses. The inferred soil map is Figure 4-12.

The soils in the Project area are classified into alluvial and upland soil or soil which evolved from igneous rocks and limestone.

The soil of the alluvial plain is clay loam to silty clay loam over clay, deep, and generally poorly drained. It is strongly to moderately acidic with medium to high organic matter. Phosphorus (P), potassium (K), cation exchange capacity (CEC), and base saturation percentage are all high. Cu is very high and Mn is low to medium. Overall, the soil has high fertility.

The soil in the upland that developed from igneous rocks is clayey, deep, and well drained. It is very strongly acidic with medium content of organic matter. P is low, K is high, CEC is high, and base saturation percentage ranges from low to medium. Cu is very low and Mn is from low to medium. Generally, the soil has medium fertility.

The upland soil that developed from limestone is loam over clay, deep, and well drained. It is strongly acidic with medium content of organic matter. P, K, CEC, and base saturation percentage are high. Cu and Mn are low and medium, respectively. Overall, the fertility of the soil is medium.

Soil Suitability - A qualitative suitability classification of selected forest tree species, fruit bearing trees, and agricultural crops was made by comparing the plant's environmental requirements with the physico-chemical properties of the different soils. The plant's requirements are listed in Table 8-4.

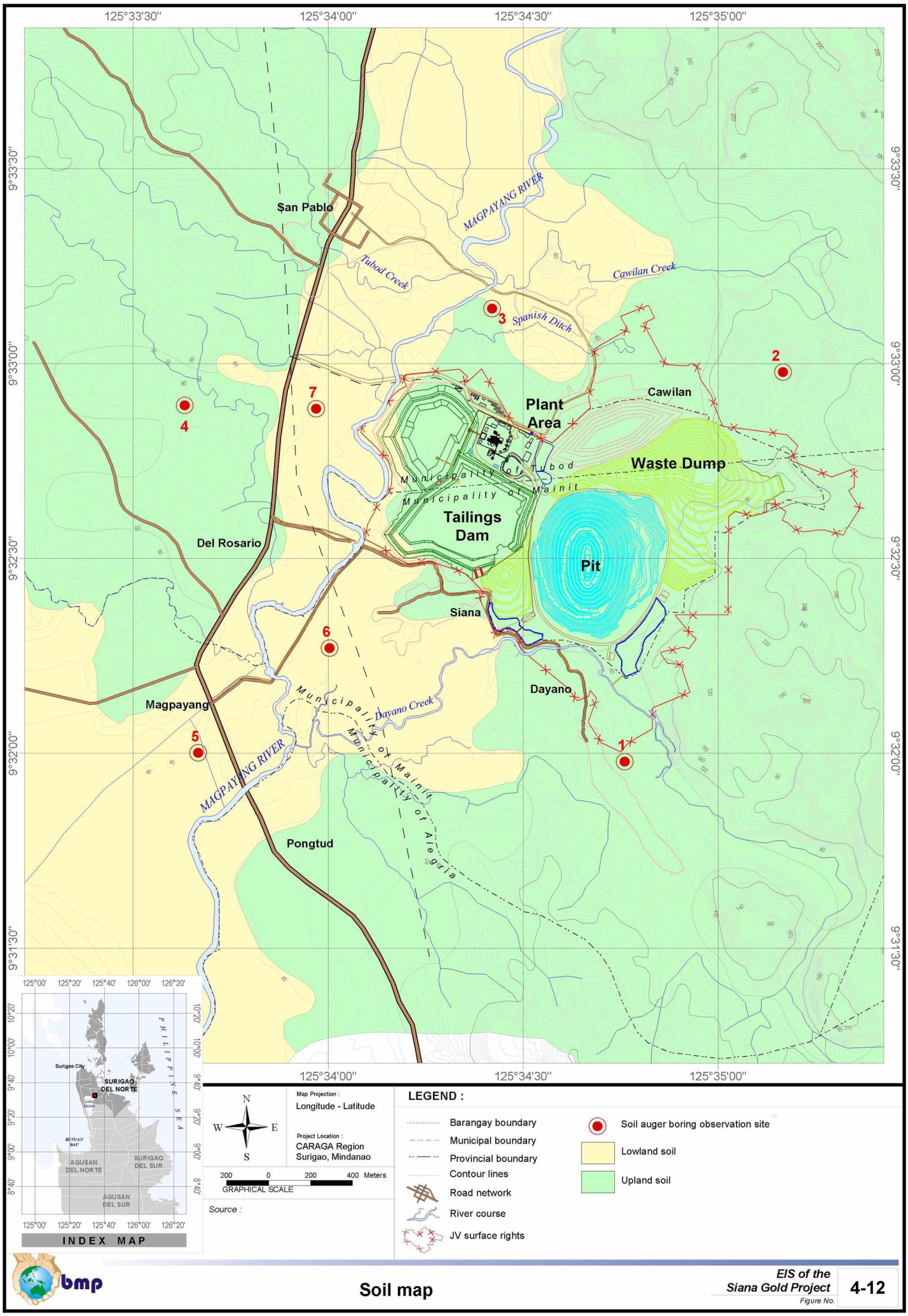
From Table 8-5, the selected forest tree species of Agoho and Mahogany and fruit bearing trees such as lanzones and rambutan are suitable in soils with slopes ranging from 8 to less than 30 %. Acidity and low P and Zn content are the limitations.

The forest tree species and Vetiver are suitable in the limestone area with more than 50 % slopes. All fruit-bearing trees considered are not suitable due to the steep slopes. Upland annual crops such as ginger, gabi, and arrowroot are suitable in the upland with 8 to 18 % slopes.

Paddy rice is suitable in the alluvial plain, while forest tree species, fruit bearing trees, and upland annual crops are not suitable due to the poor drainage condition. Where drainage is possible, corn and monggo can suitably be planted in the rice areas to serve as cash crop and for soil productivity improvement.

Photo 4-3. The unproductive coconut grove in Brgy. San Pedro, Tubod.

Photo 4-4. Coconut intercropped with rainfed paddy rice in Brgy. Cawilan, Tubod.



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Soil map

EIS of the Siana Gold Project

Figure No. 4-12

Photo 4-5. Irrigated paddy rice on the alluvial plain of Brgy. Magpayang, Mainit.

Photo 4-6. The dense limestone forest of karst landscape east of the open pit.

Agricultural Livelihood - The Magpayang River catchment is mainly agricultural, except for the upland to the east which is predominantly a limestone forest. The usable portion of the upland including the transitional fringe is devoted to coconut; the alluvial plain is planted to paddy rice.

Photo 4-7. Abundance of Golden Kuhol in paddy rice in Brgy. Magpayang, Mainit.

Rice production in the alluvial plain can be sustained with appropriate fertilization, proper cultural practices, and pest and disease control through the Integrated Pest Management (IPM) approach. Golden Kuhol is common in the paddy fields. This pest can be controlled through biological means, *i.e.*, hand picking, as feed for ducks or use of organic-based pesticides like "Botong" (beach type plant species). Monggo can be broadcast in the paddies just after harvest for additional income and nutrition of the household members. Monggo biomass can be incorporated into the soil as green manure for paddy soil improvement.

Coconut is the dominant landuse in the transitional fringe and upland. Based on the suitability classification (Table 8-5), there is a big potential for the improvement of coconut land productivity. High-value fruit trees and upland crops can be intercropped with the coconuts. The fruit trees, which may be planted on areas with slopes up to 30 %, are Lanzones, Rambutan, Citrus, Banana, Coffee, and Cacao. Upland crops for slopes up to 18 % are Ginger, Gabi, Arrowroot, and Pineapple. Intercropping will allow increased land utilization, increased productivity, and more efficient use of farm labor. It will also increase coconut yield as a result of improved physical condition of the soil due to cultivation, improved nutrient status due to fertilizer application, and weeding of intercrops.

Soil Erosion – The current drivers of soil erosion in the Magpayang River catchment are ricefield tillage and irrigation in the alluvial plain, slash-and burn farming in the andesitic and limestone upland which is discernible from Figure 4-3, and small-scale mining in SURICON's waste rock dump and tailings. All activities involve the clearing of vegetation, breakage of soil, and soil compaction. Tillage aids in the development of hard pan – a layer of increased soil density and decreased permeability that restricts the movement of water into the subsurface (FISRWG, 2001). The consequences of the disturbances are sheet and rill as well as gully erosion, increased surface runoff, increased streambank erosion, unstable stream channels, and impaired habitat.

Photo 4-8. This sediment plume along Magpayang River immediately west of the planned TSF originates from the ricefields of Brgy. Del Rosario, Tubod.

Photo 4-9. A close-up view of the same sediment plume taken during a rainy day.

Impacts

The Project will aggravate soil erosion in the following ways:

- Stripping works for the access road and facility sites including the process plant area, mine service area, TSF embankment foundations, and open pit pushback removes the soil binding and cover provided by grass and saplings. This exposes the soil to impact, detachment, and transport by rainwater.
- Rock breaking, crushing, and grinding fragments the rock into smaller pieces, thus enhancing the erodibility.
- As the open pit progresses, slopes are added and steepened. These slopes concentrate and accelerate the velocity of runoff, thereby aggravating the scouring effect.
- The natural drainage system is also altered. Sometimes, this is blocked by muckpiles or spoils causing the runoff to erode new and wider areas.

The eroded coarse sediments are usually deposited at short distances from the source. Vulnerable from erosion are the ricefields of Brgys. Cawilan, Siana, Magpayang, and Alegria. The finer sediments are transported farther. They are expected to impact aquatic habitats including those within Lake Mainit.

Apart from the physical effects, the sediments may also be enriched in heavy metals such as Cu, Pb, and Zn.

Cu adsorbs to most soil constituents, particularly, soil organic matter, clay minerals, and metal hydroxides, more strongly than any other toxic metal except Pb. However, it has a high affinity to soluble organic ligands. The formation of these complexes may greatly increase its mobility in soil (FRTR, undated).

Pb, just like Cd and Cr^{3+}, is not mobile in the environment and remains relatively close to the point of initial deposition. Under neutral to basic soil conditions, it is strongly adsorbed on the clay fractions of the soil (USEPA, 1997).

Zn is readily adsorbed by clay carbonates or hydrous oxides. Rainfall removes Zn from soil because the Zn compounds are highly soluble. As with all cationic metals, Zn adsorption increases with pH. It forms complexes with inorganic and organic ligands (FRTR, undated).

The Project's management measures for erosion and sediment include:

- Minimization of ground clearings
- Surface runoff diversion from disturbed areas
- Recovery and use of topsoil
- Placement of spoils in designated areas away from streams and channels
- Grading and sloping of work areas and channels
- Scheduling of construction during the dryer months
- Sediment traps, settling ponds, and geotextile tubes
- Mine rehabilitation and decommissioning at the end of mine life.

Terrestrial Biology

Methodology

A total of nine (9) observation stations were established to assess the terrestrial flora and fauna (Figure 4-13). The first assessment for flora and fauna was done from 5 to 10 January 2005 which was a rainy period. A second assessment for fauna was completed on 9 to 11 May 2008, a less rainy period. No second floral assessment was undertaken in view of unchanged conditions as confirmed by a site assessment.

For trees, the point-centered quarter method of sampling was employed; for undergrowths, the line-intercept method, both as described by Mueller-Dombios and Ellenberg, 1974.

For bird sampling, a line transect survey was conducted following Bibby *et al.* (1998) and Sutherland *et al.* (2004). Whenever possible, a 1.5 to 2-km transect line was established in each station and the straight line route was maintained to minimize duplication of recorded species. Birds encountered by sight or sound on either side of the transect were recorded. Mammals and herpetological species observed during the bird survey were also noted. To augment the data from transect walks, local guides and residents were interviewed. Pictures and other visual materials to aid the identification process were made available.

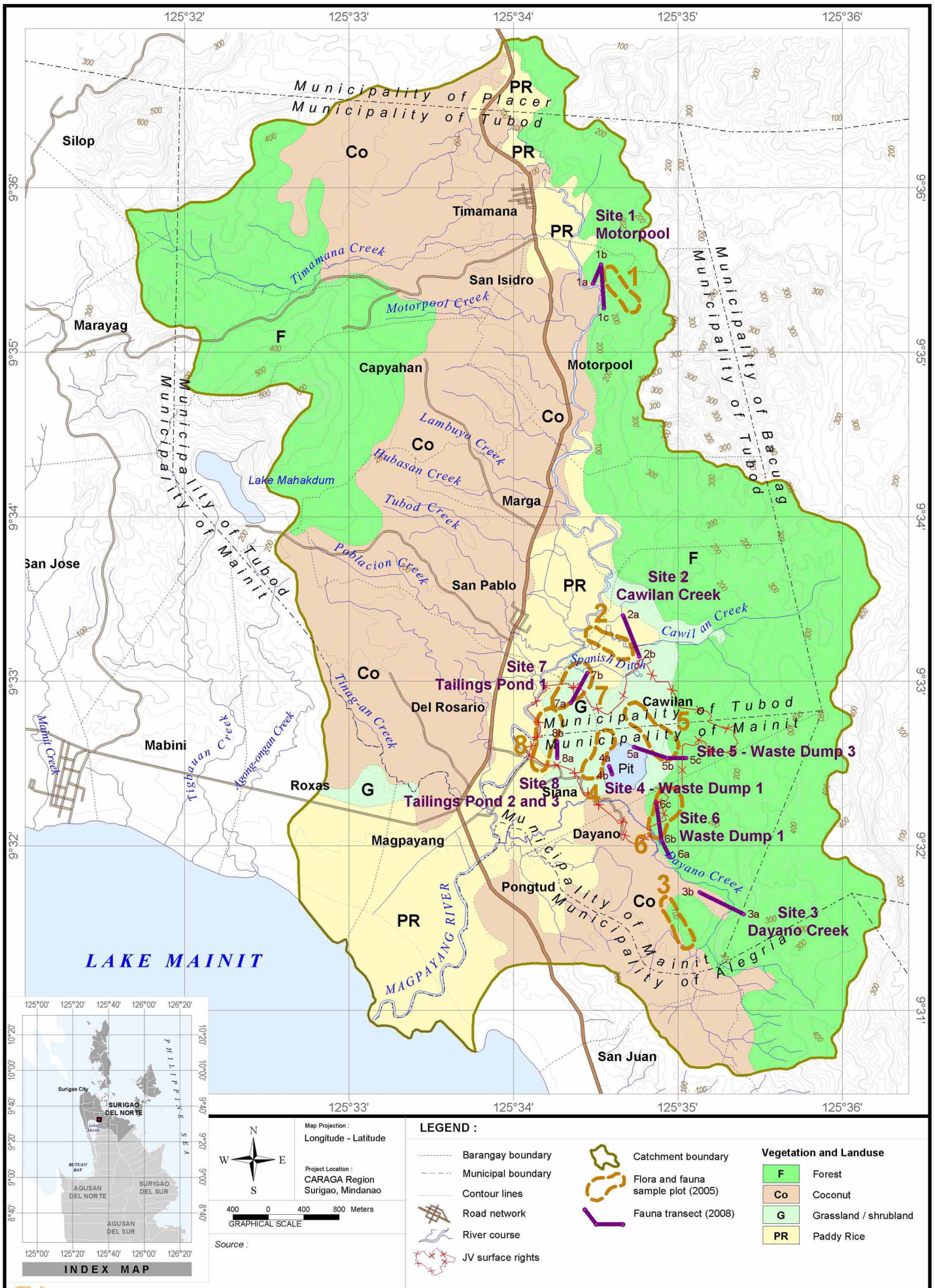
The following diversity indices were computed from the bird data obtained in 2008: Mergalef's Index for species richness, Shannon-Weiner Index for species diversity, Simpson's Index for species dominance, and Pielou's Index for evenness (Brower *et al.* 1990).

Species Richness which is the number of species represented in a sample was measured using Mergalef's Index D

D = (S-1) / ln N

where S is the number of species and N is the total number of individuals.

Species Diversity incorporates the concepts of species richness and species evenness or the relative abundance of species. Relative abundance refers to the number of individuals of a given species divided by the total number of species. The species diversity was computed using the Shannon-Weiner formula:



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Flora and fauna sampling plots and transects

$H' = - \sum pi \ln pi$

where p_i is the proportion of individuals found in the i^{th} species. The maximum likelihood estimator of p_i is n_i/N, where n_i is the observed abundances for each species i and N is the total abundance observed in the sample.

Species Dominance is the probability that two individuals chosen at random belong to the same species. The measure of species dominance used was the Simpson's Index:

$\lambda = \Sigma pi^2$

Evenness Index is a measure of how the individuals of the population are partitioned among species. The value approaches one with increasing evenness. Pielou's Evenness Index has the formula:

$J = H / \ln S$

One major limitation of the faunal surveys was the non-coverage of the breeding, non-breeding, and migration seasons. The breeding season for many species differs and at times, it occurs several times in a year. The southward migration of birds, on the other hand, is from September to November corresponding to winter in the northern hemisphere. This is followed by a northward return flight, *i.e.*, spring migration in February to April.

The survey results were complemented by secondary data listed in Table 2-4.

Baseline Conditions

Typical of the Greater Mindanao Biogeographic Zone (Heany, 1984), the Project area and vicinities were originally dominated by the Dipterocarp forest types. These also support a variety of associated wildlife populations.

To meet the material requirements for house construction, mining supports, piles, bridges, and railroad ties during the logging and mining booms, the dipterocarps and the associated wildlife habitats were decimated. The opening up of the forestlands led to the establishment of unplanned agriculture-based settlements by the migrant labor force.

Terrestrial Flora – Table 8-6 lists the forest tree species, introduced fruit trees, climbers, palms, and herbs, weeds, and grasses observed in the nine (9) sampling plots in 2005. A total of 55 forest tree species in 26 families were recorded. The most common were Antipolo and Rimas. There were twelve (12) species in seven (7) families of introduced fruit-bearing trees; four (4) species in four (4) families of climbers, and 21 species in ten (10) families of herbs, weeds, and grasses.

Terrestrial Fauna – Table 8-7 gives the faunal species, particularly, birds, mammals, and reptiles, observed in the nine (9) transects in 2005. Tables 8-8 and 8-9 list the bird species and the mammals and herpetological species recorded in 2008.

- **Birds** – In 2005, 31 species in 25 families were observed. The commonly observed species were the passerines and they include the Sunbirds *Nectarinia jugularis*, Cane Grass Warbler *Megalurus palustris*, and the Tree Sparrow *Passer montanus*. The migratory species include the Brown Shrike *Lanius cristatus*, Barn Swallow *Hirundo rustica*, and Painted Snipe *Rostratula benhalensis*. Three (3) species are listed under the Convention on International Trade in Endangered Species of Flora and Fauna (CITES) Appendix II, *i.e.*, national and international trade of such species is strictly regulated. They are the Brahminy Kite *Haliastur Indus*, Philippine Serpent Eagle *Spilornis holospilus*, and Philippine Hanging Parakeet *Loriculus philippensis*. One species, the Philippine Duck *Anas luzonica* is considered "vulnerable" and included under the International Union for Conservation of Nature and Natural Resources RED List (IUCN, 2007). As defined by the Protected Areas and Wildlife Bureau (PAWB), "vulnerable" refers to a taxon that is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium-term.

  In 2008, a total of 83 species of birds, of which, 15 are from interviews, five (5) are migrants, 20 are country endemics or near-endemics, and 43 are residents, were recorded. The increase in species over the 2005

observation is most likely due to the less rainy period that prevailed during the 2008 sampling. Only 13 of the 31 species identified in 2005 were observed during the 2008 transects.

Three (3) species were identified as "vulnerable" under the IUCN Red List. These are the Philippine Duck *Anas luzonica*, Philippine Eagle-Owl *Bubo philippensis*, and Visayan Flowerpecker *Dicaeum haematostictum*. Except for the *B. philippensis* which was recorded from interviews, the rest were observed first-hand during the transects. Additionally, seven (7) birds were listed under the CITES Appendix II. These are the Brahminy Kite *Haliastur Indus*, Guaiabero *Bolbopsittacus lunulatus*, Colasisi *Loriculus philippensis*, Philippine Eage-Owl *Bubo philippensis*, Mindanao Tarictice *Penelopides affinis*, Writhed Hornbill *Aceros leucocephalus*, and Rufous Hornbill *Buceros hydrocorax*.

The endemic *A. luzonica* was reportedly found in most of the wetland habitats within the Siana property. During the survey, a small flock was observed swimming in the flooded open pit; another was flying low over Station 5 in the Waste dump 3 area. Security guards manning the tower overlooking the pit reported more than a hundred *A. luzonica* visiting the pit at certain times of the year. The guides described the breeding behavior of the ducks which is not yet fully known to science. They reported that they occasionally flush out adult ducks from the tall grasses and reeds in the hills, leaving the ducklings scurrying for cover. The ducks lay their eggs, which number from 12 to 14, inside tall grasses or reeds in the hilly areas surrounding the open pit. Local people gathered the eggs that are all white and are as large as the eggs of domestic ducks for food. It is surmised that after the eggs hatch, the ducklings are allowed to grow into almost adult size within the waterlogged reed and grassland areas. Fully grown, they are brought by the parent ducks to the large body of water. This corresponds with the popular observation that no ducklings accompany adult ducks when foraging in ponds. Ducks feed on fish, shrimps, insects, rice, and young vegetation. Their population undergoes a rapid and continuing decline due to extensive overhunting and widespread conversion of wildlife habitat.

The Visayan Flowerpecker *D.haematostictum* is found in a variety of habitats in the lowlands and hills generally below 1,000 masl. This includes primary and secondary forests, heavily degraded forests, scrubby habitats, and even gardens where it frequents fruiting or flowering trees. The local guides frequently see the birds feeding on the nectar of flowering fruit trees and shrubs cultivated near houses. A guide even mentioned grabbing a bird at night by blinding it with bright light.

Another threatened species that is reportedly hunted in the area is the Philippine Eagle-Owl *Bubo philippensis*. The species is locally persecuted because it is considered an omen of death due to the eerie call it makes. It is found in disturbed, selectively logged and secondary forest and even coconut plantations with patches of thick secondary growth.

The most abundant species was the Yellow-vented Bulbul *Pycnonotus goiavier* followed by Glossy Swiftlet *Collocalia esculenta,* Island Swiftlet *Aerodramus vanikorensis*, and Chestnut Munia *Lonchura malacca*. The most widely distributed species were the Yellow-vented Bulbul *Pycnonotus goiavier*, Glossy Swiftlet *Collocalia esculenta*, and Chestnut Munia *Lonchura Malacca*. Considering the heterogeneous habitat characteristics of each observation site and the short distances between sites, it is likely that by lengthening the survey period, most of the recorded species will be found in all of the sites.

Majority of the species recorded during the survey were edge specialists, *i.e.*, those that thrive best in disturbed forests and mixed habitats. However, species like the Mindanao Tarictic *Penelopides affinis* are cavity-nesters which require good forest and large-diameter trees in order to breed successfully. It is significant that these birds were recorded in good numbers in the limestone forest. From interviews with the local people, the *P. affinis* comes to feed in the lowlands and even near houses at the foot of the hills. This can be explained by their diet which is predominantly frugivorous but also includes insects, frogs, and even small rats which are abundant in agricultural habitats. However, the birds still require healthy forests as cover from predators, as secure breeding sites, and as sources of fruits. Interestingly, the more charismatic hornbills such as Rufous Hornbill *Buceros hydrocorax* and Writhed Hornbill *Aceros leucocephalus*, which have the same feeding requirements as the *P.*

affinis, can no longer be found in the area. This may be due to hunting and the absence of undisturbed nesting sites.

Table 4-3 presents the computed bird species diversity indices for each of the sample sites and for all sites. Site 1 (Mototrpool) is the most rich and diverse of all the sites followed by site 8 (old Tailings Ponds 2 and 3), site 7 (old Tailings Pond 1) and site 5 (old waste rock dump). Overall, the species diversity is high (Brower *et al.* 1990) at H′ = 3.64. The evenness index is above average at J = 0.86. Evenness index values range from 0 to 1 with populations having an even distribution of individuals among species getting a value equal to one. There are no dominant species in the population as shown by the very low overall Simpson's Index of λ=0.04.

Table 4-3. Bird species diversity indices in 8 sites in the Siana Gold Project in Surigao del Norte, May 2008

Index	S1	S2	S3	S4	S5	S6	S7	S8	overall
Mergalef's Index (D)	7.62	3.28	1.88	2.74	4.21	2.03	4.74	5.37	9.89
Shannon-Weiner Index (H')	3.36	2.34	1.69	2.12	2.58	1.82	2.85	3.00	3.64
Simpson's Index (λ)	0.05	0.14	0.25	0.15	0.10	0.22	0.07	0.06	0.04
Pielou's Evenness Index (J)	0.89	0.85	0.77	0.85	0.86	0.83	0.89	0.92	0.86

- **Mammals** – The 2005 assessment identified seven (7) species in six (6) families. One species, the Long-tailed Macaque *Macaca fascicularis*, is listed under CITES Appendix II. Another species, the Philippine Warty Pig *Sus philippensis*, is considered vulnerable (IUCN, 2007).

  In 2008, a total of nine (9) mammals were recorded. Of the seven species identified in 2005, only three (3) were recently noted. Of the nine (9) species, two are under the vulnerable category of threat, *i.e.*, the Philippine Brown Deer *Cervus mariannus* and Philippine Warty Pig *Sus philippensis* (*Ibid.*). Two are listed under CITES Appendix II. These are the Long-tailed Macaque *Macaca fascicularis* and the Philippine Tarsier *Tarsius syrichta.*

  An unknown species of flying fox that reportedly flew in big numbers and darkened the skies have not been seen for more than a decade already. These flying foxes are hunted by the Mamanwas living at the foot of the hills. As regards the Philippine Brown Deer *Cervus mariannus*, Mr. Felipe Bartoli, a 54 year old forester residing in Brgy. Siana, mentioned that the last time he saw deer meat in the market was in the 1980s. The last time he saw a Philippine Warty Pig *Sus philippensis* was a week before the interview when he bought several kilos of meat from a hunter. According to the local hunters, Philippine Warty Pigs still abound in Brgy. Dayano.

- **Herpetological Species** – A total of six (6) reptilian species in five (5) families were recorded in 2005. Two (2) species are listed under CITES Appendix II: the Monitor Lizard *Varanus salvator* and Reticulated Python *Python reticulates*.

  In 2008, a total of twelve (12) herpetological species were recorded. Only two (2) of the reptilian species observed in 2005 were recorded.

  The Mindanao Fanged Frog *Limnonectes magnus* is the only species considered "vulnerable" (IUCN, 2007). Four (4) species are listed under CITES Appendix II, namely, Reticulated Python *Python reticulates*, Samar Cobra *Naja samarensis*, King Cobra *Ophiophagus Hannah*, and Variable Malay Monitor Lizard *Varanus salvator*. Cobras and most snakes are indiscriminately killed on sight because they are known to be poisonous and deadly. The other species are prized by hunters for their meat which is believed to have aphrodisiac properties and for the pet trade locally and abroad.

Habitats – The current terrestrial flora and fauna assemblages within the Project site may be classified into four (4) types:

1. *Remnant agro-forest habitats* - This is represented by Stations 1 (Motorpool) and 3 (Bubudhan), as shown in Figure 4-13. The dominant tree species are Balobo *Diplodiscus paniculatus*, Antipolo *Artocarpus blancoi*, Hagimit *F. minahassae*, Rimas *A. Altilis*, and Tibig *F. nota*. Other associated species include Malugai *Pometia pinnata* and Amamali *L. aculeate*. According to local Mamanwas in the Motorpool Area, the once common species of Molave *Vitex parviflora* and Narra *Pterocarpus indicus*, both classified as premium species by the DENR, have been extirpated to supply local demand for furniture making.

   In this habitat type, the dominant avian species are the passerines represented by the species Sunbird *Nectaria jugularis,* Starlings *Aplonis panayensis*, and Wood Swallow *Artamus leucorynchus*. The associated forms include White-collared Kingfisher *Halcyon chloris*. Two species are considered migratory, namely, Barn Swallow *Hirundo sp*. and Brown shrike *Lanius cristatus*. The diurnal raptor group Falconiformis is represented by the Brahminy Kite *Haliastus indus*, a resident species of the Family Accipitridae with a wide distribution that extends as far as India and mainland Asia (Rabor, 1975) and the Serpent Eagle *Spilornis holospilus*. Native Mamanwas report the presence of Kulasisi, an indigenous psittaciform of the species *Loriculus* and the Philippine Red Jungle Fowl or Labuyo *Gallus gallus.*

   With respect to mammals, the local informants report the thriving troops of monkeys *Macaca fascicularis*, which local coconut farmers consider as pests; the Palm Civet locally called Milo *Paradoxurus sp.,* a vivirred; giant field rats *Rattus sp.,* representing the murid rodents; the Phil. Musk Shrew *Suncus occultidens*; and the Warty Pigs *Sus philippensis*. The Chiropterans or true flying mammals are represented by species belonging to *Pteropus sp.*

   Among the reptilian forms, secondary data reveal the existence of Bayawak *Varanus salvator* and Sail-fin Lizard *Hydrosaurus palustris*, a varanid and an agamid lizard, respectively, and the Reticulated Python *Python reticulatus* and the Philippine Cobra *Naja naja*. In tribal practices, the above-mentioned mammalian and herpetological species are considered a delicacy and served to supplement their protein requirements.

Photo 4-10. The Station 1 transect runs parallel to Magpayang River which is bordered by limestone karst hills to the west and agricultural fields to the east.

2. *Fully developed agricultural habitats* - This type is represented by Station 2 (Cawilan). The farming system is coconut-based. Maximization of land productivity is achieved through rice farming under coconuts where irrigation water is either rainfed or provided through pumping of water from the Cawilan River.

Photo 4-11. The Station 2 transect is in the vicinity of Cawilan Creek which supplies irrigation water to the extensive ricefields.

The tree forms associated with coconuts include Ipil-ipil *Leucaena leucocephala*, a neotropical species introduced into the Philippines by the Spaniards. This species is a good source of fuelwood.

Faunal forms are limited to those that could adjust to altered habitat conditions – the generalists. For birds, the most common species are Sunbirds, Warblers and Starlings. The mammals are mostly represented by murid rodents. The reptiles are limited to gekkonid and scincoid lizards, although Reticulated Python and the Philippine Cobra are occasionally reported.

3. *Secondary forest habitats (plant succession)* - This is represented by Stations 4 (Edge of Mine Pit) and 6 (Waste Dump No. 2).

Practically bare during the active years of mining, these sites have been left undisturbed with SURICON's termination of operations in early 1991. In a span of barely 14 years, the mechanisms of natural plant succession, as described by Whitmore (1979), have taken over. The assemblage of vegetative cover has grown past the grass stages and is now dominated by secondary tree species. Pioneer species such as Anabiong *Trema orientalis*, Batino *Alstonia macrophylal*, and Malapapaya *Polyscias nodosa* are discernible. The former is so far the only known non-leguminous tree species that has a symbiotic relationship with the bacteria *Rhizobium*. This bacterium is capable of fixing atmospheric nitrogen into usable nitrates for plant nutrition.

The associated avifauna are similarly dominated by the passerines. The cuculiforms are represented by the Philippine Coucal *Centropus viridis*. These sites are reported to be within the feeding range of the Brahminy Kite. As manifestation of its fast-tracked natural restoration, Mr. Joel Pacatang, a local resident experienced in hunting as a hobby, reported the presence of the Jungle Fowl, monkeys, and the Palm Civet in the area. Similarly, the Warty Pigs use the sites as feeding grounds and as passageways to natural waterholes.

The facility by which the sites are colonized by faunal forms is explained by their proximity to the remaining natural forests in the headwaters adjacent to and outside the MPSA area.

Photo 4-12. Station 4 was at the edge of the flooded open pit.

Photo 4-13. The Station 6 transect passes through paddy fields near Dayano Creek.

4. *Wetland habitats* - This is represented by Sampling Areas 5 (Waste Dump 2), 7 (Tailings Pond 1), and 8 (Tailings Pond 2).

   The dominant vegetative covers are those adapted to periodic waterlogged conditions, *i.e.*, members of Family Poacea, Cyperaceae and Typhaceae. Cattail *Typha latifolia* is a gregarious species that thrives up to the Northern hemisphere (Dr. Gruezo, pers. Comm.). The local people use the plant for torch making. They tie the stalks into bundles and soak them with diesel fuel. When ignited, the improvised torch can lighten footpaths and ease movement in paddy fields during moonless nights.

   The associated avifauna is dominated by wetland species, all belonging to Family Rallidae. Two species of wild ducks, namely, the Philippine Duck *Anas luzonica* and the Wandering Whistling Duck *Dendrocygna arcuata* use the wetlands as alternate sites, adjunct to their feeding and roosting sites within the flooded Siana Pit. The Painted Snipe *Rostratula benghalensis*, a migratory species was observed to be common during the survey in January 2005.

Photo 4-14. The Waste rock dump at Station 5 with its grassland or reed habitat is where the vulnerable Philippine Ducks have been observed by locals to breed.

Photo 4-15. Station 7 is a waterlogged area for most part of the year. The tall grass and reed habitat supports a population of waterbirds.

Current Stressors – Three (3) human activities threaten the extant biodiversity resources. These are:

1. *Hunting and gathering activities by the Mamanwas* – Mamanwas hunt wildlife mainly for food. Excess materials are sold to lowlanders. They also gather and sell rattan, saplings, and other minor forest products.

Interviews conducted in 2005 with Messrs. Felipe Morales and Bernabe Mayan, headmen of the ten (10)-household Mamanwa community near the Mariano Darap Elementary School in Brgy. Cawilan revealed several wildlife trapping techniques. One is the "Lit-ag" where the bait is tied to a rattan strip and held taut by a bent tree branch. When the bait is disturbed, the branch is released, and the wildlife is caught through the limbs or neck. The Labuyo, Palm Civet, and Giant Field Rats are caught by this trap. Another is the "Tugop" which is an adhesive exudate extracted from the Antipolo *Artocarpus blancoi* tree species. Spread over twigs on roosting sites of birds, the "Tugop" catches small parrots. A previously caught parakeet is usually placed on the roosting site to attract the other birds. A third type is the "Batong" which is used for wild pigs. It is a net made of abaca ropes or nylon twines usually more than 20 m long and not less than 1 m wide. It is set in strategic sites along tracks or near waterholes where the wild pigs are forcibly driven into. Cornered into the net, the wild pig is usually killed using bolos or spears. The last type is the "Lugpit" which draws its trapping mechanism from the strength of a partially split branch. The bait is placed so that the limb of the monkey or Palm Civet will pass through the slit. When the bait is disturbed, the split part closes in.

2. *Small-scale gold mining*- Both the lowlanders and Mamanwas are engaged in this activity. They operate at the tailings ponds and waste rock dumps of the Siana property. They excavate, manually crush, and sluice the materials. Gold that is recovered is sold to buyers; the processed materials are sacked and sold to small CIL plants located in Brgy. Timamana, Tubod and Brgy. Siana, Mainit adjacent to Tailings dam 3. During the interviews, the miners denied using mercury to extract the gold.

   Small-scale miners impact the wildlife when they use toxic chemicals like mercury or when they collect eggs or trap wildlife encountered near their working areas. On the other hand, small-scale mining can also have a positive contribution when it dampens the hunting and gathering propensity of the Mamanwas.

3. *Agriculture* – Lowland and upland agriculture requires vegetative clearing and human presence that restricts the movement of wildlife.

Impacts

1. Remnants of forest tree species, such as Antipolo *Artocarpos blancai*, Rimas *A. altilis*, Balobo *Diplodiscus pariculatus*, Dalunot *Pipterus arborescens*, etc. and wildlife will be affected as the demand for wood materials and other forest-based resources increases because of the relocation and community development aspects of the Siana Project.

2. The abandoned waste rock dump and tailing pond areas which are now in the process of plant adaptation and succession by Anabiong *Trema-orientales*, Anilau *Coloma serratifolia*, Bayok *Pterospermum diversifolium*, Talahib *Saccharum spontaneum* Cogon *Imperata cylindrica*, Hagonoy *Chromolaena odorata*, etc. will be affected. The loss of vegetation in these areas will restrict the movement and foraging of wildlife.

3. The wetland habitats of the Philippine Duck, i.e, the flooded pit and wetlands in the tailings ponds and waste rock dump areas, will be lost.

4. Dust, noise, vibration, and airblast from operations will drive the wildlife farther into the uplands.

The appropriate management measures are:

- Enrichment planting at the remnant agro-forest and secondary forest habitats – Augmentation planting of about 500 to 600 seedlings of Narra, Malapapaya, Mangium, and fruit trees will increase the stocking density and improve the area's productivity. The increase in vegetative cover will enhance the support systems for the maintenance of viable wildlife populations. The recolonization by wildlife is best facilitated through vegetative corridors within the Project areas that join with the adjacent natural forests.

  Narra and Malapapaya are endemic in the area. *Acacia mangium*, an exotic species, was included for mixing with the endemic species only on the open patches of the area to be enriched. Being a fast-growing species,

A. mangium will inhibit the growth of undesirable weeds and grasses. It will produce biomass and nitrogen-fixing bacteria that will complement the growth of the planted trees and enhance plant succession in the area.

- Rattan plantation – The remnant agro-forest and secondary forest habitats will be developed into rattan plantation to further improve the carrying capacity and create an alternative livelihood for the Mamanwas and lowlanders. Limuran *Calamus omatus Blume*, Ditaan *Daemonorops mollis Blanco* and Palasan *Calamus merrillii Becc* are the recommended species. The species were not part of those observed inside the sampling plots. However, their presence in the area is indicated by the Limuran fruits as well as Ditaan and Palasan poles being sold along the highway of the locality.

- Contour trenches, fiber mats, and mulches – These are appropriate for the waste dump areas and edges of the open pit which will no longer be disturbed during operations. Contour trenches are constructed at certain intervals to collect or obstruct runoff along the slope. Coconut fiber mats are placed to cover the slopes pending the full growth and cover by the pegs and mulch. The recommended peg materials are Narra, Ipil-ipil, Kahoy dalaga, Gumamela, and Alagaw. The mulches are Pakpak paniki and Damong kalabaw.

- Shrub and mulch cover and matting – This is recommended for the exposed embankments of the TSFs. The appropriate pegs (shrubs) are Alagaw, Gumamela, and Kahoy dalaga. The suggested weed and grass are Vetiver and Pakpak Paniki.

- Collaboration with the local governments in sponsoring an ordinance that will ban hunting, collection of eggs, and logging within the Project site and surrounding watershed except to meet the cultural needs of the Mamanwas.

- Information, education, and communication campaign (IEC) for the Project employees and contractors and surrounding communities on basic ecological and conservation concepts that encourage a balance between natural resource exploitation and preservation of the ecological functions of the environment. The IEC will also address the local people's negative perceptions on certain wildlife species.

- Support to the establishment of a woodlot to serve as source of fuel and lumber for the community. The inadequately stocked forest area has been designated as the area for enrichment planting using the endemic timber-producing Narra and Malapapaya. Open areas of the mining claim which will not be affected by mining operations as well as the banks of creeks and rivers are identified as plantation sites for fuel wood, *e.g.*, Giant Ipil-ipil.

THE WATER

Hydrology and Hydrogeology

Methodology

The assessment made use of secondary data listed in Table 2-4. These data were supplemented by a topographic and bathymetric survey of riverbanks and river system from the pit outflow into Dayano Creek down to the Magpayang River conducted from 20 to 26 April 2008, numerical modelling for flood peaks and mean flows and for water usage, a field mapping and interviews of water users.

Baseline Conditions

Catchments - The Project site with an area of approximately 240 ha falls within the 5,700-ha catchment of the Magpayang River. The river drains into Lake Mainit. The lake drains towards Bohol Sea.

Figures 4-2, 4-4, and 4-5 are the land use map, slope map, and geomorphological map of the Magpayang River catchment. The catchment extends as far north as Brgy. Timamana, Tubod; Brgy. Magpayang, Mainit and Brgy. Pongtud, Alegria to the south; and Brgy. Candiis, Alegria to the southeast. The easternmost part of the catchment with slopes in excess of 50 % and where the Timamana Limestone occurs is forested. Forest growth is likewise found at the equally steep northwestern andesitic portion up to the vicinity of the access road to Lake Mahakdum. The gentler slopes adjacent to the forests comprising the transitional fringe of the stream corridor are planted to coconuts. At the alluvial plains of Magpayang River are the ricefields. Along the National Highway and secondary roads that lead to the other barangays are the built-up areas for settlements, markets, eateries, government offices, churches, and variety stores.

Magpayang River and 27 other rivers and creeks drain into the Lake Mainit (Figure 4-14). The lake is the fourth largest freshwater lake in the Philippines. It has an approximate surface area of 17,100 ha (BFAR), a water volume of 18 km^3, a lakeshore circumference of around 62 km, and a total catchment of 87,100 ha (LMDA). The lake water elevation fluctuates at different times of the year. During heavy rains, the lake water level rises by as much as 1 m. During episodic storms, it rises by 2 to 3 m (Tumanda *et al.*, 2005). The Kalinawan River at the southern end drains the lake into the Bohol Sea.

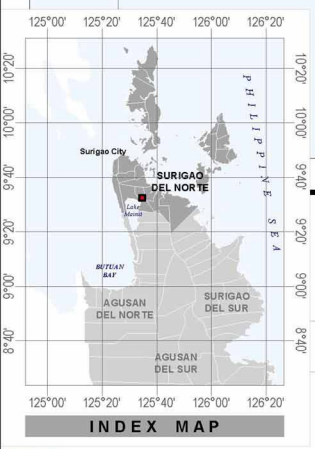
The lake is bounded on the west by the Malimono Range; on the north by Mount Maniayao and the floodplains of Mayag and Magpayang River; on the east by the lowlands and northern Diwata Range; and on the south by the Kalinawan River floodplains. During the Southwest Monsoon which is from May to October, the western part of the lake is protected by the Malimono Range. At the eastern coasts, Alegria and Magpayang are impacted by the wind-generated waves. The Northeast Monsoon winds blow without restraint in the lake from October to March. During this time, the Malimono coasts are hammered by wind-generated waves that begin at the northeastern coasts.

The lake orientation is NNW-SSE which is identical to those of the adjacent Philippine Fault Zone, Tubay Valley, and Maniayao volcanic complex. With maximum and average depths of 260 m and 122.5 m, respectively, the lake is relatively deep. The basin walls at the west are steep; the eastern, northern, and southern parts are gentler with a shelf region. The tectonic origin of the lake is apparent from the collocation of its western and eastern ends with the observed and inferred portions of the fault (Figure 4-3).

The lake straddles two provinces - Surigao del Norte and Agusan del Norte. The lakeshore municipalities include Mainit and Alegria of Surigao del Norte and Kitcharao and Jabongga of Agusan del Norte. About 31 barangays in the four (4) municipalities depend on the lake's fisheries for food and livelihood.

Photo 4-16. Fishing using a huge net at Lake Mainit.

Drainage – The major drainage of the catchment is the 15.3-km long dendritic Magpayang River. The river is a fourth-order single-thread stream that flows southeasterly from the headwaters in Brgy. Timamana, Tubod. Before reaching Brgy. Motorpool, the flow becomes southwesterly. At Brgy. Marga, the flow switches again to the southeast. Starting at Brgy. Poblacion, the river generally flows southwesterly ultimately discharging into Lake Mainit. The overall slope or relief ratio of the Magpayang River is 0.51 %.



N
W E
S

Map Projection :
Longitude - Latitude

Project Location :
CARAGA Region
Surigao, Mindanao

1 0 1 2 3 Kilometers
GRAPHICAL SCALE

Source :
NAMRIA, except bathymetry

LEGEND :

- Barangay boundary
- Municipal boundary
- Provincial boundary
- Contour lines
- Road network
- River course
- JV surface rights
- Catchment boundary

bmp

Magpayang River and Lake Mainit catchments

EIS of the Siana Gold Project

Figure No. 4-14

Table 4-4 provides some details for the tributaries of Magpayang River. The karst topography at the eastern portion of the catchment reduced the surface water flow. This is apparent in the relatively smaller drainage density of the adjacent creeks, particularly the Spanish Ditch which partially drains the northernmost portion of the Project site, or the complete absence of streams.

Table 4-4. Tributaries of Magpayang River

Tributary	Stream Order	Total Length (m)	Subcatchment Area (ha)	Overall Slope	Drainage Density ($m\ ha^{-1}$)
Unnamed Creek 1	2	3910	420	2.5 %	9.4
Timamana Creek	2	5660	600	7.2	9.5
Motorpool Creek	2	2655	285	3.7	9.3
Unnamed Creek 2	1	1380	75	4.8	18.6
Unnamed Creek 3	2	2010	190	4.5	10.6
Lambuyo Creek	1	1175	55	5.2	20.6
Hubasan Creek	1	1755	110	5.2	15.7
Unnamed Creek 4	2	2825	155	2.8	18.3
Tubod Creek	1	3515	210	3.1	16.9
Poblacion Creek	2	3555	205	3.6	17.2
Unnamed Creek 5	2	4555	230	2.1	19.8
Tinag-an Creek	2	3295	165	1.4	20.2
Unnamed Creek 6	1	725	35	5.7	20.7
Unnamed Creek 7	1	790	35	2.1	22.6
Cawilan Creek	2	3700	540	7.3	6.8
Spanish Ditch	1	1200	270	5.7	4.4
Dayano Creek	4	7245	915	3.3	7.9

Notes:

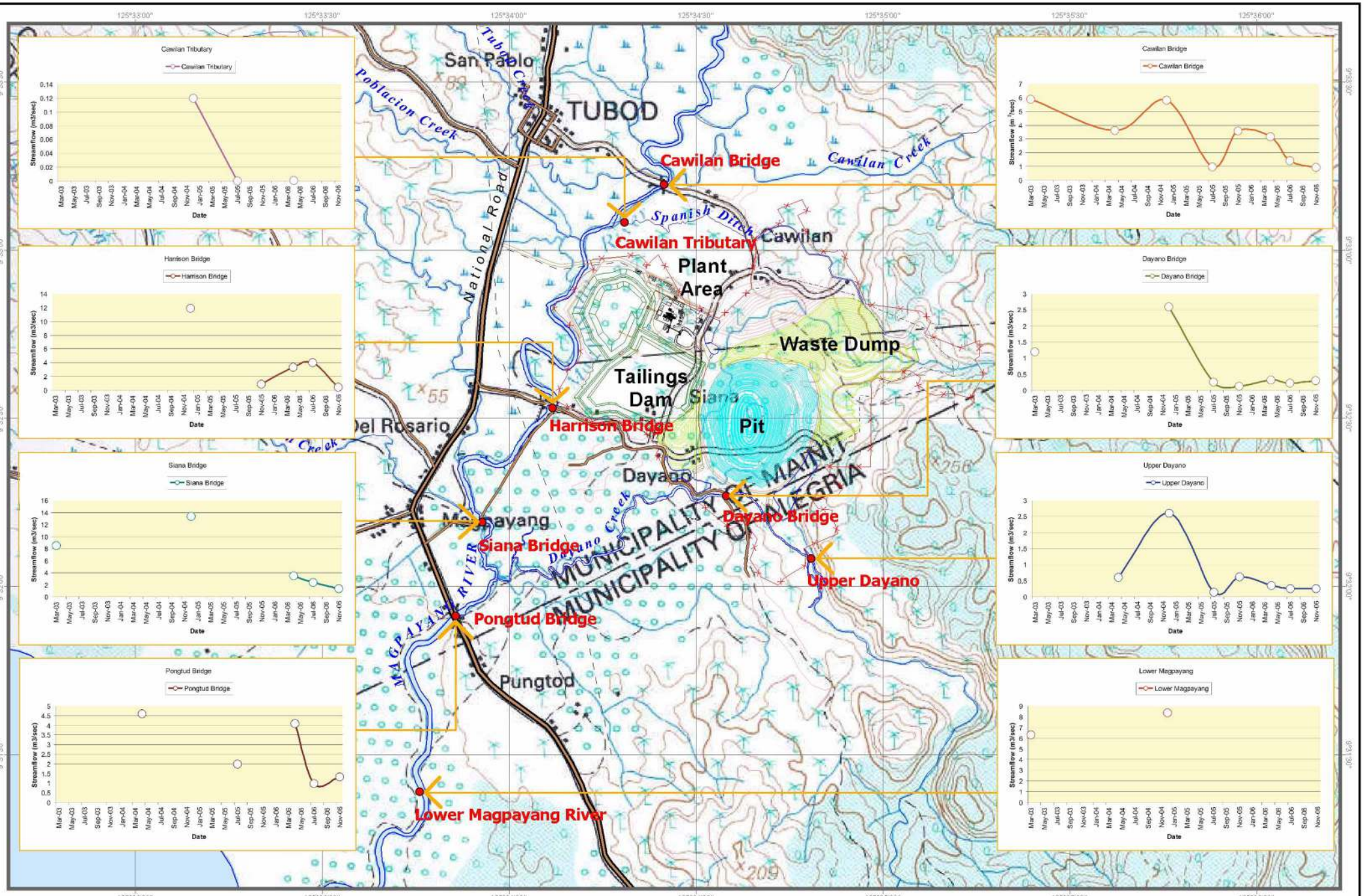
1. Stream ordering follows the Strahler System.
2. The overall slope is a weighted average using five sections along the channel.
3. Drainage density is total stream length divided by the subcatchment area.

From Figure 4-1, the Spanish Ditch to the north, Magpayang River to the west, and the Dayano Creek to the south drain the property.

MWES established five (5) streamflow monitoring stations along Magpayang River, two (2) stations along Dayano Creek, and one (1) station along the Spanish Ditch immediately upslope of Magpayang River. Streamflow was estimated from the measurement of water height (which corresponded to a water cross-section area since the channel cross-section has been pre-determined) and flow velocity using an impellor-type velocity meter. MWES' accumulated streamflow estimates are graphed in Figure 4-15. Along both Magpayang River and Dayano Creek, the lower flow measurements downslope reflect the diversion of river water into the irrigation canals.

The maximum flow estimate recorded along Magpayang River was more than 12 $m^3\ s^{-1}$ recorded at Siana Bridge in November 2004. Along Dayano Creek and the Spanish Ditch, the maximum flow was more than 2.5 $m^3\ s^{-1}$ and 0.12 $m^3\ s^{-1}$, respectively during the same sampling episode. In the site investigation conducted by MWES for the planned causeway crossing across Magpayang River, the maximum known flood was reckoned to occur on 18 December 2003 at a peak flood level of 42.5 mRL. From the water cross-section area and assumed mean velocity of 0.2 L s^{-1}, MWES estimated the peak river flow at 90 $m^3\ s^{-1}$.

SURICON's open pit has a surface area of 21 ha and average depth of 90 m. The volume of impounded water is estimated at 8.2 million m^3. To enable the redevelopment of the open pit, GRC plans to pump out the water over a period of four (4) to six (6) months into Dayano Creek. During the dewatering period, GRC estimates an additional



Magpayang and Dayano flow measurements

EIS of the Siana Gold Project

Figure No. 4-15

inflow of 0.6 million m^3 of rainfall and 2.8 million m^3 of groundwater. This is based on historical records, discussions with a former SURICON dewatering engineer and the numerical groundwater flow model. The required average rate of pumping is 780 L s^{-1} at a maximum head of 100 m.

During the operating year, annual water inflows to the pit are estimated at 5.9 million m^3 from groundwater and 1.06 million m^3 from rainfall. Most of the rainfall occurs between November and March.

Groundwater – The lithologic formations underlying the Magpayang River catchment allow groundwater flow in varying degrees (Figure 4-6). For the highly permeable sand and gravel deposits of the Quaternary Alluvium, the groundwater occurs mainly in unconfined condition. For the Timamana Limestone, the solution cavities and karstic nature are favorable to groundwater flow. The other stratigraphic units such as andesites and basalt allow groundwater flow either through the weathered mantle, solution-enlarged joints and fractures, or bedding planes (MGB, 2003).

At the Project site, MWES (2006) inferred three (3) main aquifers:

- Alluvial aquifer which is 6 to 12 m thick and located beneath the near-surface soils. It comprises yellow, orange and brown sands and gravels with inter-layered clays.
- Saprolite aquifer is within the highly weathered bedrock and above the fresh bedrock.
- Bedrock fractured aquifer which includes volcaniclastics, basalts on the eastern side of the pit, and karstic limestone.

Mining One's geotechnical investigation and monitoring of water levels around the tailings dam and proposed process plant site suggest that the groundwater in the deeper aquifers flows towards Siana open pit from the north and west. Groundwater in the near-surface alluvial aquifer flows towards Magpayang River from the east and northeast and the area of the existing tailings dams.

Water Usage - The local residents rely on the Magpayang River for their agricultural needs, washing of clothes, bathing, and care for their animals. The river is also a source of fish.

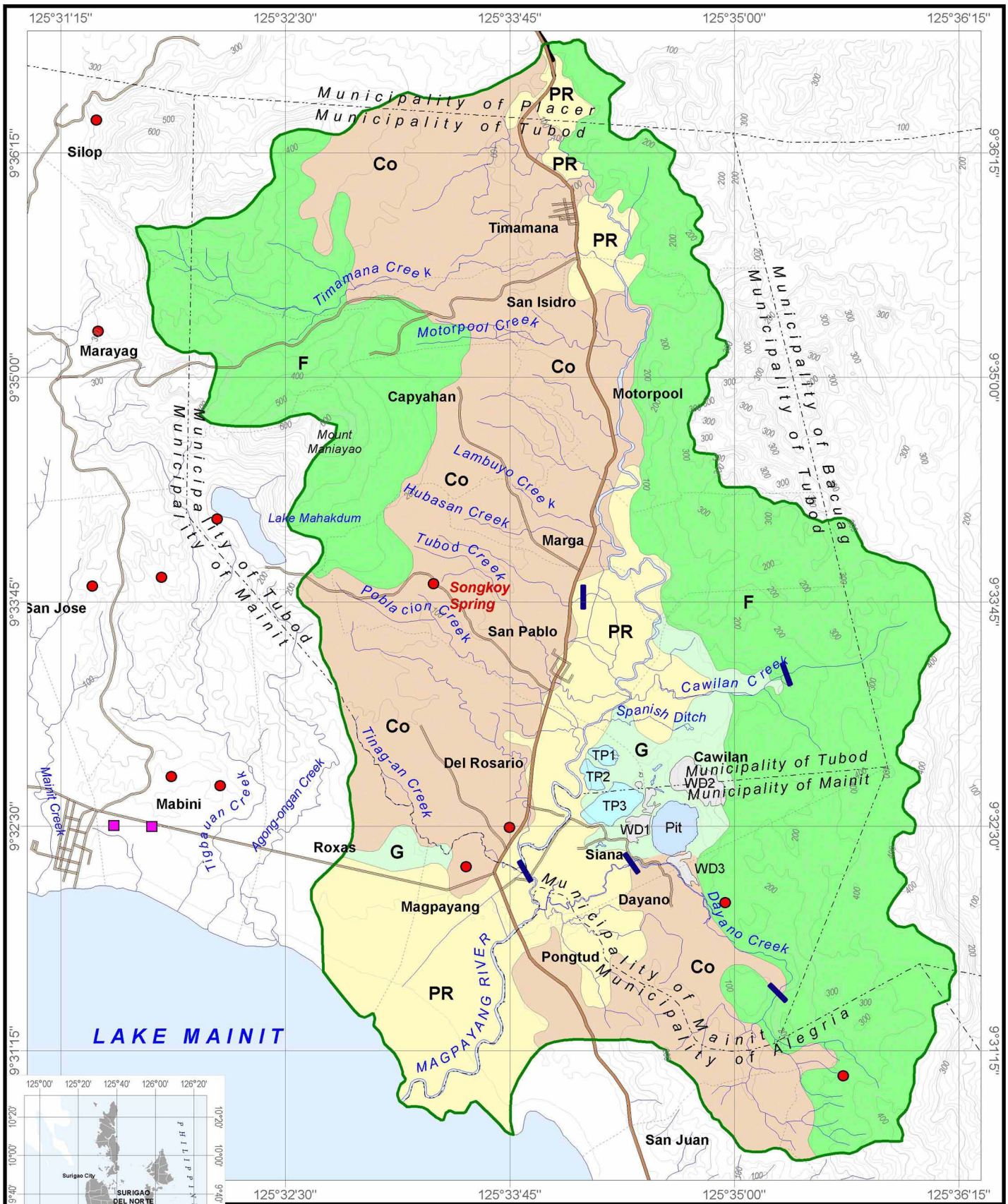
Water to irrigate the rice fields on the alluvial plains is extracted either by pumping or through irrigation canals (Figure 4-16). At Brgy. Marga, river water is diverted into the irrigation channels of that barangay and Poblacion. Downstream of the discharge point of SURICON's old tailings pond and immediately upstream of the bridge that connects Brgy. Siana to the National Highway is the irrigation intake for the rice fields of Brgy. Magpayang.

The water of Cawilan Creek is also used to irrigate the rice fields. Along Dayano River, downstream of the discharge of the Siana pit, is an irrigation dam for the ricefields of Brgy. Siana. Pumps are also installed at some sections of the river for the fields outside of the irrigation network.

The Siana Pit water is used for washing clothes and bathing. In 2005, fish cages with fingerlings provided through the DSWD-CIDDS program were observed inside the pit. Currently, the fish cages no longer exist.

Up to 2005, springs and shallow wells are the sources of potable water in the area (Figure 4-16). Songkoy Spring near Lake Mahakdum, which is hosted by diorite and floats of andesite, provides drinking water to Brgys. Marga, Poblacion, San Pablo, Del Rosario, and Cawilan of Tubod and even Brgy. Magpayang of Mainit. A spring in Brgy. Dayano, in an andesite porphyry, provides drinking water to that barangay and Brgy. Siana. Brgy. Pongtud residents get their potable water from a spring and shallow well.

In 2005, GRC established a potable water supply and distribution system for the direct impact barangays. The water source is the open pit. Treatment consists of chlorination and filtration.



Springs, wells, and irrigation dams

Photo 4-17. The irrigation dam at Magpayang River for Brgy. Magpayang.

Photo 4-18. This irrigation dam at Dayano Creek services the rice fields of Brgy. Siana.

Photo 4-19. The small irrigation dam across Cawilan Creek.

Photo 4-20. Some fields at Brgy. Siana are irrigated by pumped water from Dayano River.

Photo 4-21. Brgy. Cawilan residents bathe and wash their clothes at Magpayang River near the bridge.

Photo 4-22. The fish cages and huts at the Siana Pit in 2005. To date, these structures no longer exist.

Impacts

The hydrological and hydrogeological impacts of and to the Siana Project are the following:

1. Pumped out water from the pit will discharge into Dayano Creek and Magpayang River. An uncontrolled release coinciding with heavy rain may alter the channel geometry and cause flooding.

   To evaluate the flooding impacts of the pit dewatering on the river system, BMP implemented a topographic and bathymetric survey of the riverbanks starting from the pit discharge into Dayano Creek, along Dayano Creek and then Magpayang River, down to its mouth in Lake Mainit. The survey stations were selected

based on changes in river cross-section, tributary occurrence, and bends or change in flow direction. Figure 4-17 shows the location of survey stations and surveyed cross-sections.

The USEPA Storm Water Management Model (SWMM) was then used to generate, rout, and track the quantity of runoff and the flow rate and depth in each stream channel during the simulation period. The computational period used in the modelling was three (3) hours. Two (2) simulation runs were made: one assumed no pit dewatering, *i.e.*, the baseline condition; the other assumed pit dewatering. For the dewatering case, the open pit was assumed to have a total water volume of 11.15 million m^3 to account for runon and groundwater contribution during the dewatering. Pumps with a total normal capacity of 780 L s^{-1} would be used. The two (2) diversion gates of the irrigation dam along Dayano Creek located downstream of the open pit were assumed fully open during the whole simulation period (Figure 4-17).

The simulations used the 2003 daily rainfall data and rainfall intensity-duration-frequency curve for Surigao City. The total rainfall recorded for that year was 4,073 mm which is higher than the mean annual rainfall of 3,573 mm for the period 1984 to 2004. Specifically, the simulations used rainfall data for the less rainy months of April to September.

The modelling results for the baseline case show overflow occurring at various depths, times, and periods in ten (10) canal reaches, *i.e.*, Canals 1, 2, 3, 5, 6, and 7 in Dayano Creek and Canals 14, 15, 18, and 19 in Magpayang River, out of the 22 canal reaches (Figure 4-17). The predicted overflow depth ranges from 0.02 m at Canal 1 to a maximum of 0.79 m at Canal 5 for Dayano Creek and from 0.01 m at Canal 15 to 1.58 m at Canal 14 for Magpayang River. The overflow occurs from 3 hours to a maximum of 9 days and for a total of 133 days in a year.

For the dewatering case which lasted for 166 days, there were 56 flooding days. This is six (6) days more than the 50 days of flooding for the same period without dewatering. The observed extension of the overflow period is from three (3) to six (6) hours. No significant difference is observed on the overflow depth between the baseline and dewatering cases.

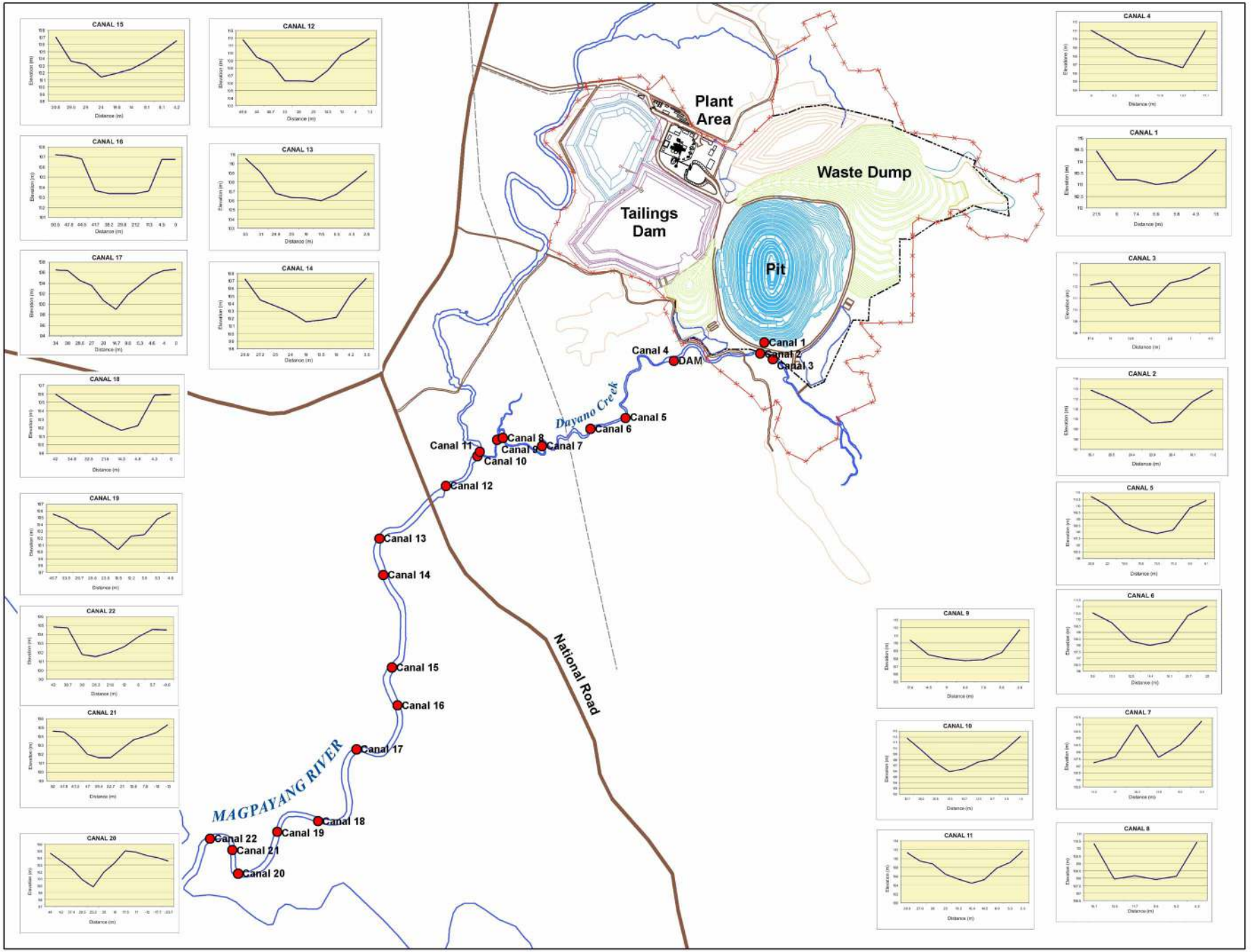
Beyond the riverbanks, the area on both sides of Dayano Creek and Magpayang River is mostly paddy rice. If the rice production is at the initial growing stage, the water overflow from the stream to the paddy field will not have a negative impact, *i.e.*, growing rice needs to be flooded to a certain depth with excess water draining into the canal.

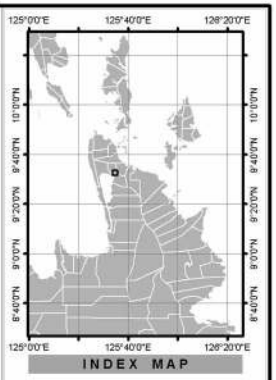
2. During the operating year, annual water inflows to the pit are estimated at 5.9 million m^3 from groundwater and 1.06 million m^3 from rainfall. Most of the rainfall occurs between November and March. This can flood the open pit and underground works. To prevent this, GRC will install a pit perimeter drainage to keep surface runoff away from the open pit, dewatering bores, and pumps.

3. Clearings of grasslands and saplings and earthworks at the TSF, process plant, mine services area, waste rock dump, and access road will increase surface runoff. This can cause flooding and erosion which will impact the adjacent ricefields primarily along Dayano Creek and secondarily along Maypayang River.

   To manage the water inflows, GRC proposes to install sized drainage channels, sediment traps, settling ponds, and geotextile tubes (Figure 3-4). For human safety, the measures will be complemented by emergency planning and decommissioning. During mine closure, mine rehabilitation and decommissioning works will be undertaken.

4. Underground mining can cause ground subsidence and the formation of open cracks, fissures, or pits. Connected either directly or indirectly to surface water, the openings may lead to partial or complete loss of water that is drained to the lower strata or mine workings. GRC will conduct detailed geotechnical and hydrogeological studies to predict the hydrological impacts of underground mining. Hydrologic control measures will then be formulated and implemented.





N
W E
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Map Projection :
Longitude - Latitude

Project Location :
CARAGA Region
Surigao, Mindanao

0 75 150 300 450 600
Meters

LEGEND :

- River stations
- Households
- Security fence
- JV surface rights

Source:

Water Quality

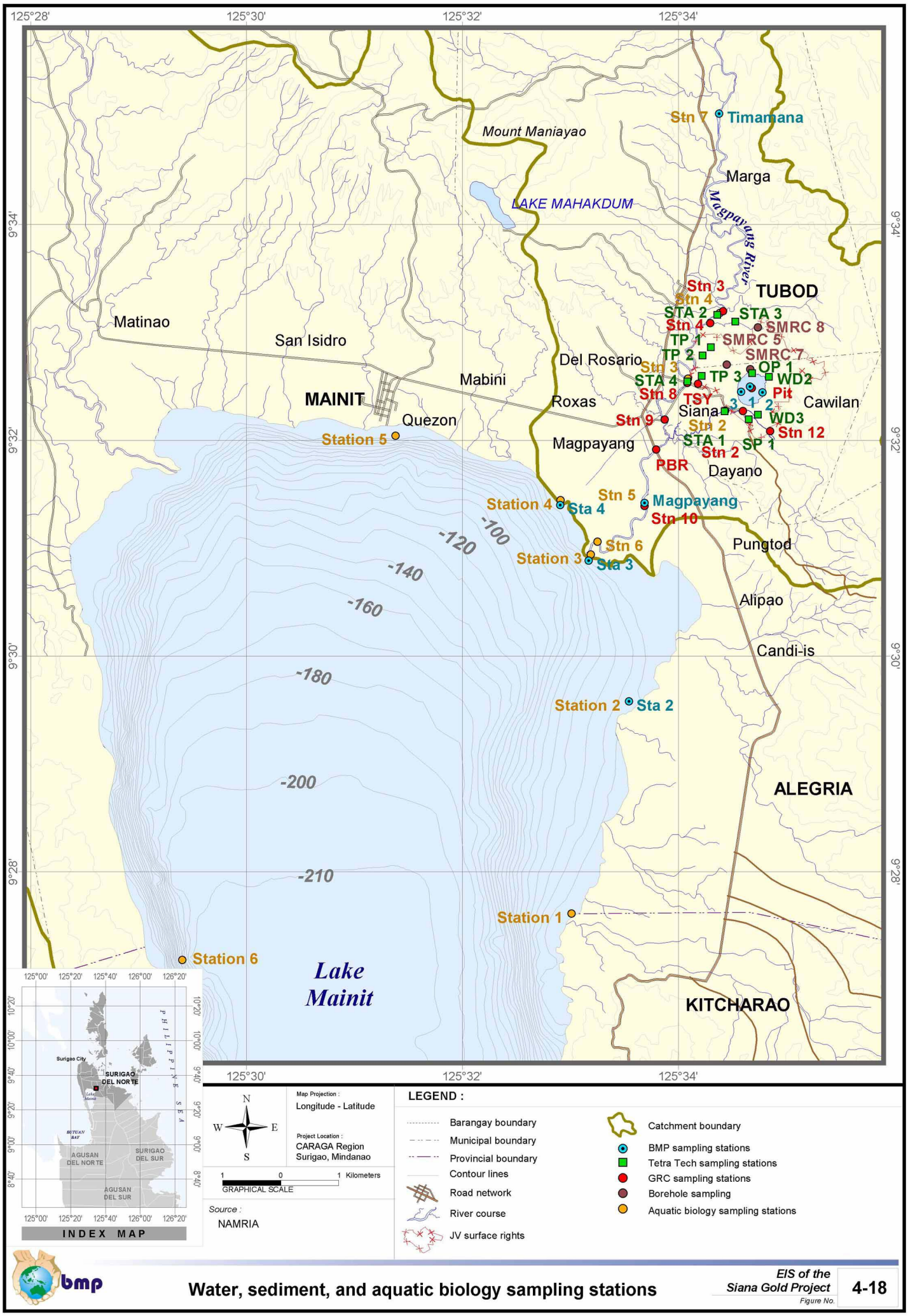
Methodology

The surface and ground water bodies within the SURICON facility as well as the surrounding and receiving creeks, rivers, and lake were subjected to water and sediment sampling on various occasions. Figure 4-18 plots the sampling locations while Table 4-5 provides details of the sampling episodes.

Table 4-5 groups the sampling stations by location, *i.e.*, inside the SURICON facility, along a stream upstream of the facility, and along a stream downslope of the facility. Tetra Tech commenced sampling (on a one-time basis) within the SURICON site in February 2001. GRC started its sampling works in March 2003; said sampling was continued to the present on a quarterly basis. BMP conducted supplementary samplings in February, March, and May 2005.

Table 4-5. Details of sampling episodes

Location	Type of Samples	Sampling Stations	Dates of Sampling	Sampler
SURICON facility				
• Tailings ponds	• Water	TP1, TP2, TP3	5 to 7 February 2001	Tetra Tech EM, Inc.
		TSY	5 June 2003 5 April 2005 12 July 2005 8 November 2005 25 April 2005 26 July 2006 7 November 2006 30 January 2007 1 May 2007 24 July 2007 30 October 2007	GRC
	• Groundwater	SMRC5 (TP3)	19 March 2003 27 July 2003 19 November 2003 4 March 2004 15 December 2004	GRC
	• Tailings sediment	TP1, TP2, TP3	5 to 7 February 2001	Tetra Tech
	• Soil	TP1, TP2, TP3	5 to 7 February 2001	Tetra Tech
• Waste dumps	• Rock	WD1, WD2, WD3	5 to 7 February 2001	Tetra Tech
• Settling pond	• Water	SP1	5 to 7 February 2001	Tetra Tech
• Open pit	• Water	OP1	5 to 7 February 2001	Tetra Tech
		Pit near-surface	19 March 2003 27 July 2003 19 November 2003 3 March 2004 17 December 2004 6 April 2005	GRC



Water, sediment, and aquatic biology sampling stations

Location	Type of Samples	Sampling Stations	Dates of Sampling	Sampler
			12 July 2005 8 November 2005 25 April 2006 27 July 2006 8 November 2006 31 January 2007 2 May 2007 30 October 2007	
		Pit center 1-05, 1-20, 1-40, 1-80, 1-88.5 (5, 20, 40, 80, and 88.5m deep)	19 March 2005	BMP
		Near limestone 2-05, 2-20, 2-70 (5, 20, and 70m deep)	19 March 2005	BMP
		Far from limestone 3-05, 3-20, 2-40 (5, 20, and 40m deep)	19 March 2005	BMP
	• Sediment	OP1	5 to 7 February 2001	Tetra Tech
• North of open pit	• Groundwater	SMRC7	19 March 2003 27 July 2003 19 November 2003 3 March 2004 16 December 2004 5 April 2005	GRC
• North of WD1	• Groundwater	SMRC8	19 March 2003 4 June 2003 27 July 2003 20 November 2003 3 March 2004	GRC
River upslope of facility				
• Magpayang River	• Water	STA2 (d/s Cawilan Bridge, u/s Spanish Ditch)	5 to 7 February 2001	Tetra Tech
		Stn 3 (Cawilan Bridge)	20 March 2003 28 July 2003 19 November 2003 3 March 2004 15-16 December 2004 3-4 April 2005 12 July 2005 7 November 2005	GRC

Location	Type of Samples	Sampling Stations	Dates of Sampling	Sampler
			24 April 2006 25 July 2006 6 November 2006 29 January 2007 30 April 2007 23 July 2007 29 October 2007	
		Timamana	18 February 2005	BMP
	• Sediment	STA2	5 to 7 February 2001	Tetra Tech
		Stn 3	28 July 2003	GRC
		Timamana	18 February 2005	BMP
• Spanish Ditch	• Water	STA3	5 to 7 February 2001	Tetra Tech
		Stn 4 (d/s STA3)	28 July 2003 19 November 2003 3 March 2004 16-17 December 2004 5 April 2005 12 July 2005 7 November 2005 24 April 2006 25 July 2006 6 November 2006 29 January 2007 30 April 2007 23 July 2007	GRC
	• Sediment	STA3	5 to 7 February 2001	Tetra Tech
		Stn 4	28 July 2003 4 March 2004	GRC
• Dayano Creek	• Water	Stn 12 (u/s Dayano Bridge)	4 June 2003 16 December 2004 3-4 April 2005 12 July 2005 7 November 2005 24 April 2006 25 July 2006 6 November 2006 29 January 2007 30 April 2007 23 July 2007 29 October 2007	GRC
	• Sediment	Stn 12	4 June 2004	Greenstone

Location	Type of Samples	Sampling Stations	Dates of Sampling	Sampler
River downslope of facility				
• Magpayang River	• Water	STA4 (d/s TP3, u/s Harrison Bridge), STA5 (d/s Dayano and Magpayang confluence)	5 to February 2001	Tetra Tech
		Stn 8 (Harrison Bridge)	28 July 2003 20 November 2003 4 March 2004 16 December 2004 4 April 2005 12 July 2005 7 November 2005 24 April 2006 25 July 2006 6 November 2006 29 January 2007 30 April 2007 23 July 2007 29 October 2007	GRC
		Stn 9 (Siana Bridge)	19 March 2003 4 June 2003 28 July 2003 20 November 2003 3 March 2004 15-16 December 2004 3 April 2005 12 July 2005 7 November 2005 24 April 2005 24 July 2005 6 November 2006 29 January 2007 30 April 2007 23 July 2007 29 October 2007	GRC
		Stn 10 (d/s National Highway)	20 March 2003 28 July 2003 20 November 2003 3 March 2004 17 December 2004 4 April 2005 27 April 2006	GRC

Location	Type of Samples	Sampling Stations	Dates of Sampling	Sampler
			24-25 July 2006 6 November 2006 29 January 2007 30 April 2007 23 July 2007 29 October 2007	
	• Sediment	STA4, STA5	5 to 7 February 2001	Tetra Tech
		Stn 8	28 July 2003 4 March 2004	GRC
		Stn 9	4 June 2003 28 July 2003	GRC
		Stn 10	28 July 2003	GRC
		Magpayang	18 February 2005	BMP
• Dayano Creek	• Water	STA1 (d/s Dayano Bridge)	5 to 7 February 2001	Tetra Tech
		Stn 2 (Dayano Bridge)	20 March 2003	GRC
			4 June 2003 27 July 2003 19 November 2003 3 March 2004 16 December 2004 3 April 2005 12 July 2005 7 November 2005 24 April 2006 25 July 2006 6 November 2006 29 January 2007 30 April 2007 23 July 2007 29 October 2007	
	• Sediment	STA1	5 to 7 February 2001	Tetra Tech
		Stn 2	4 June 2003	GRC
Lake Mainit	• Water	Lake (various depths of 1 – 12 m)	17 December 2004 6 April 2005 14 July 2005 8 November 2005 27 April 2006 27 July 2006 8 November 2006 31 January 2007	GRC

Location	Type of Samples	Sampling Stations	Dates of Sampling	Sampler
			1 May 2007 25 July 2007 30 October 2007	
		Sta 3 (2 and 10m deep, Magpayang River mouth)	1 May 2005	BMP
		Sta 4 (5m deep, NW of Sta 3)	1 May 2005	BMP
		Sta 2 (10 m deep, fronting Alegria)	1 May 2005	BMP
	• Sediment	Sta 3, Sta 4, Sta 2	1 May 2005	BMP

Baseline Conditions

Tables 8-1 and 8-10 present the laboratory results of the sediment and water quality sampling, respectively. The sequence of discussion of the results is by water body and subsequently by location referenced to SURICON's facility.

Table 4-4 extracts the water quality laboratory results for some key parameters for comparison with the reference values for freshwater body classification as per DAO No. 1990-34. Results for oil and grease were excluded for non-reliability as evidenced by readings on commercial bottled drinking water control samples. It should be noted that for classification purposes, yearly average values for certain parameters are required. The compilation of sampling data over a full year has not been achieved for some parameters such as total coliforms, phenols, NO_3 as N, and PO_4 as P. Hence, what is possible is just a tentative classification of the water bodies.

Table 4-6. Classification of water bodies based on sampling results

Parameter	Water Body	Sampling Results	Class AA	Class A	Class B	Class C	Class D
pH	All	6.7 – 8.6	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	6.0 – 9.0
Temperature ^{o}C	All	25.0 – 31.9					
DO mg L^{-1} or %	All	6.31 – 10.19 71 – 100 %	5 70 %	5 70 %	5 70 %	5 60 %	3 40 %
BOD_5 mg L^{-1}	Magpayang River	<1 – 8.8	1	5	5	7 (10)	10 (15)
	Spanish Ditch	<1 – 3.8	1	5	5	7 (10)	10 (15)
	Dayano Creek	<1 – 6.1	1	5	5	7 (10)	10 (15)
	Open pit	<1 - 4.4	1	5	5	7 (10)	10 (15)
	Lake Mainit	<1 – 2.7	1	5	5	7 (10)	10 (15)
Total Coliforms MPN $100mL^{-1}$	Magpayang River	34 - 1600000	50	1000	1000	5000	---
	Spanish Ditch	<2 - 30000	50	1000	1000	5000	---
	Dayano Creek	80 - 16000	50	1000	1000	5000	---
	Open pit	<2 - 300	50	1000	1000	5000	---
	Lake Mainit	9 - 1600	50	1000	1000	5000	---
Phenols mg L^{-1}	Magpayang River	<0.001 – 0.2	nil	0.002	0.005	0.02	---
	Spanish Ditch	<0.001	nil	0.002	0.005	0.02	---
	Dayano Creek	<0.001 – 0.3	nil	0.002	0.005	0.02	---
	Open pit	<.001	nil	0.002	0.005	0.02	---

Parameter	Water Body	Sampling Results	Class AA	Class A	Class B	Class C	Class D
	Lake Mainit	<0.001 - 0.3	nil	0.002	0.005	0.02	---
NO_3 - N mg L^{-1}	Magpayang River	<0.002 – 1.8	1	10		10	---
	Spanish Ditch	0.07 – 2.9	1	10		10	---
	Dayano Creek	< 0.001 – 0.99	1	10		10	---
	Open pit	<0.001 – 0.88	1	10		10	---
	Lake Mainit	<0.001 – 0.58	1	10		10	---
PO_4 - P mg L^{-1}	Magpayang River	0.06 – 0.5	nil	0.1	0.2	0.4	---
	Spanish Ditch	0.07 – 0.21	nil	0.1	0.2	0.4	---
	Dayano Creek	<0.01 – 0.47	nil	0.1	0.2	0.4	---
	Open pit	<0.01 – 0.07	nil	0.1	0.2	0.4	---
	Lake Mainit	<0.01 – 0.8	nil	0.1	0.2	0.4	---
Pb mg L^{-1}	Magpayang River	<0.03 – 0.07	0.05	0.05	0.05	0.05	0.10
	Spanish Ditch	< 0.03	0.05	0.05	0.05	0.05	0.10
	Dayano Creek	<0.03	0.05	0.05	0.05	0.05	0.10
	Open pit	<0.03	0.05	0.05	0.05	0.05	0.10
	Lake Mainit	<0.03	0.05	0.05	0.05	0.05	0.10
CN mg L^{-1}	Magpayang River	<0.001 – 0.07	0.05	0.05	0.05	0.05	---
	Spanish Ditch	<0.001 – 0.07	0.05	0.05	0.05	0.05	---
	Dayano Creek	<0.001– 0.07	0.05	0.05	0.05	0.05	---
	Open pit	<0.001 – 0.06	0.05	0.05	0.05	0.05	---

Notes:

1. The reference values without parentheses are yearly average values. Those enclosed in parentheses are maximum values.
2. When applied to lakes or reservoirs, the PO_4 as P concentration reference value should not exceed an average of 0.05 mg/L or a maximum of 0.1 mg/L.
3. The reference values for total coliform are the geometric mean of the most probable number of coliform organism during a 3-month period. The limit indicated shall not be exceeded in 20 % of the samples taken during the same period.
4. The standards for water body classification are taken from DAO No. 1990-34.

Table 4-5 presents the tentative classification. As shown, total coliforms, phenols, and PO_4 as P are the limiting factors. Magpayang River is tentatively classifiable as Class C. Dayano Creek is either Class A or C. Lake Mainit though classifiable as Class A may slide down to Class C or D depending on future samplings on oil and grease and phenols. It is interesting to note that the Environmental Management Bureau Caraga Regional Office classified the lake as Class A. Phenols were not included in the parameters for evaluation.

Table 4-7. Tentative classification of water bodies

Parameter	Magpayang River	Spanish Ditch	Dayano Creek	Lake Mainit	Open Pit
BOD_5	A	A	A	A	A
Total coliforms	C	C	A	AA	AA
Phenols	C	A	D	D	---
NO_3 – N	AA	AA	AA	AA	AA
PO_4 – P	C	B	AA	AA	AA
Pb	AA	AA	AA	AA	AA
CN	AA	AA	AA	AA	AA

The water quality sampling results do not manifest any consequences of prior SURICON operations. The possible effects include elevated metal concentrations and acid mine drainage (AMD). The former is due to the exposure and dissolution of metals. AMD which enhances the dissolution of metals is the consequence of oxidation of sulfide minerals such as pyrite (FeS_2) in the presence of water.

Sulfides, primarily pyrite, galena (PbS), and sphalerite (ZnS) are present in the Siana Orebody. The sulfides are in the tailings ponds and the waste rock dumps. In the presence of water and oxygen, sulfides oxidize and form sulfuric acid. This is typified by the oxidation of pyrite (Lowson, 1982 and Nordstrom, 1982):

$$FeS_2 + \frac{7}{2}O_2 + H_2O \rightarrow Fe^{2+} + 2SO_4^{2-} + 2H^+$$

As the oxidation continues, pH goes down. Aided by bacterial oxidation at pH values below 4.1 (Brierly, 1978; Lundgren and Silver, 1980; Torma and Banhegy, 1984; Ahonen *et al.*, 1986), the ferrous iron is oxidized:

$$2Fe^{2+} + \frac{1}{2}O_2 + 2H^+ \rightarrow 2Fe^{3+} + H_2O$$

The ferric iron does not remain in solution at pH above 3. It forms the ferric hydroxide precipitate which is a distinguishing feature of AMD:

$$Fe^{3+} + 3H_2O \rightarrow Fe(OH)_3 + 3H^+$$

At the Siana site, the pH does not go down after the oxidation of pyrite. This is due to the high buffering capacity of the limestone ($CaCO_3$) in the various formations. The calcareous formations include the Timamana Limestone, Mabuhay Formation, Bacuag Formation, and Siana Formation. These formations are responsible for the Ca present in the waters of the Magpayang and Dayano Rivers and at the Siana Pit. $CaCO_3$ reacts with H^+ in the following manner:

$$CaCO_3 + 2H^+ \rightarrow Ca^{2+} + H_2CO_3$$
$$CaCO_3 + H_2CO_3 \rightarrow Ca^{2+} + 2HCO_3^-$$

With enough $CaCO_3$, calcium and bicarbonate alkalinity becomes available for acid neutralization reactions.

The water quality sampling results also do not show any effects of gold small-scale mining. This may be attributed to two factors, namely, the limited volume of materials excavated and processed and the reagents used to extract the gold.

One additional remark is needed for Table 8-10. Conductivity which measures the ability of the water to conduct an electric current shows a background level of 269 to 316 μS/cm for the Magpayang River and Dayano Creek, respectively. For the Tailings Pond 1 and Tailings Pond 2 water samples, conductivity rose to 657 and 482 μS/cm. The elevated concentration and valency of ions is due to the amount of exposed minerals and water ponding at the two sites. The conductivity readings were confirmed by TDS measurements.

At the Siana Pit, conductivity and DO saturation were measured at various depths using a Yeokal probe. Surface water measurements were 388 µS/cm and 100 % saturation. As expected, conductivity increased at depth, reaching 596 µS/cm at 90.8 m below surface. DO saturation decreased, bottoming out to 35 %.

Five months later, water samples were taken from the pit at various pre-determined depths using a Van Dorn Bottle. As shown in Table 8-10, there was no marked deviation from the near-surface measurements at depth. This may be due to the aerobic conditions even at the bottom. As regards TDS, the measurements were not consistent with the earlier conductivity readings. Either the conditions changed or there were problems in the laboratory measurements.

The sediment sampling results shown in Table 8-1 indicate no significant elevation of Cu, Hg, Cd, and As in the stream or lake sediment downslope of the SURICON facility. For Pb and Zn, however, a rise in concentrations is discernible. For instance, Pb was less than 10 ppm upslope. Downslope, the measurements ranged from 40 to 82 ppm. For Zn, the upslope measurements were 44 to 74 ppm. Downslope, the readings were 113 to 297 ppm.

Photo 4-23. GRC's Insoy Caballes collects the deep pit water sample from the Van Dorn Bottle.

Impacts

The prospective water quality impacts of the Siana Gold Project are:

1. Sediments – The Pedology Section of this EIS discussed how the Project will aggravate soil erosion and bring sediments to the Spanish Ditch, Dayano Creek, and Magpayang River. The water will become turbid and unfit for washing and bathing. Aquatic organisms and their habitats will be lost. The ricefields near the stream channels may be overwhelmed with sediment resulting in the loss of their productivity.

   Magpayang River has a catchment area and relief ratio of 57.37 km^2 (22.15 mi^2) and 0.5 %, respectively. The corresponding figures for Dayano Creek and the Spanish Ditch are 9.16 km^2 (3.54 mi^2) and 3.3 %, and 2.71 km^2 (1.04 mi^2) and 5.7 %, respectively (Table 4-2). The Roehl Curve relates the sediment delivery ratio (SDR) of streams to the size of the drainage area, sediment grain size, and relief ratio. Based on the Roehl Curve shown in Figure 4-19, the SDR of Magpayang River ranges from 14 % for average to coarse grain size to 35 % for average to fine grain size. For Dayano Creek and the Spanish Ditch, the SDRs are higher, *i.e.*, from 20 to 42 % and from 42 to 48 %, respectively.

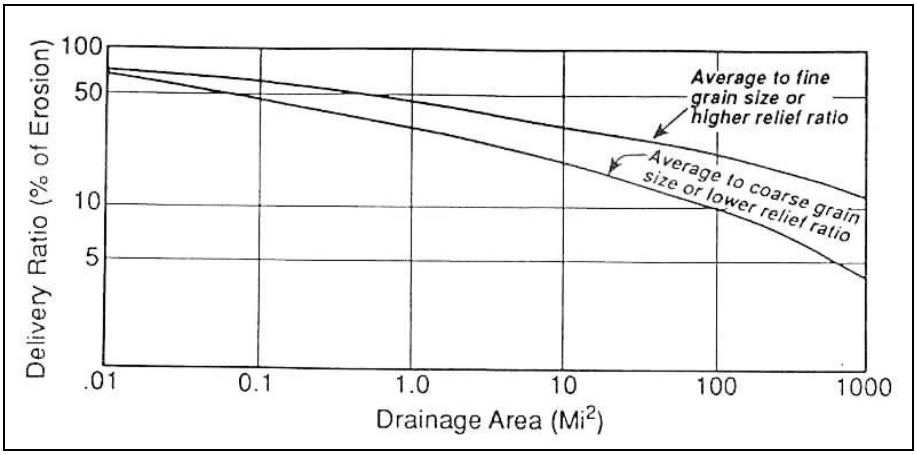


Figure 4-19. The Roehl Curve

The low SDR for Magpayang River indicates the increased likelihood for deposition of the eroded sediment, especially the coarse-grained particles, along the channel. The channel shoaling in turn leads to flooding. During big river flows, the deposited sediment is re-suspended. It may deposit farther downslope or along the banks and adjacent rice fields.

Figure 4-20 shows the settling velocities of different sediment sizes as low as 0.01 mm. Obviously, coarser materials with high settling velocities are deposited close to the source. Finer materials are transported significant distances from the source before settling down.

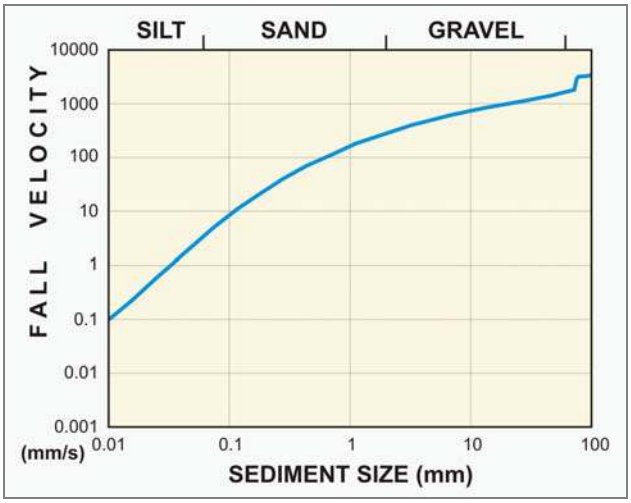


Figure 4-20. Estimated settling velocity for different sediment sizes (Jenkins, 2002).

Lake Mainit is the repository of discharges along the Magpayang River and Dayano Creek. To determine potential impact areas within the lake if sediment is released via Magpayang River, a hydrodynamic modeling of the lake forced by wind and river input and output was performed.

A lake bathymetric survey and measurements of temperature, conductivity, and surface currents were conducted from 17 to 19 February 2005. Based on the findings, a hydrodynamic model of the lake was developed using the Princeton Ocean Model (POM, Blumberg and Mellor, 1987). The POM is a three dimensional primitive equation circulation model which uses a bottom-scaled vertical coordinate system called the sigma-coordinate. For the lake modeling, no open boundaries were prescribed. The model was

initialized with a thermal stratification derived from the measurements and forced by both wind and river fluxes. No fluxes of heat and freshwater were assumed to occur at the water-air interface.

Three (3) simulations were conducted. The first was designed to examine the significance of river input and outflow out of the lake in influencing circulation pattern. This was done by prescribing the inflow from the Magpayang River and allowing the same volume of water to exit from the southernmost tip of the lake, *i.e.,* Kalinawan River. The remaining two simulations were wind-driven simulations – one blowing to the northeast and the other to the southwest. In the absence of any wind records over the lake, climatological wind speeds and directions compiled at the Surigao City PAGASA station were used. A Lagrangian dispersal modeling, which entailed the release of some 1,000 virtual neutrally buoyant passive particles from the Magpayang River mouth, was then performed on the three (3) lake circulation situations. Compared to actual sediment, a neutrally buoyant particle remains in the water column far longer. During the modeling, each particle, as advected by prevailing currents and influenced by diffusion, is tracked over time.

The river discharge-forced Lake circulation shows advection towards the south with the spread of particles dependent on the diffusion rate used. As shown in Figure 4-21a, the impact areas are most likely within 1.2 km on either side of the river mouth.

In the presence of winds, particles floating at the surface will either be trapped along the coast in case of southwest winds or advected directly offshore for northeast winds. From Figure 4-21b, during southwest wind-forcing, the advection of particles within the first three days is along the coast north of the river mouth. The particles follow the coast for about 2 km before turning and moving offshore. In contrast, during the northeast wind-forcing, the advection of particles within the first three days is southward beyond the boundary of Alegria and Kitcharao (Figure 4-21c). Some particles move farther south up to the boundary of Kitcharao and Jabonga.

Based on the Lagrangian dispersal modeling results, the areas most likely affected by the release of sediment (or tailings) via the Magpayang River are the easternmost coast of Mainit, the coast of Alegria, and to a lesser degree, the coast of Kitcharao. Figure 4-22 highlights the potential impact areas.

The management measures for erosion and sediment control have been discussed in the Pedology Section of this EIS.

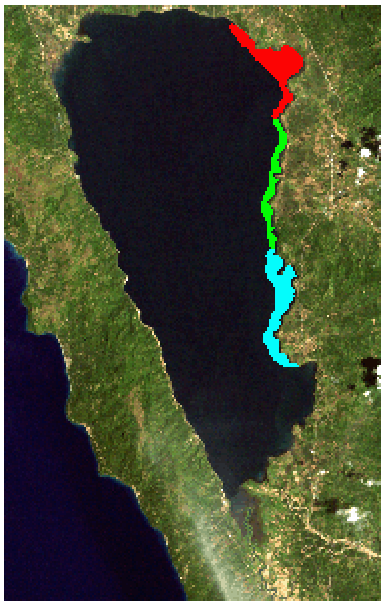
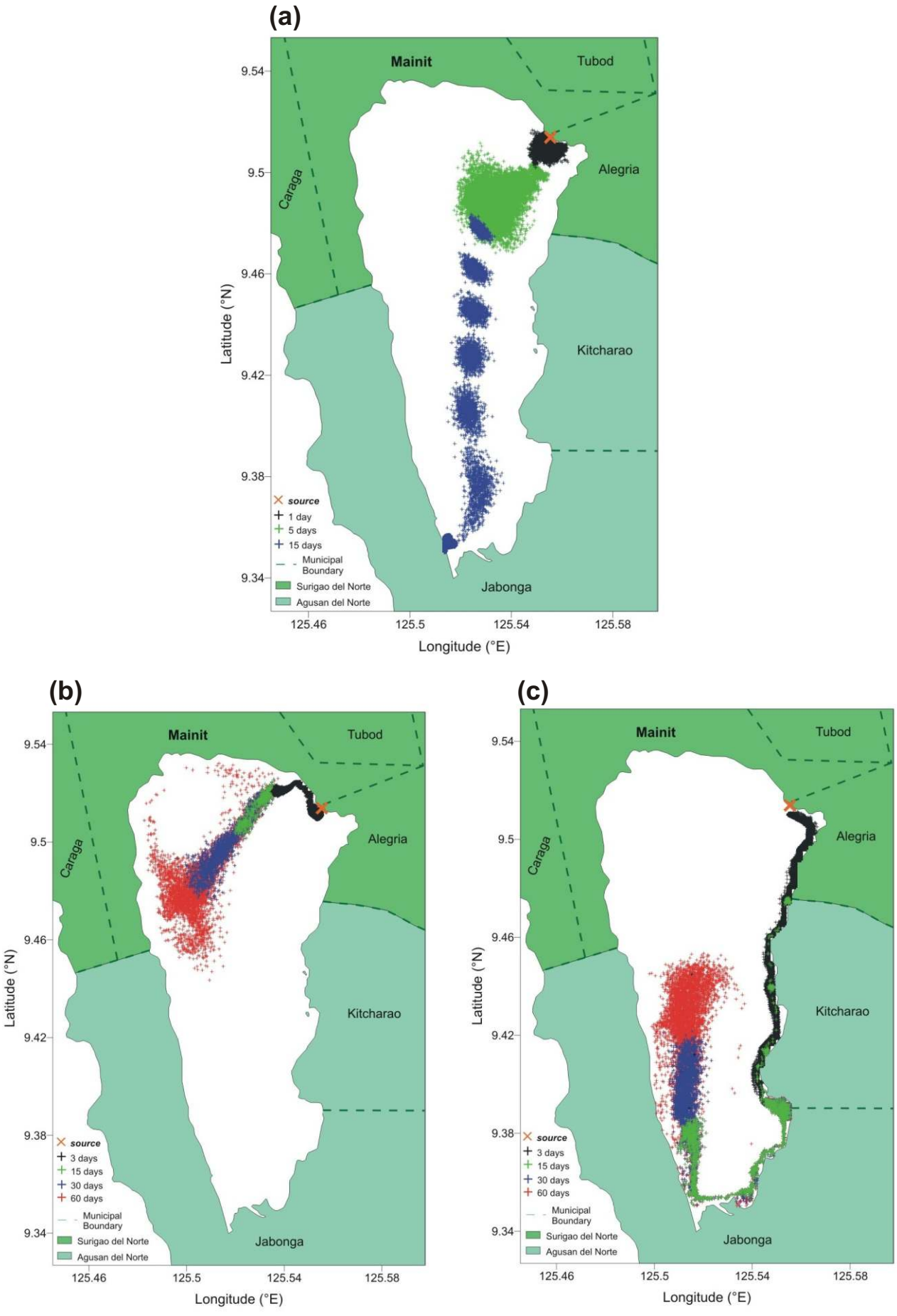


Figure 4-22. Impact areas of sediment or tailings release.



Particle dispersal modeling (a) River discharged-forced (b) Southwest wind-forced, (c) Northeast wind-forced

2. Tailings – The Project will crush and grind the ore. After the gold is extracted, the ground materials will pass a CN destruction circuit. The CN-cleansed tailings are then deposited at the TSF.

   The tests for engineering properties carried out on the process tailings and remined tailings samples found that about 35 % and 30 % of the remined and process tailings are clay sized, *i.e.*, diameter less than 2 µm. Settling tests established that due to the high clay content, the particles settle at a very slow rate. Tailings consolidation is also very slow. From these tests, it may be inferred that the clay and fine silt portions of the tailings solids will remain suspended in the supernatant water and be released into Dayano Creek. The results of GCA's geochemical testworks shed light on the composition of the tailings solids – Al at 7.33 %, Ca 8.71 %, Fe 6.4 %, K 2.43 %, Mg 1.11 %, As 131 mg kg^{-1}, Cr 197 mg kg^{-1}, Cu 272 mg kg^{-1}, Mn 4425 mg kg^{-1}, Pb 1126 mg kg^{-1}, Zn 1629 mg kg^{-1}, Cd at 7 mg kg^{-1}, and Hg 0.70 mg kg^{-1}. The heavy metal content is comparable to that of solid samples taken from SURICON's tailings dams (Table 8-1).

   Apart from release through decant or spillway discharge of excess water from the TSFs, there are other pathways for tailings release:

   1. As an extreme event which is a dam break – As discussed in the Geology and Geomorphology Section, the preventive measures are geotechnical site investigation and engineering design prior to earthworks, implementation of design with strict quality control, regular stability inspection and monitoring, observance of buffer or exclusion zone, emergency planning and testing, and mine rehabilitation and decommissioning.

   2. Seepage – Golder (2007) simulated seepage through the TSF based on site survey data, design drawings of the embankment, and air-lift and recovery tests on three (3) holes. They found as likely the development of a gentle groundwater mound in the lower portion of the TSF, drainage of TSF3 groundwater towards the open pit, and non-seepage at the toe of the TSF. The planned placement of tailings over the existing tailings surface will assist in reducing the rate of seepage loss during the initial tailings deposition.

   3. Leak from the tailings delivery pipe – During the normal operation of the TSFs, tailings will be discharged via HDPE delivery pipelines from the perimeter embankment. The pipelines will be contained inside a lined channel. Any leak will be collected and brought to a collection pond in the process plant area (Figure 3-4).

   Considering that the sources of potable water for the communities are either upslope or far from the Project site, the risk of direct ingestion by humans of heavy metals in released tailings is insignificant. The likely pathway for human ingestion is by consumption of metal-contaminated fish or other edible organisms from Magpayang River, Dayano Creek, and to a limited extent, Lake Mainit. The human health effects of heavy metals vary:

   - When ingested, Pb can affect almost every organ and system. The most sensitive is the central nervous system. Pb also damages kidneys and the immune system.

   - Long-term exposure to low levels of Cd leads to build-up in kidneys and possible kidney damage. Other long-term effects are lung damage and fragile bones.

   - The long-term ingestion of As at low levels can cause skin darkening and small corns or warts. High levels can cause death. Lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm and damage to blood levels.

   - Mercury has a number of effects on humans. These are disruption of the nervous system; damage to brain functions; DNA damage and chromosomal damage; allergic reactions resulting in skin

rashes, tiredness and headaches; and negative reproductive effects such as sperm damage, birth defects, and miscarriages.

The tailings will be managed through CN detoxification of tailings prior to discharge to the TSF; design of TSF embankment following the ANCOLD guidelines, and other measures listed in the Geology and Geomorphology Section.

4. Chemicals – Tables 3-4 and 3-5 list the chemicals with significant hazard ratings which will be used by the Project in the process plants. Other chemicals with hazard ratings will also be used at the open pit and underground operations: ammonium nitrate fuel oil (ANFO) explosive and diesel.

   Oil and grease will require the following management measures: training of personnel on proper oil handling, drip trays, oil spills containment, oil-water separators, and the collection, containment, and disposition of used oil.

   Management of the other chemicals will entail personnel training, physical systems to fully contain or prevent the escape of chemicals, and systems and procedures on the transport, handling, storage, use, and disposal of chemicals and their chemical wastes.

5. AMD – As discussed previously, notwithstanding the sulfide minerals present in the Siana orebody such as PbS, ZnS, and FeS_2, no AMD is generated from SURICON's tailings ponds and waste rock dumps. This is attributed to the abundance of calcareous materials within the orebody itself and the surrounding areas. Such conditions are expected even with GRC's redevelopment of the Siana orebody.

   BMP's (2007) acid-base accounting of waste rock samples found that 24 % of the estimated waste rocks is NAF; for 60 % of the waste rocks, 13 % to 15 % is PAF; for 16 % of the waste rocks, 38 % is PAF. Assuming a good statistical representation by the samples, only about 15 % of the total waste rocks is PAF. This means that NAF materials are more than adequate to encapsulate the PAF materials. To ensure that PAF materials are identified and placed properly in the waste rock dump, NAG pH=4 tests on blasthole cuttings of Domain 600 (feldspar porphyry) primarily and Domains 100 (volcaniclastics, mudstone, sandstone, tuff, basalt, and coal) and 400 (basalt) will be conducted.

   GCA (2006) likewise conducted static tests on a metallurgically prepared sample of process tailings. It was concluded that the tailings solid sample is NAF due to the strongly calcareous minerals.

6. Sewage – About 75,000 m^3 of sewage will be generated annually during construction. This will decline to about 48,300 m^3 annually during operation. Sewage impacts on the visual aesthetics. It generates foul smell, degrades the stream, and gives rise to water-borne diseases. GRC proposes to install bacteriological sewage treatment systems, preferably BioMAX.

7. Solid waste – During construction, about 91 t of domestic solid waste will accumulate annually. This is expected to reduce to 57 t during operations. GRC will implement a waste segregation, recycling, and composting. Non-usable wastes are deposited in a landfill near the waste rock dump.

Freshwater Biology

Methodology

Available literature on Lake Mainit limnology and water quality was reviewed (Table 2-4). Using NAMRIA's 1988 1:50,000 topographic map and the Ikonos 2005 satellite image, sampling stations were selected. Five (5) stations were established along Magpayang River; two (2) stations along Dayano Creek, and six (6) stations within Lake Mainit (Figure 4-18). The freshwater biological assessment of inland waters was conducted on 6 to 8 January 2005; the limnological survey of Lake Mainit was from 29 April to 1 May 2005.

The biological sampling focused on plankton, benthic macroinvertebrates, fish and other aquatic vertebrates.

Plankton samples were collected from approximately 50 L of river water that passed an 80 µm mesh net. The samples were immediately preserved in 10 % formalin. In the laboratory, the samples were concentrated to a volume of 5 mL. For each sample, a 1 mL sub-sample was examined.

Benthic macroinvertebrate samples were obtained from different habitat types: leaf packs (submerged macrophyte beds), sand, and riffle rock. An approximate habitat surface area of 1 m^2 was examined for each habitat type. A 500 µm mesh net was used as sieve for the collection of samples. Uncollected but visually observed organisms were noted. All collected macroinvertebrate samples were immediately preserved in 75 % ethanol for processing and identification.

Fish sampling was not undertaken due to the strong current and deep water.

The sampling information was supplemented by interviews of local residents on river biota.

Baseline Conditions

Inland Streams – A total of 241 individuals from 31 macro-invertebrate taxa were collected and identified (Table 8-11). The list includes aquatic insects, mollusks, freshwater earthworms, crabs, and shrimps.

- **Aquatic Insects** - The aquatic insects were dominated by the groups Coenagrionidae (damselfly nymph), Heptageniidae, and Baetidae (mayfly nymph).

  In Dayano Creek, there were more insect larvae taxa found in the reach downstream of the SURICON facilities (Station 2). However, these are the moderately tolerant to tolerant types. The absence of sensitive species in the downstream sampling site may be due to:

  1. Fewer bank vegetation and tree cover compared to the upstream station; thus, fewer suitable habitats for the adults or

  2. Relatively deeper and sandy muddy type of substrate which is unsuitable for insect larvae.

  The effects of water outflow from the adjacent flooded open pit are ruled out because of the good water quality.

  In Magpayang River, the Motorpool (Station 7) sampling site, which is the most upstream sampling station, has the highest total number of individuals and species. The site apparently receives fewer disturbances from human activities. The rocky-stony substratum creates many riffle areas suitable for benthos and some fishes. Most taxa collected were of the sensitive type, dominated by the mayfly nymph Baetidae. There were some moderately tolerant species such as the Coenagrionidae damselfly nymph.

  The next sampling station downstream, Cawilan Station 4, contains about four (4) species taxa of insect larvae. Three (3) are sensitive and one is moderately tolerant.

  Farther downstream, the Tailings Pond Station 3 contains about five (5) taxa of insect larvae. Of this, two (2) are sensitive and two (2) are tolerant types.

  In the more downstream sampling stations along Magpayang River, the collection of insect larvae, even on the riverbanks, was difficult because of the very deep waters. Furthermore, the substratum is a combination of stone, sand, and mud. Sandy-muddy substrates are usually not preferred by insect larvae, even if the water is relatively clean. Two (2) moderately tolerant insect larvae taxa were collected from Alegria Station 5.

- **Other Invertebrates** - Other aquatic invertebrates are present in Dayano Creek and Magpayang River. As regards molluscs, the relatively swifter upstream portion of Dayano Creek contains two species of melaniids, while the relative slower downstream portion contains other epiphytic molluscs aside from the bottom dwelling melaniids. A notable mollusc species collected in the downstream portion of Dayano Creek is *Oncomelania hupensis*

quadrasi, the intermediate host of the blood fluke *Schistosoma japonicum*. This confirms the report that schistosomiasis is present in the area. The shrimp, *Macrobrachium mammilodactylus*, is present in both sampling sites along Dayano Creek. It is also found in Motorpool Station 7, Tailings pond Station 3, and Cawilan Station 4.

- **Plankton** - As shown in Table 8-12, plankton collection in the sampling sites was relatively low. Lotic systems in general contain much lower plankton as compared to standing water systems like lakes and ponds. In the case of Magpayang River and Dayano Creek, the collection was further affected by the heavy rains which made the flows bigger and swifter.

- **Fish -** The bad weather condition during the time of sampling prevented the collection of fish from both rivers. According to the local fishermen, the following fishes are present:

  Oreochromis niloticus - "tilapia"

  Clarias batrachus - "hito"

  Glossogobius giuris - "biya"

  Ophieleotris aporos - "biya"

  Ophiocephalus striatus- "dalag"

  Anguilla marmorata - "igat"

  Puntius binotatus - "pait"

  It is highly probable that there are more fish species that inhabit the rivers.

Lake Mainit – Tumanda *et al.* assessed the physical, chemical, and biological characteristrics of the lake in October 2003 and January and April 2004. The lake characteristics that were investigated include morphology, bathymetry, visibility, vertical temperature-DO profile, baterial load profile, and the vertical variations of nutrients in the lake basin including those from the river tributaries.

- **Physico-Chemical and Bacteriological Properties** – The following were extracted from Tumanda *et al.* (2005):

  1. The surface temperature of Lake Mainit ranged from 27 to 30.7^{o}C. The vertical water temperature was from 26.6 to 30.7^{o}C. There are hot springs in the northern and eastern part of the lake and possibly within as indicated by temperature anomalies. The epilimnion or mixed layer is found at the upper 10 m; Lewis (1973) measured it at 12 m. The mixing may be expected to reach 30 m during intense weather conditions. The thermocline layer was observed between 10 to 35 m; the hypolimnion was beyond 35 m.

  2. Secchi depth measurements ranged from 3.2 to 6.65 m. The Mainit, Kitcharao, and Alegria areas close to the ricefields had very low water clarity. Areas away from the tributaries and those close to the Malimono Rangehad higher visibilities.

  3. The oxycline was observed to be between 10 to 35 m at about 27.5 to 30^{o}C. DO is more or less uniform in the epilimnion, *i.e.*, from 7.31 to 7.67 mg L^{-1}. DO rapidly decreases below the thermocline to less than 2 mg L^{-1} at 50 m depth. DO levels of 5 to 6 mg L^{-1} are required for growth and activity of aquatic organisms. DO less than 3 mg L^{-1} is stressful to most aquatic organisms; DO less than 2 mg L^{-1} can no longer support fish life.

  4. The mean pH observed at the surface water down to a depth of 5 m was 7.9. The pH decreased to 7.2 at 45 m depth.

5. Nutrient concentrations in the lake showed a strong vertical gradient. Mean NO_3-N varied from 0.099 mg L^{-1} at 35 m depth to 0.507 mg L^{-1} at the surface. The mean NH_3-N concentration was uniform from the surface down to 60 m depth at 0.004 mg L^{-1}, gradually increasing with depth to 0.037 mg L^{-1}. The mean PO_4-P levels ranged from below detection at the surface to 0.20 mg L^{-1} at 200 m.

   Nutrients like P and N can enter a lake from surface runoff, groundwater, streams, and by atmospheric deposition as well as recycling from bottom lake sediments. The main source of nitrate is sewage. It is also widely used in inorganic fertilizers, explosives, and as raw chemical in industrial processes. P in PO_4 form is present in most fertilizers, synthetic detergents, and toothpastes. It is also present in almost all volcanic and sedimentary rocks. The excreta of aquatic organisms are very high in ammonia.

6. Pb was not detected in most parts of the lake, except near the Municipality of Mainit at 0.04 mg L^{-1}. Cd was measured in several locations within the lake, ranging from 0.001 to 0.044 mg L^{-1}. Among the twelve lake tributaries, Tapian River had the highest Cd concentration at 0.016 mg L^{-1}, followed by Roxas River and Tagbuyawan Rivers at 0.013 mg L^{-1}. Hg was not detected in the water samples. Sediment samples from Magpayang and Agong-ongan Rivers had 208 µg L^{-1} and 139 µg L^{-1} Hg, respectively.

7. The discharge rate of lake tributaries and their TSS were measured in October and November 2003. The inferred sediment load and contributions to the lake are presented in Table 8-13. As shown, Magpayang River contributes a mere 1.09 % of the total daily sediment load of 88.84 t. Mayag River delivers 87.66 % of the total sediment load. Kalinawan River which drains the lake is inferred to discharge only 4.43 % of the sediment inflow.

8. Twelve sites within Lake Mainit were sampled for heterotrophic plate counts (bacterial density), total coliforms, and fecal coliforms. From Table 8-14, the sites with the highest bacterial densities were Mainit and Jaliobong at 41,333 cfu mL^{-1} and 14,329 cfu mL^{-1}, respectively. Total coliform and fecal coliform counts were also highest in Mainit, followed closely by San Roque at 1,600 MPN mL^{-1}. The other areas had far lesser densities and counts. The least readings were for stations at the center of the lake, away from the sources.

- **Phytoplankton –** Lewis (1973) identified ten (10) genera and 21 species belonging to five (5) phytoplankton families within the lake (Table 8-15). Tumanda *et al.* (2005) identified 27 genera and 11 species belonging to five (5) families (Table 8-16). Tumanda *et al.* reported that:

  1. The important genera of Bacillarophytes, or diatoms, are the *Nitzchia*, *Diatoma*, *Fragillaria*, and *Melosira*. All belong to pinnate groups except *Melosira* which belongs to the centric group. The Bacillarophytes comprise about 0.82 % of the observed phytoplankton population.

  2. Chlorophytes are the most abundant, *i.e.*, 94.05 % of the population. Comprising the major group of green algae that exhibits tolerance for a wide range of environmental conditions, they include the unicellular, colonial, fiulamentous, membranous, and tubular forms. Its member genera include the *Apiocystis*, *Bactrachospernum*, *Chlorosarcina*, and *Golenkenia*.

  3. The Cyanophytes, or blue-green algae, make up 4.28 % of the observed phytoplankton population. The member genera are *Gomphosphaera*, *Anabaena*, *Anacystis*, and *Lyngbia*.

  4. The Dinoflagellates were observed in minimal numbers, *i.e.*, 0.84 % of the population. The member genera are *Gonyaulax*, *Glenodinium*, *Ceratium*, and *Peridinium*.

  BMP's limnological survey in 2005 identified a total of thirteen (13) genera of phytoplankton – five (5) genera of blue-green algae, six (6) genera of green algae, and two (2) genera of diatoms in the six (6) lake stations (Table 8-17 and Figure 4-18). Of the blue-greens, *Anabaena* and *Lyngbya* were dominant. Individuals of the genus *Aphanothece* were third in abundance. Of the green algae, *Oocystis* was present in all stations. It is the only genus

present in Stations 3 (Magpayang River mouth) and 5 (off the shore of Mainit poblacion). Of the diatoms, only *Synedra* and *Melosira* were present and distributed throughout the lake.

Station 1 (off Kitcharao) was the most species-rich with twelve (12) genera present in the coastal waters. Individuals of the genera *Lyngbya, Anabaena* and *Aphanothece* dominated the blue-green algae. Individuals representing all six (6) genera of green algae (Chlorophyta) were represented but in relatively low counts. Individuals of the genus *Chroococcus,* present in all other stations, were not observed in the samples from the coast of Kitcharao. The diatoms (*Synedra* and *Melosira*) were present in moderate amounts, relative to other sites.

The phytoplankters of Station 2 (Alegria) appeared similar to Station 1. The waters of Station 2 hosted a relatively greater number of *Anabaena* and *Synedra* cells than Station 1.

Station 3 (Magpayang River mouth) had the least number, *i.e.*, seven (7), of genera represented. Of the green algae, only the genus *Oocystis* was represented. There was also a general reduction in the number of individuals in all the genera present. Station 3 was the most turbid of the six (6) stations.

The phytoplankters of Station 4 represented eleven (11) genera. The station was similar to Station 2 but had comparatively lower individual cell counts, except for the diatoms.

Station 5 (shore of Mainit town) appeared to be similar to Station 3, although the former contained a greater number of *Anabaena, Oocystis,* and *Melosira* individual cells and lower numbers for the other genera.

The waters of Station 6 (western side, Jabonga) contained phytoplanktons that represented nine (9) genera. This station had all the blue-greens present in the samples and had the most number of individuals in the group. It also had the most number of diatoms – with the number of *Synedra* individuals the highest among all the stations. Conspicuosly low are the green algae (Chlorophyta).

The number of phytoplankton species and individuals observed in 2005 was much lower than those reported by Lewis (1973) and Tumanda *et al.* (2005).

- **Zooplankton** – Lewis (1973) listed one (1) phylum, one (1) sub-class, one (1) order, one (1) genera, and seven (7) species of zooplankton (Table 8-18). Tumanda *et al.* (2005) identified a greater number, *i.e.*, one (1) phylum, two (2) sub-classes, one (1) order, nine (9) genera, and ten (10) species (Table 8-19). They reported that:

    1. The average population density was 184 indiv. L^{-1} with the highest population of 578 indiv. L^{-1} observed in Puyo and the lowest of 22 indiv. L^{-1} in Pakuyab.

    2. The eggs, nauplii, and adult stages comprised the copepod group while *Brachionus spp.*, *Keratella*, and *Proales* made up the rotifers. The cladecorans were represented by the *Diaphanosoma sp.*

    3. The zooplankton does not graze solely on phytoplankton. Bacteria largely make up the diet of some zooplankton species. It was observed that the copepods outnumbered the cladecorans which may indicate an unproductive community.

  The zooplankton genera observed during BMP's limnological survey are listed in Table 8-20. Again, the number and individuals are less compared to the two earlier surveys. Stations 1 (Kitcharao) and 2 (Alegria) had the greatest number of zooplankters. Stations 3 (Magpayang River mouth), 4 (northwest of Station 3), and 5 (off Mainit poblacion) had a lesser number of zooplankters. The copepods (probably belonging to the genus *Thermocyclops*) and rotifers were the dominant taxa. The copepods and their larval stages were present in all the stations, although there were more individuals present in Stations 1 (Kitcharao) and 2 (Alegria). The cladocerans were present only in Stations 1 and 2. The rotifers were also present in almost all stations except for the absence of individuals of the genus *Keratella* in Station 3. The rotifers were abundant in Stations 1, 2, and 6. Interestingly, the numbers of zooplankton and phytoplankton in the lake are positively correlated.

- **Ichtyofauna** – Lewis (1973) identified about 12 species of fish in the lake. Gracia (1981) reported that seven (7) species are commercially exploited by fishermen. Some were migratory or introduced by the Bureau of Fisheries and Aquatic Resources or private individuals. The most dominant in terms of fish catch, *i.e.*, about 63.3 %, was the gobies (*pidianga*). The rest of the catch was distributed among the other groups such as tilapia, mudfish, catfish, common carp, eel, and some miscellaneous species.

  Ten (10) species of fishes caught in the lake were noted in BMP's 2005 survey (Table 8-21). The decline in fish catch from the lake was established from the interviews with fishermen. The latter admitted that the catch per unit effort was a dismal 0.5 kg fisherman-hr^{-1}; fewer species, confined to the benthic gobiod species and to the exclusion of water-column species like tilapia, carps, and guoramis, were being caught. The fishermen said that to enhance the lake productivity, aquaculture was tried. However, this failed due to unfavourable weather conditions that destroyed the aquaculture structures.

- **Other Lake Biota** – Three (3) crustacean taxa were observed during the 2005 survey: the freshwater shrimp *Macrobrachium mammilodactylus* caught from the lake shore with the use of bamboo/chicken wire traps or crab traps and is being sold fresh or dried in the market; the smaller *Atya* sp. which is included in the catch being sold in the market as "bolinao" together with N. thessa and the juveniles of gobies; and the freshwater crab of the genus *Varuna*.

Impacts

1. The proposed Project can cause stressors that are directly toxic to freshwater biota. These include heavy metals, high pH, reduced DO, AMD, and toxic chemicals like $CuSO_4$, NaCN, NaOH, HCl, and diesel. An erosion and sediment control plan, chemicals management plan, and AMD management plan are needed to prevent the release of these stressors to the aquatic environment.

2. The Project can also generate non-toxic stressors that affect the ecosystems and biota. These are flows from the pit dewatering or tailings water releases and turbidity. The latter reduces DO and light penetration in the water column. It also interferes with the interaction between air and water, a natural process crucial to DO. Mud accumulation leads to anoxic and unstable conditions unfit for many aquatic organisms. Fine particulate matter easily suffocates newly-hatched larvae, clogs or damages the gill structures of fishes, decreases their resistance to diseases, and prevents proper egg and larval development.

   Excessive flows to the streams will be regulated and confined to the less rainy months of April to September. Turbidity will be addressed by the stormwater management plan and erosion and sediment control plan.

THE AIR

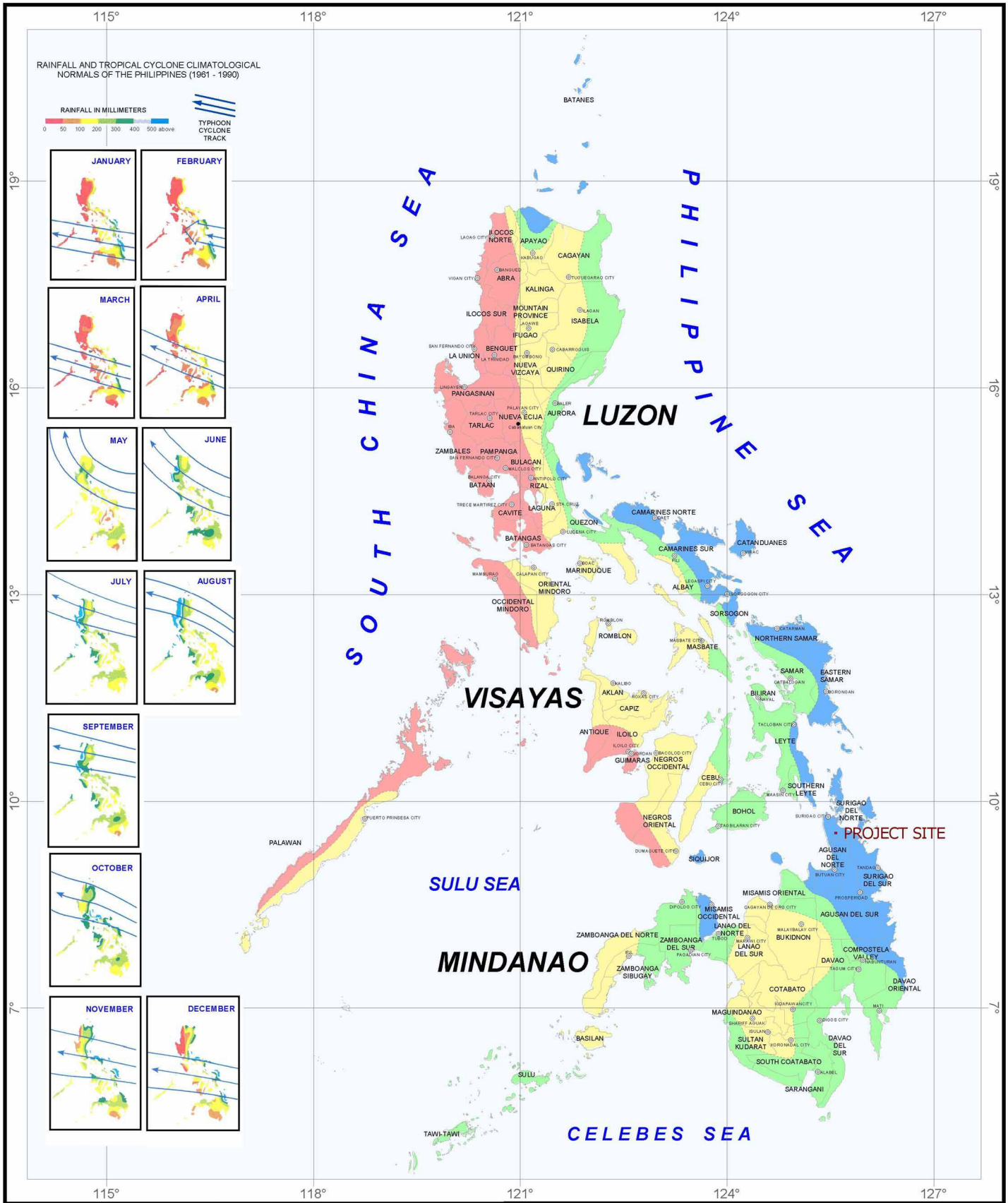
Climate

Climate Type and Controls - The climate at the Project site is classified as Type II under the Modified Coronas Classification (Figure 4-23). This climate type does not have a dry season; a very pronounced maximum rain period occurs from November to February.

Two of the major climatic controls are air streams or masses and tropical cyclones.

The Northeast Monsoon[1], Southwest Monsoon, and the North Pacific Trades are the principal air streams. The Northeast Monsoon generally affects the country in October and gradually weakens in March. The Southwest Monsoon arrives in early May and gradually disappears in October. The North Pacific Trades is dominant in April and early May and over the central and southern Philippines in October. The air stream typically overlies the Northeast Monsoon over the eastern section of the country.

[1] A monsoon is defined as a seasonal shift in wind direction.



N
W E
S

Map Projection :
Longitude - Latitude

Project Location :
CARAGA Region
Surigao, Mindanao

0 50 100 150 Kilometers
GRAPHICAL SCALE

Source :
PAGASA

LEGEND :

	TYPE I	Two pronounced seasons; dry from November to April, wet during the rest of the year.
	TYPE II	No dry season with a very pronounced maximum rainfall from November to January
	TYPE III	Seasons not very pronounced; relatively dry from November to April and wet during the rest of the year.
	TYPE IV	Rainfall more or less evenly distributed throughout the year.

bmp

Climate map of the Philippines

EIS of the Siana Gold Project

Figure No. **4-23**

Tropical cyclones are destructive weather disturbances that are marked by strong winds and heavy rains. They have a low-pressure center which is called the "eye" of the storm with no clouds and wind. In the northern hemisphere[2], the winds of a tropical cyclone blow around this low-pressure center in a counter clockwise direction with increasing magnitude nearer the center.

Tropical cyclones are classified in the Philippines according to the accompanying maximum winds. A tropical depression has winds of less than 63 km hr^{-1}, a tropical storm has winds of speed from 63 to 117 km hr^{-1}, a typhoon has wind speeds of more than 117 km hr^{-1}.

The typhoon season begins in May and lasts until December. Tropical cyclones may form as early as January to April but these are relatively few in number. Most typhoons occur from July to September. According to the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA), an average of 22 typhoons hit the country each year. Of these, five will be destructive (Gonzales, 1994). The paths of tropical cyclones vary with the season. Figure 4-23 plots the average cyclone tracks for each month.

The residents of the communities adjacent to the Project site recall the devastating effects of two typhoons. One was Typhoon Ining in 1964. The other was Typhoon Nitang which ravaged the country from 31 August to 4 September 1984.

According to the residents, Typhoon Ining damaged agricultural lands, houses, schools, and other properties. Many carabaos and one person died. Typhoon Nitang was worse. Five persons reportedly died. In Brgy. Pongtud, Municipality of Alegria, around 60 % of the houses were destroyed. Based on the records of the Office of Civil Defense, Typhoon Nitang caused 900 deaths and a total property damage of P 3.913 billion nationwide.

Rainfall - The synoptic station closest to the Siana Project site is PAGASA's Station 653 in Surigao City. It is 30 km northwest of the site. The succeeding discussions are based on data gathered at the Surigao City station.

Table 8-22 presents the climatological normals based on data compiled from 1971 to 2000. Table 8-23 shows the climatological extremes based on various periods up to 2003. Table 8-24 is the rainfall intensity-duration-frequency data.

Figure 4-24 plots the mean monthly rainfall for Surigao City. The months of May to September are less wet, corresponding to the Southwest Monsoon. October to March, the period when the Northeast Monsoon is operative, are wet months. The mean annual rainfall stands at 3,556.4 mm. From Figure 4-23, the heavy precipitation during the months of November to January is also due to the tropical cyclones. During said period, the mean cyclone path passes very closely to the Project site.

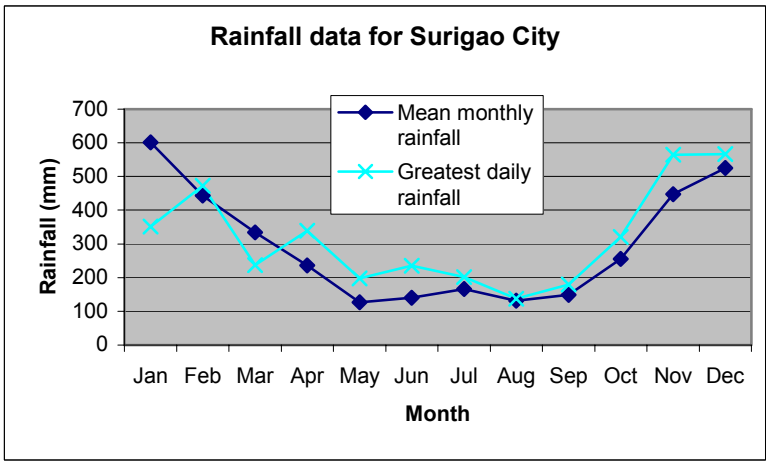


Figure 4-24. Line chart for mean monthly and greatest daily rainfall.

[2] The Philippines is part of the northern hemisphere.

Figure 4-24 also plots the greatest daily rainfall recorded for each month. In some months, *i.e.*, from April to December, the greatest daily rainfall exceeds the average total rainfall for the month.

The average number of rainy days per month is shown in Figure 4-25. The trend closely mimics that of the mean monthly rainfall.

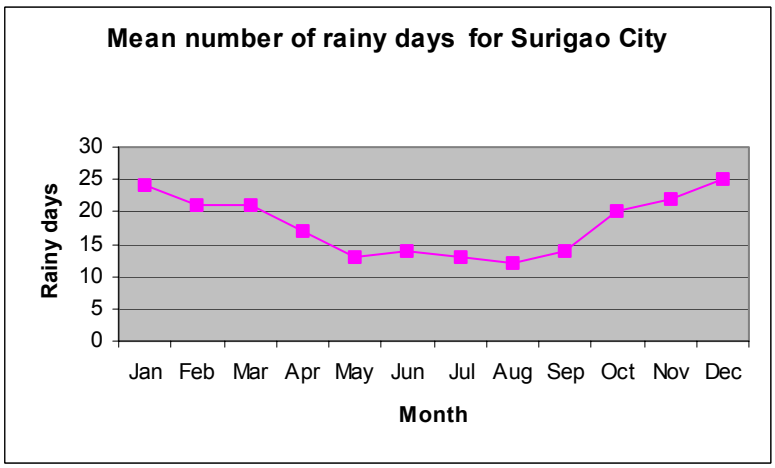


Figure 4-25. Line chart of mean number of rainy days.

Figure 4-26 is taken from the rainfall intensity-duration-frequency dataset (Table 8-24). The two years' 24-hour storm has an estimated precipitation of 204.8 mm. For a hundred years' 24-hour storm, the computed rainfall is 593.6 mm.

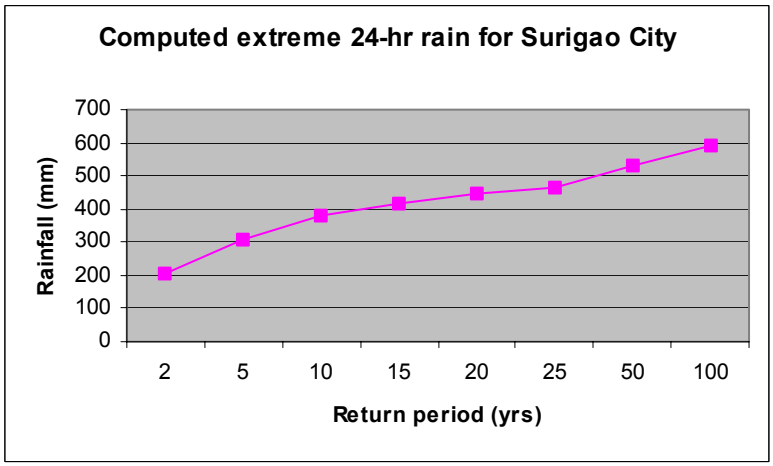


Figure 4-26. Estimated rainfall for 24-hour storms of various return periods.

Temperature - Based on the climatological normals (Table 8-22), the mean monthly temperature at Surigao City varies from a low of 26.0°C in January to 28.4°C in May, August, and September. From the climatological extremes data (Table 8-23), the lowest temperature on record was 18.2°C in February. On the other hand, the highest temperature was 37.5°C in June.

Relative Humidity - The annual average dry and wet bulb temperatures are 27.3°C and 25.1°C, respectively (Table 8-22). The annual average relative humidity (RH) is 84 %. The monthly mean RH is lowest at 80 % in August and September and the highest at 88 % for December and January.

Surface Wind - Based on the climatological normals (Table 8-22), the annual mean wind speed is 2 m s^{-1}. The monthly mean wind direction blows from five directions (Figure 4-27):

- From the east during the months of February to May
- Southwest from June to July
- West-southwest from August to September
- From the west in October
- From the east in November and
- Northeast in December and January.

The highest wind speed of 60 m s^{-1} blowing from the east-northeast direction was measured in September (Table 8-23).

Air Quality and Noise

Methodology

One-hour sampling including noise measurement was undertaken at four (4) locations on 6 to 7 January 2005 to evaluate the ambient air quality at the Project site (Figure 4-28). The weather at the time of sampling was cloudy with scattered rain showers and slight to moderate wind. The air pollutants evaluated included Particulate Matter 10 micron (PM-10), Total Suspended Particulates (TSP), Sulfur Dioxide (SO_2), and Nitrogen Dioxide (NO_2). No resampling for air quality and noise was done in 2008 in the absence of any significant new developments in the place.

Baseline Conditions

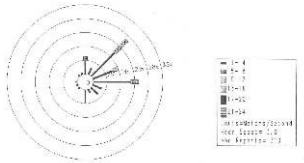
Tables 8-25 and 8-26 present the measured ambient air pollutant concentrations and noise levels, respectively. Compared to the National Ambient Air Quality Standards prescribed under the Clean Air Act of 1999, the measured ambient air pollutant concentrations were either minimal or not detectable. This is understandable considering the state of development of the area and the existence of air pollution sources. With respect to noise, all measurements exceeded the maximum allowable noise level for areas within 100 m away from the school site and residential areas. The noise sources included the students of the schools, residents, and some animals.

Impacts

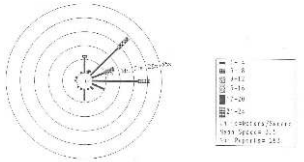
- **Air Quality** – The quantity of air pollutants generated from any source or activity is regulated by the Philippine Clean Air Act (RA No. 8749), its implementing rules and regulations contained in DAO No. 2000-81, and those prescribed by the Department of Labor and Employment. DAO No. 2000-81 defines two (2) sets of threshold values, namely, the National Ambient Air Quality Guideline Values (NAAQGVs) and National Ambient Air Quality Standards (NAAQSs). The NAAQGVs are concentrations of air pollutants over specified periods, classified as short-term or long-term, which are intended to serve as goals or objectives for the protection of public health and welfare. They are used for air quality management purposes such as determining time trends and evaluating stages of deterioration or enhancement of the air quality. The NAAQSs are concentrations of air pollutants which, for the protection of public health and welfare, shall not be exceeded at any time. The standards are enforceable and must be complied with by the facility owner. Table 8-27 provides the NAAQGVs and NAAQSs applicable to the Siana Project.

  Air dispersion modelling using ISC3 was performed to estimate the pollutant impacts, *i.e.* TSP, SO_2, and NO_2, from emissions sources of the Siana Project. ISC3 is a steady-state Gaussian plume model. Operating in both long-term and short-term modes, the model can account for settling and dry deposition of particles; downwash; point, area,

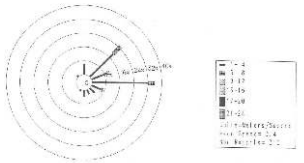
January



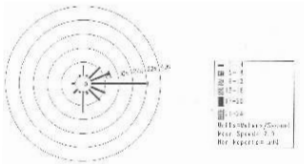
February



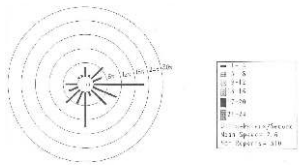
March



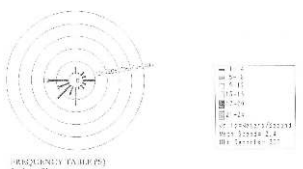
April



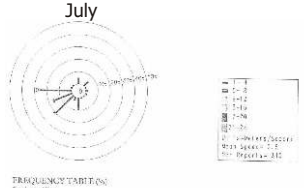
May



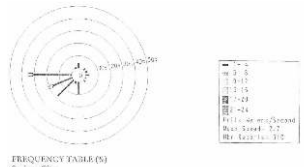
June



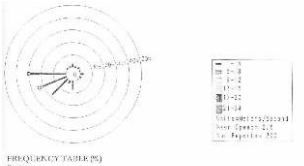
July



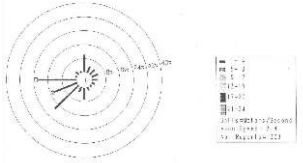
August



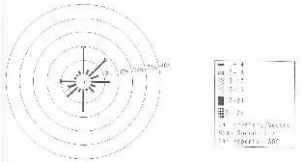
September



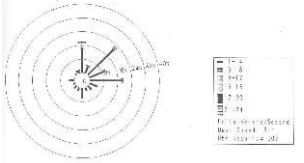
October



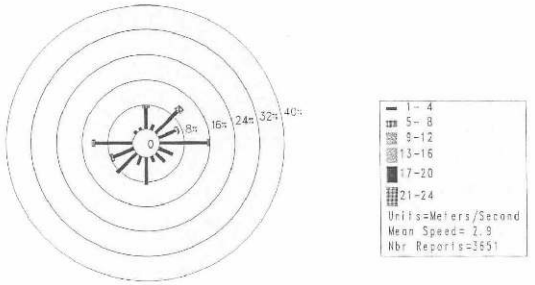
November



December



Annual

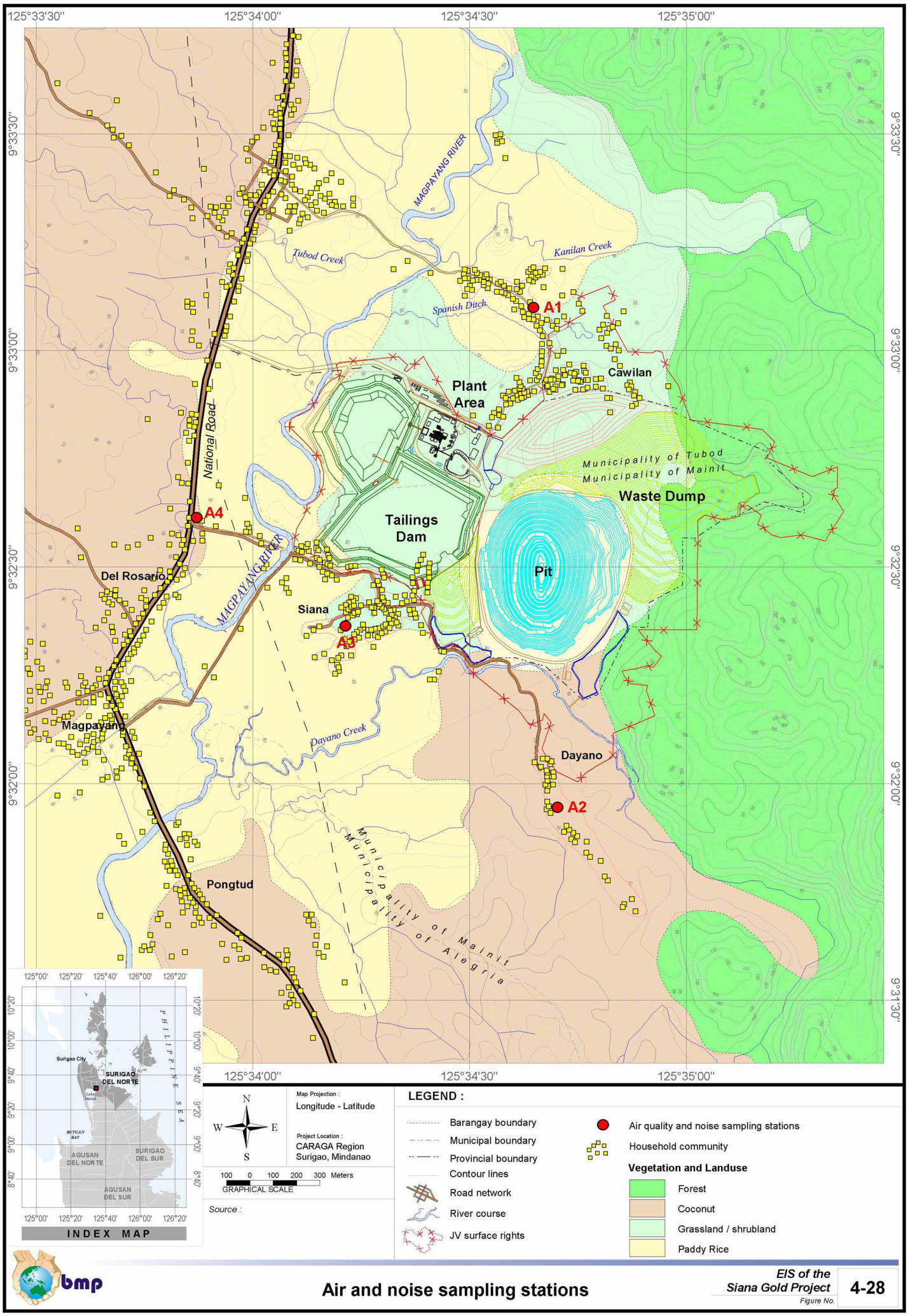


FREQUENCY TABLE (%)
Surigao, City
Wind Speed and Direction
ANNUAL (1987 - 1996)

Direction / Speed (mps)	N	NNE	NE	ENE	E	ESE	SE	SSE
CALM								
1 - 4	7.3	1.6	10.1	5.6	14.7	4.5	3.9	1.5
5 -8	.6	.2	2.1	.9	1.2	.1	.1	.0
>8	.1	.0	.1	.0	.0	.0	.0	.0
TOTAL	8.0	1.8	12.3	6.5	15.9	4.6	4.0	1.5

Direction / Speed (mps)	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM									0.0
1 - 4	9.4	2.7	9.5	7.3	12.1	.4	.6	.8	92.1
5 -8	.0	.0	.2	1.2	1.2	.0	.0	.1	7.7
>8	.0	.0	.0	.0	.1	.0	.0	.0	.2
TOTAL	9.4	2.7	9.7	8.5	13.4	0.4	0.6	0.9	100.0

Source: **PAGASA**



Air and noise sampling stations

line, and volume sources; plume rise as a function of downwind distance; separation of point sources; and limited terrain adjustment. ISC3 has two acknowledged limitations. Firstly, its emission factors are derived from a number of samples collected within the United States' western surface coal mining. Secondly, the predicted concentrations are relatively higher than the observed ground level concentrations by a factor as high as 5.

The inputs to the ISC3 modeling are as follows:

1. Topography and receptors – X, y, and z for each receptor or North-south, East-west, and elevation coordinates were determined from NAMRIA's 1:50,000 topographic map. The map was digitized and transformed into grid elevations using AUTOCAD. To comply with the maximum number of receptors, a 10 km by 10 km area was considered with grid interval of 500 m.

2. Meteorological input data – Using the model developed for the Australian Commonwealth Scientific and Industrial Research Orgnaization, PAGASA Surigao City Station's daily climatological data for 2003 were processed to obtain the hourly values and hourly mixing height.

3. Pollution sources – There are two (2) primary sources of pollution during Project construction and operation: earth movement and operation of diesel generator. Table 8-28 gives the input parameters for these two (2) pollution sources.

   The use of explosives or blasting was not included in the ISC3 modeling for air quality impacts because of the following:

   - There will be no blasting within the pit up to a depth of 30 m below surface. Up to such depth, the rocks are weathered and free-diggable with standard earthmoving equipment. Thus, there is practically a minimum enclosure of 30 m vertical distance for any blast.

     From the depth of 30 m to 60 m below surface, the rock will be 60 % free-diggable on the average. With only 40 % of the material requiring explosives, this would result in a much smaller volume of materials and suspended particulates moved by blasting.

     Full blasting will employed beyond the 60 m depth. By then, the vertical enclosure will be more than sufficient to contain any dust emission.

   - Generally, there will be one blast per day. On occasions when the working areas are separated, two smaller daily blasts may be needed. The number of blast holes per blast will range from 150 to 850. The average powder factor is expected to be 0.30 kg/BCM for dry blasting and 0.35 kg/BCM for wet blasting. These factors are low by industry standards.

   - The houses are a good 450 to 500 m from the edge of the pit. There will be structures such as the secondary waste rock dump, old waste rock dump, and main waste rock dump to shield the houses from the noise and any dust which can escape the pit enclosure.

   - Finally, the results of the dust monitoring and emission inventory done in the area of Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM) in Western Australia are instructive (Environment Australia, 1998). KCGM manages the large open cut mine commonly known as the Super Pit, adjacent to the city of Kalgoorlie-Boulder in Western Australia. Commercial and residential areas of the city are immediately west of the mining operation. KCGM's operation is large-scale, involving the mining of around 70 million tonnes of ore and waste rock annually. Most of the material requires blasting to enable its removal from the pit. Consequently, blasting is frequent. The dust emission rates of blasting compared to those of truck haulage and truck loading is very minor, about 1/8.

The ISC3 modeling returned the following:

1. Fugitive dust – For the open pit, exceedance of the NAAQS/NAAQGV at averaging periods of 1 hour and 24 hours, respectively will occur only at selected portions of Puroks Bulawanon and Malipayon 1, Brgy. Cawilan, immediately adjacent to the waste rock dump (Figure 4-29).

   For the TSF and waste rock dump, the NAAQS/NAAQGV at averaging periods of 1 hour and 24 hours, respectively have not been exceeded at the residential areas of Brgys. Cawilan and Siana (Figure 4-30).

   The 750-kVA standby generator is expected to have negligible impacts with respect to TSP for both 1-hour and 24-hour averaging periods (Figure 4-31).

   Figure 4-32 shows the aggregate TSP contours from the earthworks and generator operation at 1-hour and 24-hour averaging periods. For Brgy. Cawilan, Purok Malipayon 1 and a portion of Purok Bulawanon are expected to have ambient TSP in excess of the NAAQS, *i.e.*, 1-hour averaging. For the 24-hour averaging, Puroks Malipayon 1 and Bulawanon will have ambient TSP in excess of the NAAQGV.

   For Brgy. Siana, the NAAQS, *i.e.*, 1-hour averaging threshold, is predicted to be exceeded in Purok Riverside. The NAAQGV, *i.e.*, 24-hour averaging threshold, is expected to be exceeded in Puroks Riverside and Hilltop (Figure 4-32).

   As discussed previously, the ISC3 model predictions are limited by the use of western United States' surface coal mining data and by overestimation which can be five (5) times the actual ground level concentration. Thus, during construction and operation, regular air quality monitoring is indispensable to validating the ISC3 predictions. For public and occupational safety and health, GRC will implement dust control measures such as training on equipment use; dust suppression through water sprays, enclosures, and barriers, and dust PPEs.

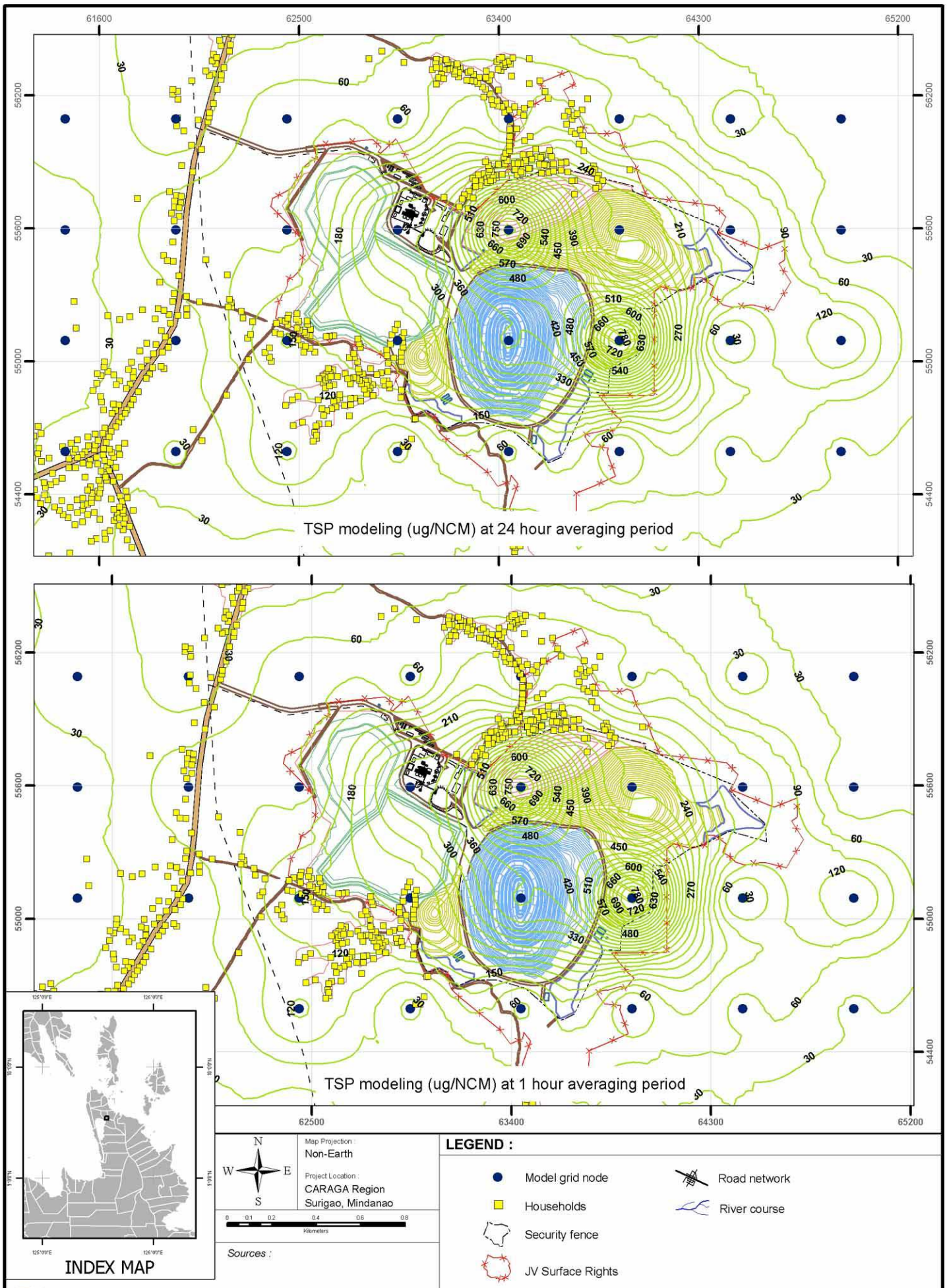
2. Generator emission – Generally, the operation of the standby generator will not cause exceedance of the DENR standards for SO_2 and NO_2 (Figures 4-33 and 4-34). Based on the results of the dispersion modelling, there is only one (1) occasion that the 1-hour NAAQS for NO_2 will be exceeded at a location close to the generator stack, *i.e.*, at 267 µg Ncm^{-1}.

- **Noise** - Noise is unwanted sound that affects human health. It results in hearing loss, stress, high-blood pressure, lost productivity, and distraction. The atmosphere that noise travels in is a "commons" or a public good. Noise emissions must be limited to one's property and measures or controls must be instituted to eliminate or limit noise that affects people located beyond the property boundary. Employees or workers inside the property must also be protected from excessive noise. Noise standards have been provided in "general" areas and in the workplace (Tables 8-29 and 8-30).

  The Project will involve the operation of different small and heavy equipment that will generate noise. A noise prediction model is employed to determine the combined impact of the expected equipment use.

  The Roadway Construction Noise Model (RCNM) is the United States Federal Highway Administration's (USFHWA) national model for the prediction of construction noise. It provides a construction noise screening tool to easily predict construction noise levels and to determine compliance with noise limits for a variety of construction projects. The model is based on a spreadsheet tool which was developed in support of the Central Artery/Tunnel Project in Boston, Massachusetts, the largest urban construction project ever implemented in the United States. It allows the estimation of L_{max}, the maximum noise level, and L_{eq}, the equivalent continuous and steady sound level which is equal in energy to the fluctuating level over the interval period, at receptor locations from a maximum of 20 pieces of equipment. The RCNM has been applied to the Siana Project since its equipment database includes the same equipment proposed to be used for the Project.

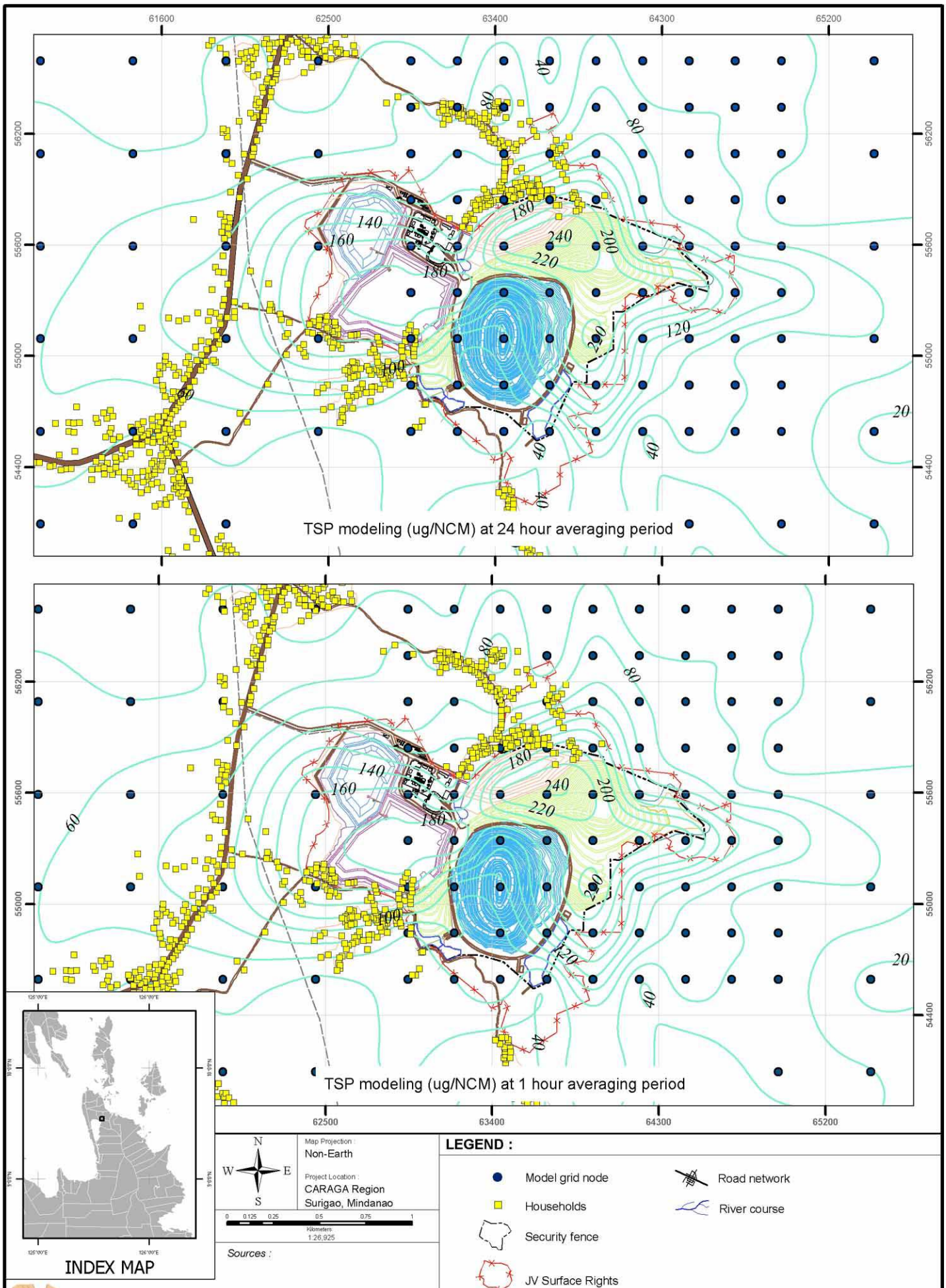
  The RCNM modelling and results are as follows:



Air Quality Impacts - TSP modeling from mining

EIS of the Siana Gold Project

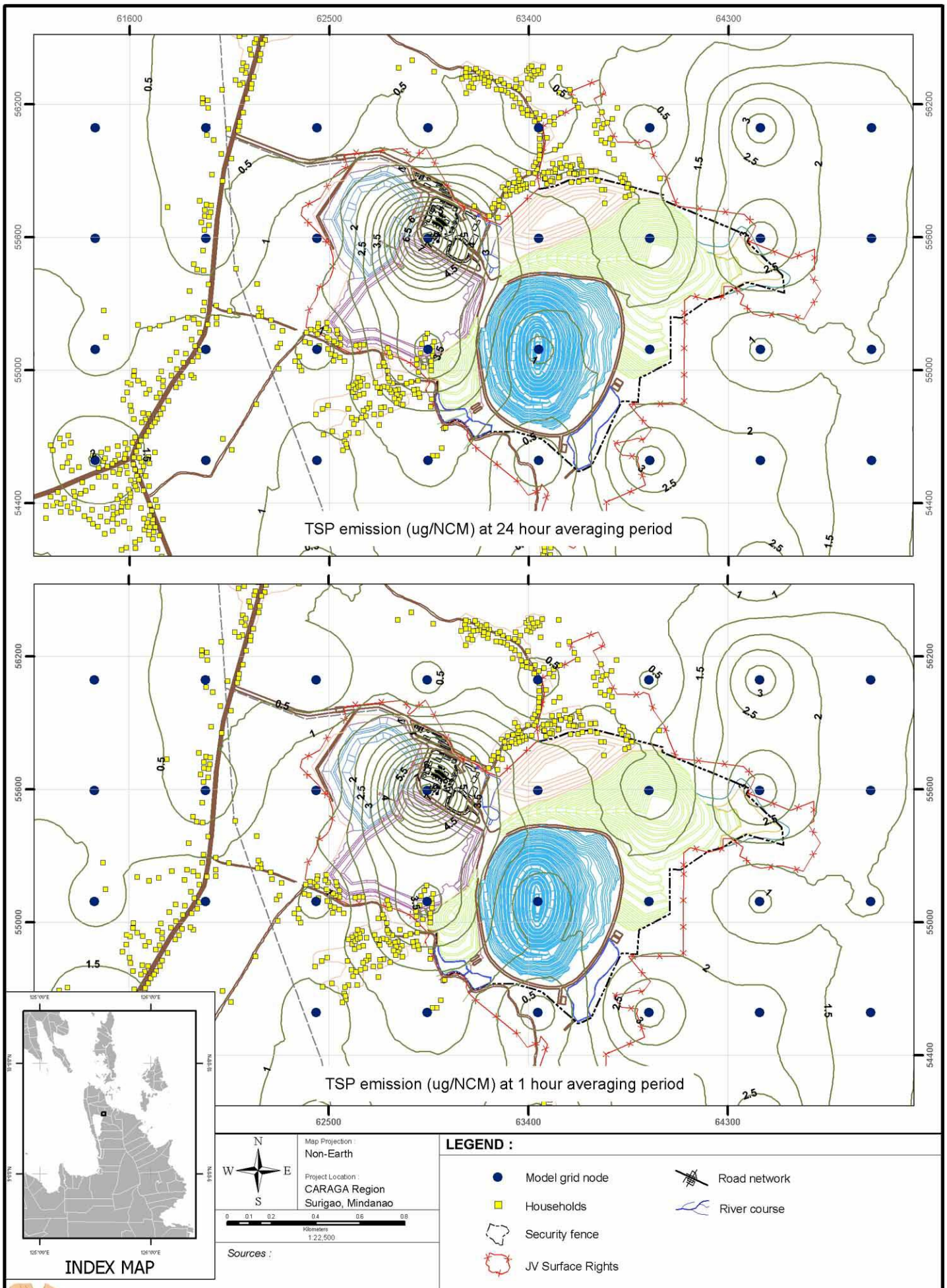
Figure No. **4-29**



Air Quality Impacts - TSP modeling from tailings dam and waste rock dump

EIS of the Siana Gold Project

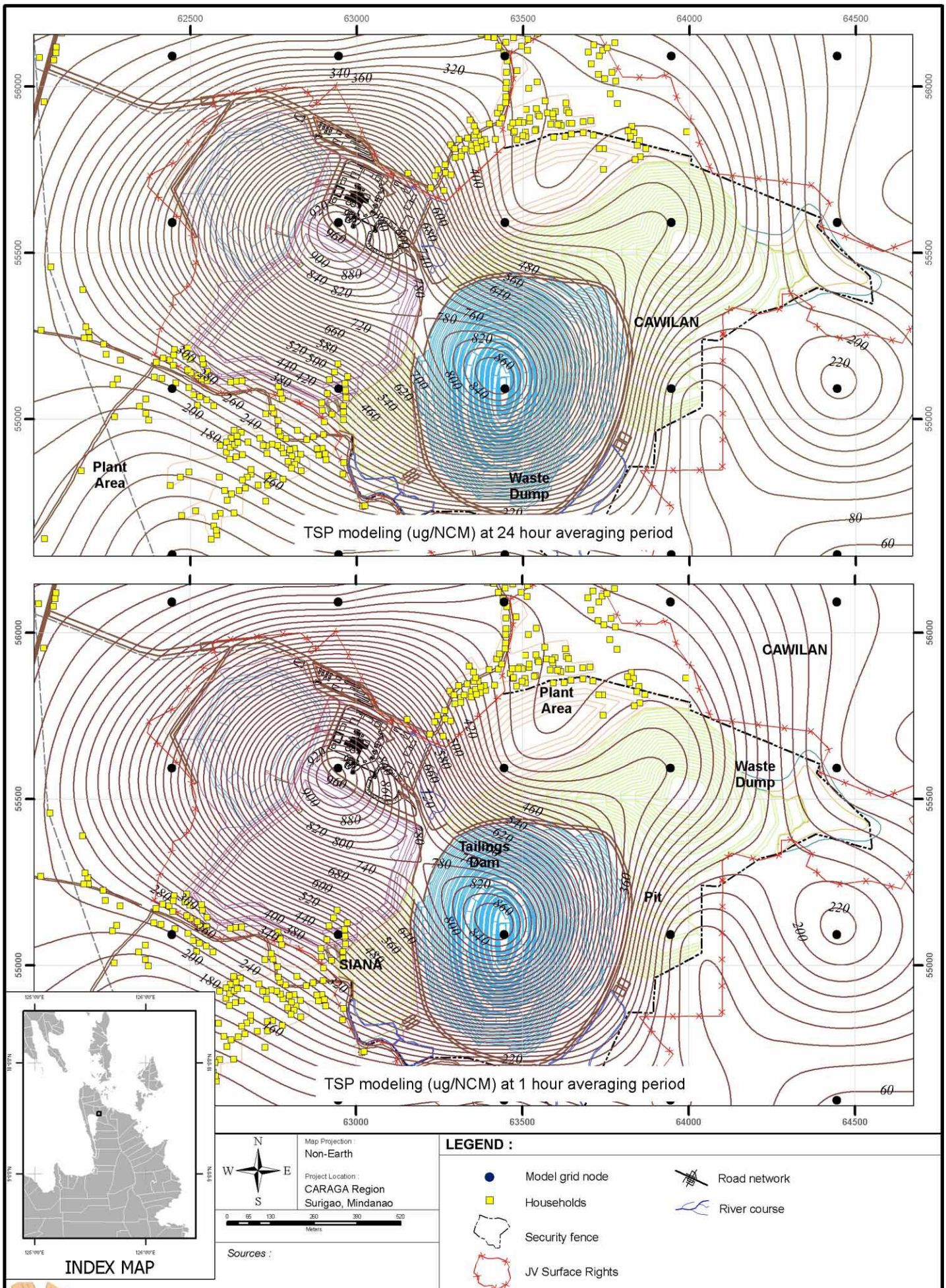
Figure No. 4-30



Air Quality Impacts - TSP modeling from generator

EIS of the Siana Gold Project

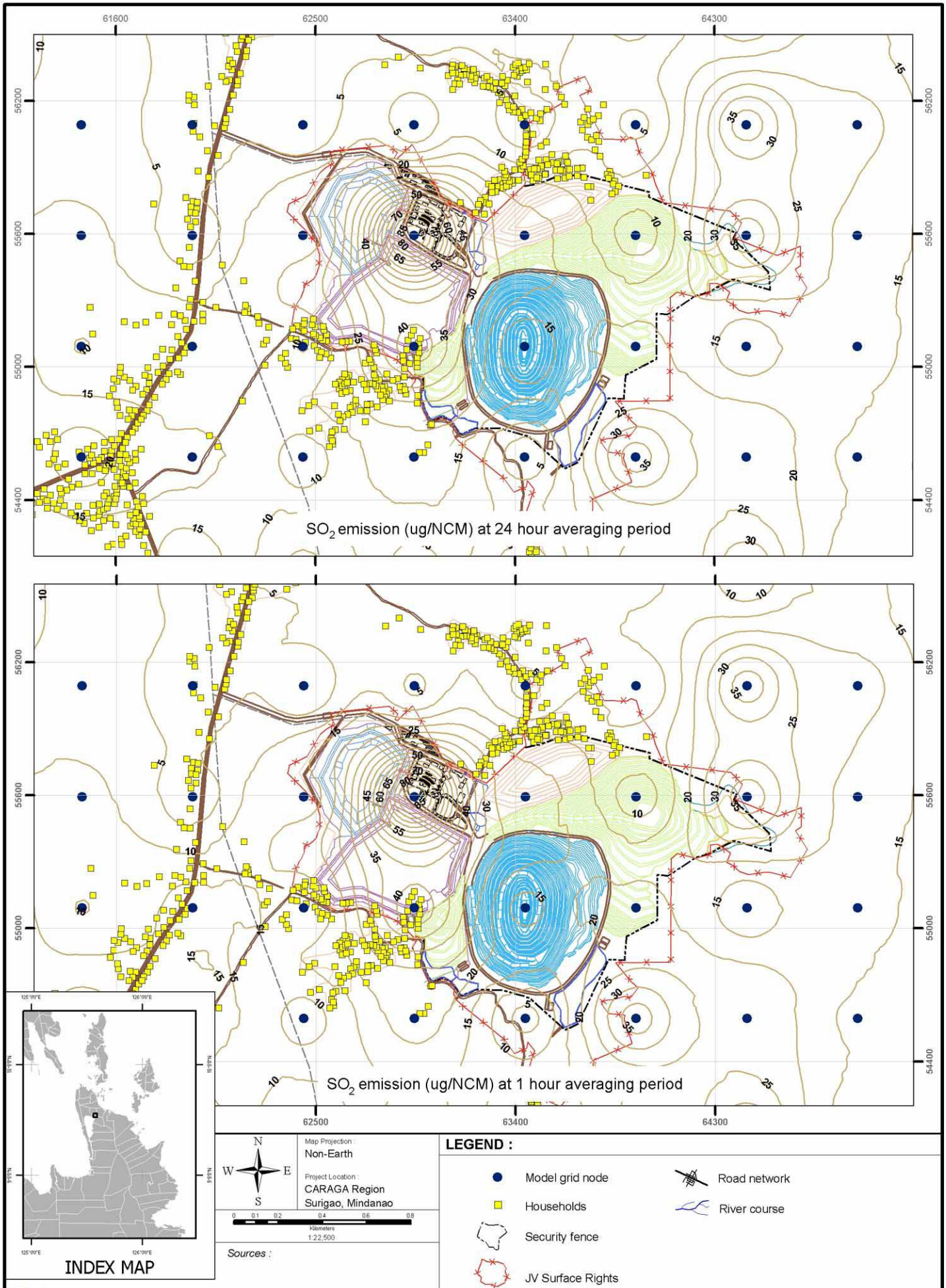
Figure No. 4-31



Air Quality Impacts - TSP modeling from all sources

EIS of the Siana Gold Project

Figure No. 4-32



N
W E
S

Map Projection :
Non-Earth

Project Location :
CARAGA Region
Surigao, Mindanao

0 0.1 0.2 0.4 0.6 0.8
Kilometers
1:22,500

Sources :

LEGEND :

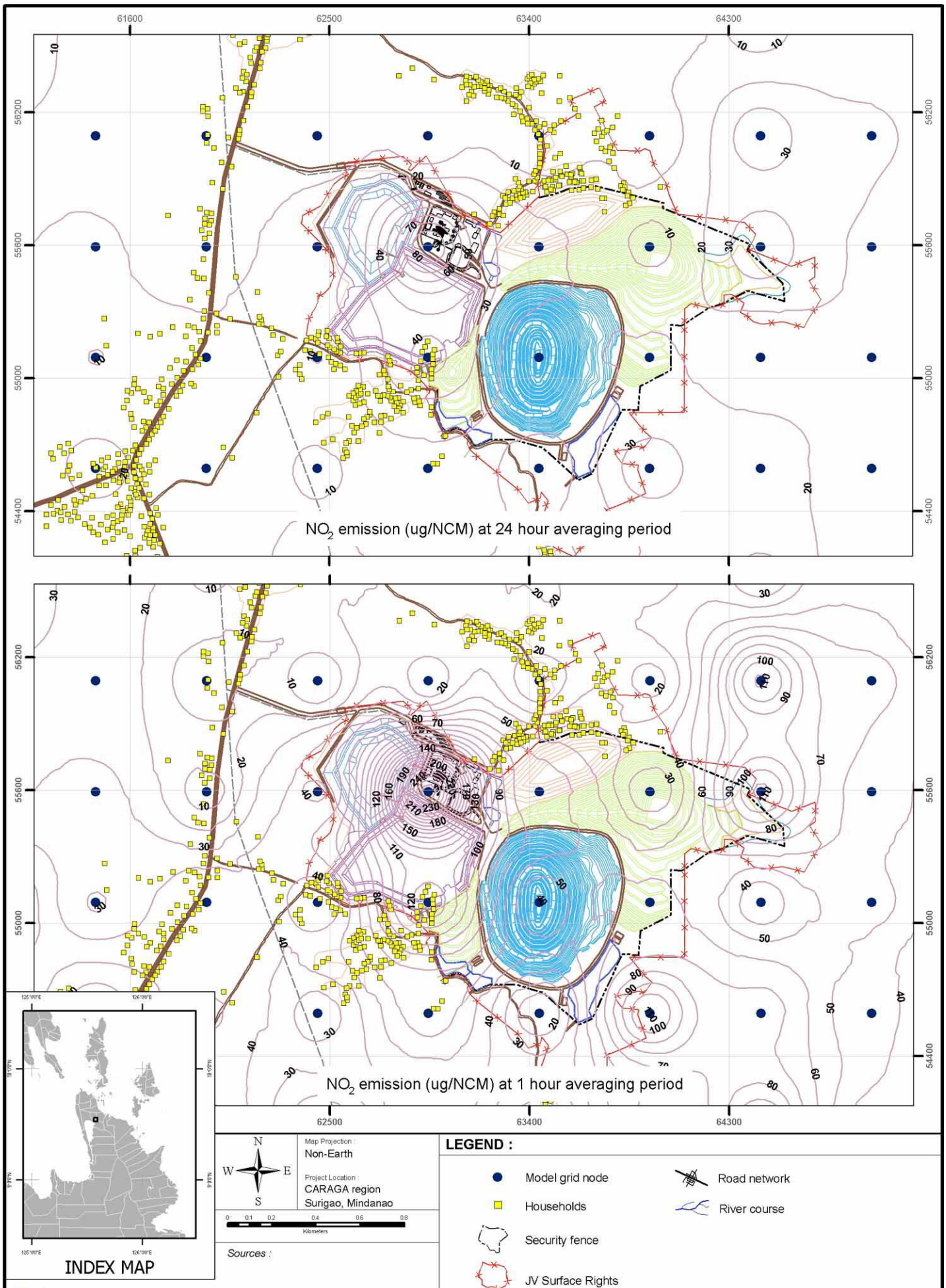
- Model grid node
- Households
- Security fence
- JV Surface Rights
- Road network
- River course

bmp

Air Quality Impacts - SO_2 modeling from generator

EIS of the Siana Gold project

Figure No. **4-33**



bmp

Air Quality Impacts - NO_2 modeling from generator

EIS of the Siana Gold Project

Figure No. 4-34

1. For the open pit area, the modelling assumes the simultaneous operation of thirteen (13) items of equipment in the open pit area during construction and operation. The equipment items are excavator, dump truck, dozer, grader, loaders, water cart, crane, rock breaker, pit bores, pumps, and pick-up trucks. At a distance of 5 m from the source, L_{eq} is estimated at 110.1 dBA (Table 8-31). At a distance of 100 m, L_{eq} goes down to 84.1 dBA. It should be noted that the predicted L_{eq}s are maximum since the modelling assumes the location of the equipment close to each other. Figure 4-35 shows the contours of the noise level estimates. Because of the pit's confining topography and distance from the residential areas, only the mine workers will be affected.

2. The TSFs and waste rock dump are located adjacent to residential areas. For the TSFs, the modelling assumes the simultaneous operation of a dozer, compactor, and two (2) dump trucks. At a 10-m distance from the source, L_{eq} is estimated at 95.3 dBA (Table 8-32). The L_{eq} is predicted to reduce to 54.9 dBA at a distance of 1,050 m. Figure 4-35 shows the contours of the noise level estimates. Based on the RCNM model predictions, the residents of Brgys. Siana and Purok Malipayon 1 of Brgy. Cawilan will be impacted.

3. For the waste rock dump, the modelling assumes the simultaneous operation of a dozer and two (2) dump trucks. From Table 8-30, the estimated L_{eq} is 93.7 dBA at a distance of 10 m. An L_{eq} of 54.6 dBA is achieved only at a distance of 900 m. From Figure 4-35, the residents of Puroks Malipayon 1 and Bulawanon of Brgy. Cawilan will be impacted by the noise.

Since the noise generators are assumed for simplicity to be adjacent to each other, the model predictions will overestimate the actual noise levels. Moreover, the RCNM model does not take into account the effects of wind, topography, and temperature gradients which will definitely affect the noise propagation. It is also worth noting that the background noise levels in the area were measured at 60 to 65 dBA. The ambient noise will mask the noise generated by the equipment.

To safeguard the health of the residents as well as its workers and contractors, GRC will regularly monitor the noise during construction and operation. The company will implement noise management measures such as the use of less noisy and shielded equipment, training on equipment use, proper equipment maintenance, and noise PPEs to workers.

THE PEOPLE

Socio-Economics and Public Health

Methodology

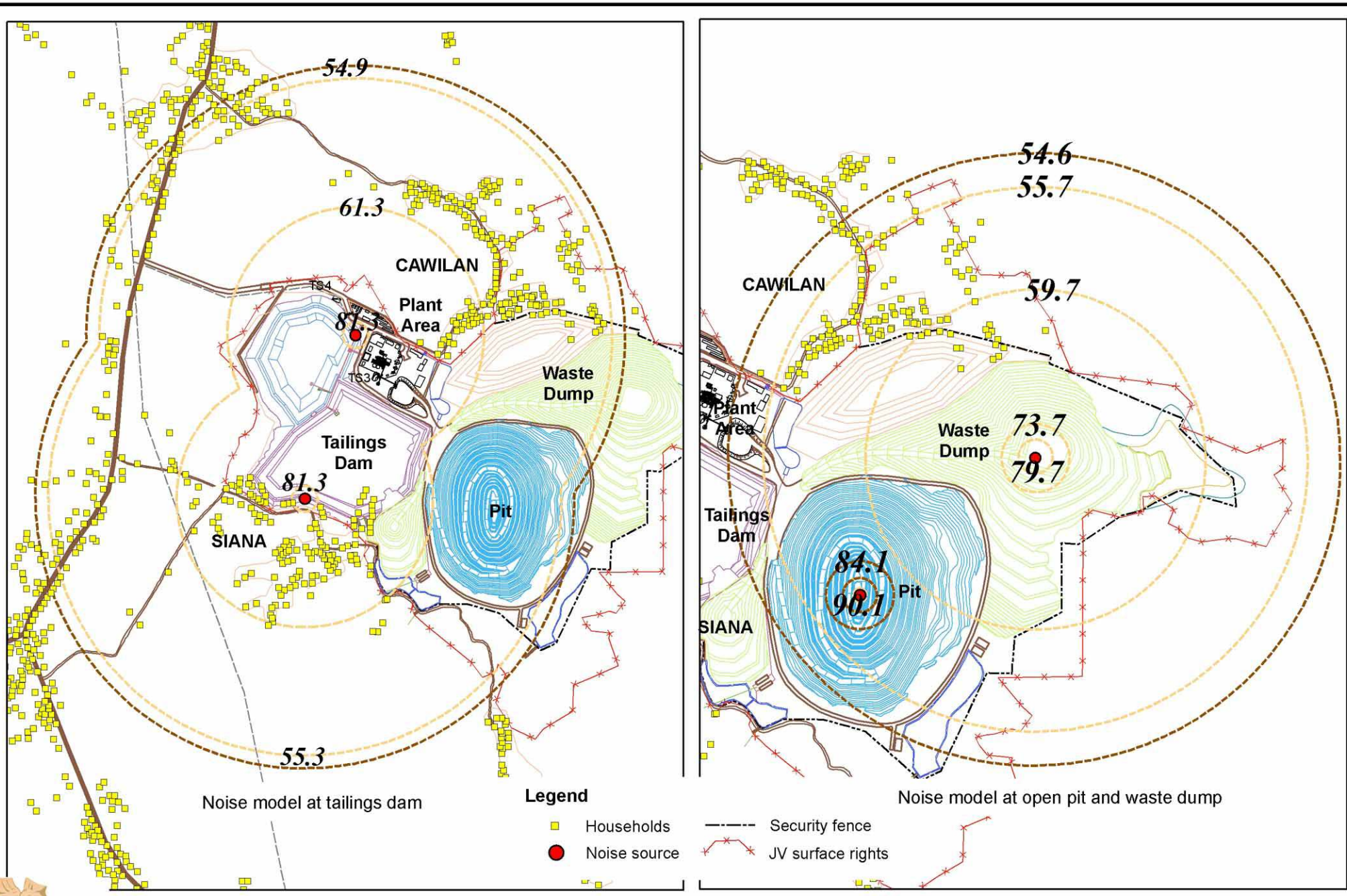
The assessment relied on municipal and provincial socio-economic data. These were supplemented by interviews with the Municipal Mayors and other officials; small meetings with Barangay leaders and residents on the community timeline and problems; small meetings with leaders and members of local irrigators, farmers, and fishermen's groups; community mapping with the Barangay Health Workers (BHWs), and household surveys.

Baseline Conditions

The socio-economic profile of the impact municipalities is discussed in Annex 8-7.

Impact Areas - The primary impact area consists of Brgy. Cawilan in the Municipality of Tubod and Brgys. Siana and Dayano in the Municipality of Mainit. (Figure 4-36). The mine, ore processing, and ancillary facilities are located in these barangays.

The secondary impact area comprises Brgys. Del Rosario in Tubod, Magpayang in Mainit, and Pongtud in Alegria. Del Rosario is impacted because a new all-weather road, that is approximately 1 km long and 16 m wide, will be built from



bmp

Noise model

EIS of the Siana Gold Project

Figure No. 4-35

the minesite to the national highway (Figure 4-36). The proposed road alignment is a mix of grassland and ricefields. The area of affected ricefields is about 0.8 ha. This road will bypass the existing barangay road network so as not to affect the users and households alongside the road. Not for the exclusive use of the Project, it will facilitate the transport of farm products.

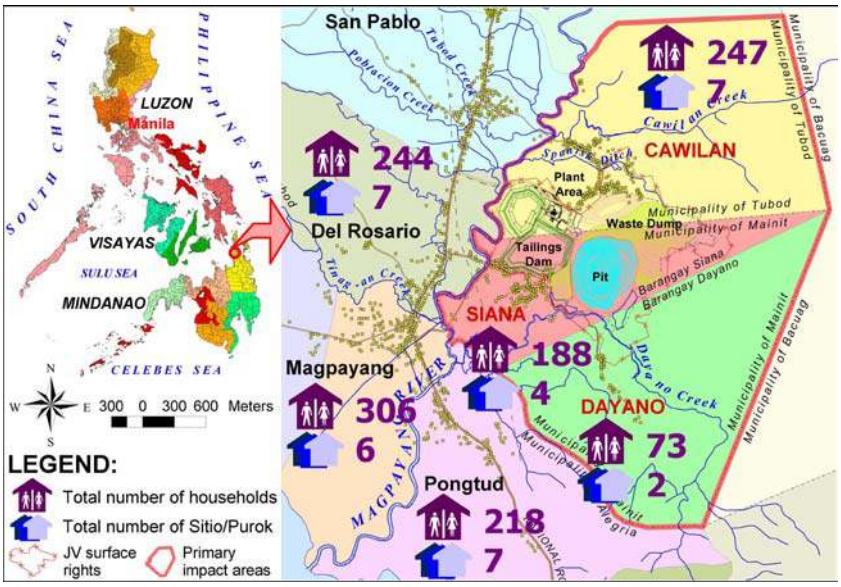


Figure 4-36. Impact barangays

Barangays Magpayang and Pongtud are in the path of the Magpayang River. The river is the recipient of possible sediments, heavy metals, and chemicals from the Project's tailings ponds and waste rock dumps as well as the 8.2 million m^3 of water to be pumped out of the open pit.

The Project is likely to impact the residents and other resource users within the six (6) barangays. The latter includes the seasonal gold small-scale miners, fishermen, and farmers who source irrigation water from the rivers.

Social Context - The residents have witnessed the opening, closure, re-opening and closure of the SURICON mine, spanning a total of 52 years from 1938 to 1990. They are familiar with both underground and open pit mining as the company used both methods to extract the gold ore.

The area has a long mining history. In the early 1800s, a Frenchman mined in the area. In 1882, six (6) Spaniards constructed the Spanish Ditch, which still exists but is much smaller and shallower. In 1887, the Spaniards made the first authenticated gold discovery in the then barrio of Magpayang, Mainit, Surigao del Norte which is now called Siana.

SURICON started underground mining in 1938. It was closed during the Second World War. In 1946, the company was the first gold mine to resume production. Fourteen years later, in 1960, the company was forced to close down due to severe operational problems aggravated by the low gold price.

In the early 70s, the company embarked on reopening the mine. A drilling program and a feasibility study were completed in 1979. In 1981, SURICON commenced development works for an open pit mine and a 1,000 TPD per day CIP-CIL mill. In July 1982, the project was fully operational and was producing gold and silver bullion. In 1990, major landslides within the pit led to a premature mine closure.

The community timeline sessions conducted with the impact barangays revealed the people's unpleasant and depressing experiences during the years when the SURICON mine was operating.

In Brgy. Cawilan, the senior citizens recalled that underground mining was done using picks and shovels. Approximately 5 % of the workers came from the barangay. SURICON reportedly did not give any assistance to the

community. When the company closed down in the 60s, the caretaker sold the scrap and other materials that were left. The people resorted to small-scale mining to survive.

When the mine reopened in the 80s, the open pit method was used. The residents remembered the damage to the rice fields caused by chemical wastes. They said that the company went from house to house to negotiate for the payment of damages. Some landowners were forced to sell their land for P 0.30 m^{-2} when the going rate was P 5. According to them, a few have not been paid up to now. They also recalled that only one person from the barangay was employed and they lamented the "bata-bata" system or favoritism of the managers.

Brgy. Siana had a similar experience. According to the residents, only a few people from the barangay were employed by the mine. They recounted that in the 60s, many people suffered from the unpleasant odor from the buried trees. In the 80s, the residents remembered the dust, noise, and polluted air and water coming from the mine. The worst incident involved the death of a man who was hit by boulders during blasting operations.

The Siana residents validated the claim of the Cawilan folks that in the 80s, the people were forced to sell their land at P 0.30 m^{-2}. They narrated that SURICON provided a relocation area (now called Purok Relocation) for the landowners but some of them have not been paid until now. The company employed about 5 % of the population but most of them were landowners. It also provided a hospital and high school for the exclusive use of its employees. The residents recalled a one and only medical mission conducted by the company in its entire lifetime.

In Magpayang, the people related the death of some animals and fishes in the river apparently contaminated by SURICON's chemicals. The ricefields were also damaged resulting to a decline in harvest. It was only when the company closed down in 1990 that the barangay was able to improve.

Reports revealed that insurgency was also one of the causes of Suricon's closure. Some residents claimed that the rebels burned the administration building which contained important records of the mining operation after the mining company left.

GRC commenced its exploration program in the SURICON property in February 2003. Mindful of the community's economic plight and prior experiences, GRC initiated a number of projects to help improve the quality of life in the impact barangays. The most notable project is the provision of potable water and a Level 2 distribution system to the three (3) direct impact barangays. The other projects include provision of medical care through the establishment of a medical clinic with a fulltime doctor and nurse, provision of medicine, feeding programs for the malnourished, playground construction, repair of schools and provision of schools supplies, tree planting, and benevolent grants. Photos 3-5 to 3-24 document some of these projects.

Population - As of 1 August 2007, a total of 6,527 people live in the impact barangays (Table 4-8). Two-fifths (40 %) are in the primary impact area and three-fifths (60 %) reside in the secondary impact barangays. Half of the population in the host barangays lives in Cawilan. Of the other half, a third resides in Dayano and two-thirds lives in Siana. In the indirect impact area, four out of ten stay in Magpayang and the balance is shared almost equally by Del Rosario and Pongtud.

Overall population in the impact area increased by an average of 0.09 % per year from 2000 to 2007. Over this period, however, only Cawilan and Siana registered population increases. Dayano's population decreased by 3 people, from 405 in 2000 to 402 in 2007. When an actual household count was conducted in May 2005 as part of the EIA household and perception survey, there were 73 households in this barangay. Applying the average household size of 5 in the area, total population is computed as 365. From 2005 to 2007, this barangay's population actually increased by 37 or 10 %.

Cawilan's average population increase of 2.45% is slightly higher than the Philippines' 2.16 %; more than double Tubod's 1.03 % and 60 % greater than Surigao del Norte's 1.53 % growth rate for the same period. Siana's population increment of 1.56 % approximates the province's but is nearly double Mainit's 0.80 % growth rate. The population increase in the host barangays is mainly attributable to the Siana Project.

Table 4-8. Population of impact barangays, 1995, 2000 and 2007

BARANGAY	POPULATION CY 1995 CENSUS	POPULATION CY 2000 CENSUS	POPULATION CY 2007 CENSUS
Cawilan	1,243	1,101	1290
Dayano	340	405	402
Siana	878	786	872
Total Direct Impact Area	2,461	2,292	2,564
Del Rosario	1,221	1,302	1249
Magpayang	1438	1,520	1498
Pongtud	1307	1,371	1216
Total Indirect Impact Area	3,966	4,193	3,963
TOTAL	6,427	6,485	6,527

Source: NCSO

Population Density - The direct impact barangays, which are classified as rural, occupy 17.92 km^2 (Table 4-9). The population density is 143 people km^{-2}. The Siana Project's footprint covers 2.4 km^2 or 13 % of the direct impact area.

The indirect impact barangays encompass 16.37 km^2 but its population density is higher at 242.1 persons km^{-2}. Of the three secondary impact barangays, only Del Rosario is rural. Being urban barangays, Magpayang and Pongtud account for the higher population density.

Table 4-9. Population density of impact barangays, 2007

Population Density	Population 2007	Land Area (km^2)	Population Density (Persons km^{-2})
Cawilan	1,290	5.42	238.10
Dayano	402	7.00	57.43
Siana	872	5.50	158.55
Total Direct Impact Area	2,564	17.92	143.10
Del Rosario	1,249	4.96	251.76
Magpayang	1,498	6.66	224.99
Pongtud	1,216	4.75	256.00
Total Indirect Impact Area	3,963	16.37	242.10
TOTAL	6,527	34.29	190.36

Sources: MPDOs

Dates of Creation - Pongtud is the oldest among the impact barangays. Created in 1935, it is the only affected barangay that predates SURICON. Magpayang and Siana were delineated as barangays in 1956, Dayano was formed in 1959, and both Cawilan and Del Rosario were officially recognized as barangays in 1960.

Barangay Income - Practically a hundred percent of the income of the impact barangays comes from the Internal Revenue Allotment or IRA, *i.e.*, the share of the local government units in the taxes collected by the National Government and is allocated based on population and land area. For 2008, the total IRA for the six impact barangays is P 3.96 million (Table 4-10). The Local Government Code mandates that a maximum of 20 % be allocated as

Development Fund. This fund is to be used for infrastructure and other social development projects. For 2008, the Development Fund for the impact barangays is P 793,000. This translates to an average per capita development fund of P 121 or P 10 person-month^{-1}.

Table 4-10. Internal revenue allotment, impact barangays, 2008

BARANGAY	POPULATION CY 2000 CENSUS	P 80,000 FOR BRGYS. OF 100 OR MORE POPULATION	SHARE BASED ON POPULATION	EQUAL SHARING	TOTAL (ROUNDED)	DEVELOPMENT FUND (20%)	POPULATION CY 2007	PER CAPITA DEVELOPMENT FUND
Cawilan	1,101	80,000	278,631	307,020	665,650	133,130	1,290	103
Dayano	405	80,000	102,494	307,020	489,513	97,903	402	244
Del Rosario	1,302	80,000	329,498	307,020	716,518	143,304	1,249	115
Magpayang	1,520	80,000	384,667	307,020	771,687	154,337	1,498	103
Pongtud	1,371	80,000	346,960	307,020	733,979	146,796	1,216	121
Siana	786	80,000	198,913	307,020	585,933	117,187	872	134
TOTAL	6,485	480,000	1,641,163	1,842,118	3,963,280	792,656	6,527	121

Source: Department of Budget and Management

Barangay Facilities - Table 4-11 presents the facilities in the impact barangays. These were taken from the social maps (Figures 4-37 to 4-42) accomplished by the BHWs and Barangay Officials during the Community Mapping Sessions conducted in April 2005.

Table 4-11. Facilities in the impact barangays, April 2005

Parameter	Cawilan	Dayano	Siana	Del Rosario	Magpayang	Pongtud	Total
Classification	Rural	Rural	Rural	Rural	Urban	Urban	
2007 Population	1,290	402	872	1,249	1,498	1,216	6,527
Households (May 2005)	247	73	188	244	306	218	1,276
Number of Puroks	7	2	4	7	6	7	33
School	1	1	1	1	3	1	8
Day Care Center			1	1		5	7
Chapel/Church	1	1	1	3	2	1	9
Basketball Court	1	1		1	2	1	6
Gym		1					1
Multipurpose Hall						1	1
Health Care Center	1	1		1	1	2	7
Barangay Hall/Office	1	1	1	1	1	1	6
Waiting Shed		2	1		3	1	7
Potable Water						4	4
Cemetery				1		1	2
Cockpit				1			1
Dryer							0

Parameter	Cawilan	Dayano	Siana	Del Rosario	Magpayang	Pongtud	Total
Rice Mill	1		1			1	3
Green Bank				1		1	2
Public Market					1	1	2

Typical of a rural agricultural setting, the basic facilities consist of health centers, elementary schools, barangay halls, daycare centers, churches and basketball courts that double as solar dryers during harvest time. The Green Bank of Caraga, a rural bank that provides micro-credit to farmers and individuals, has branches in Del Rosario and Pongtud. Of the six barangays, only Del Rosario has a dryer, a cockpit, and a cemetery. Cawilan and Siana have rice mills that were acquired with Kalahi CIDSS funding.

Educational Facilities – With the exception of Dayano, all impact barangays have complete elementary schools (Table 4-12). The Dayano Primary School offers only Grades 1 and 2. Of the six barangays, only Magpayang has a secondary school, the Magpayang High School. Elementary graduates from the five other barangays pursue high school education in Magpayang High School, San Nicolas Academy or Tubod National High School.

Table 4-12. Elementary Schools in Impact Barangays, May, 2005

Parameter	Cawilan	Dayano	Siana	Del Rosario	Magpayang	Pongtud
Name of School	Mariano Dapar Elementary School	Dayano Primary School	Siana Elementary School	Calang Custodio Elementary School	Magpayang Elementary School	Pongtud Elementary School
Grades Offered	1 to 6	1 and 2	1 to 6	1 to 6	1 to 6	1 to 6
Number of Rooms	9	1	8	7	8	8
Number of Teachers	8	1	7	7	7	7
Other Facilities	Mini Library		Mini Library	Mini Library	Complete Library and Mini Laboratory	Mini Library

Sources: School Principals

Agricultural Profile - The following profile is based on the Participatory Agriculture and Fishery Resources and Livelihood Assessment in the impact barangays conducted from 15 to 17 February 2005 by the Bureau of Fisheries and Aquatic Resources (BFAR) Region 13 with the assistance of the Lake Mainit Development Authority (LMDA) and Municipal Agriculturists and Technicians of Tubod, Mainit and Alegria.

Crops Planted

The major agricultural crops are rice and coconut. Other crops planted include cassava, sweet potato, gabi, banana, corn, ginger and vegetables. During off-season, farmers plant watermelon and vegetables.

Rice Farming

- The farm sizes range from 1 to 1.8 hectares (Table 4-13).
- Farmers plant twice a year. The first cropping is from January to April and the second is from June to October. Five croppings could be done in a two-year period to maximize the yield (Table 4-14).

- Planting is done at the same time for pest control purposes. Cutting the continuous food supply of pests such as field mice and black bug controls the population.

Table 4-13. Number of farmers and average farm size, February 2005

Barangay and Municipality	Number of Households, 2005	No. of Farmers	Average Farm Size (ha)
Cawilan, Tubod	257	32	1.50
Siana, Mainit	183	173	1.25
Dayano, Mainit	76	140	1.00
Magpayang, Mainit	350	136	1.50
Pungtod, Alegria	272	67	1.80

Table 4-14. Average yields per hectare, February 2005

Barangay and Municipality	Crops	Yield ha^{-1} (average)	Croppings $Year^{-1}$
Cawilan, Tubod	Rice	70 cavans	2 croppings
Siana, Mainit	Rice	66 cavans	2 croppings
Dayano, Mainit	Rice	66 cavans	2 croppings
Magpayang, Mainit	Rice	77 cavans	2 croppings
Pongtud, Alegria	Rice	85 cavans	2 croppings

- Carabao and small machinery such as paddy rotavator or 'turtle' are used in land preparation.
- Average yields vary from 66 cavans to 85 cavans per hectare depending on the technology and inputs.
- Maximum yields over the past 30 years have increased from 70 to 90 cavans per hectare in the 80s to 80 to 120 cavans in 2000s. The increment is mainly due to irrigation and technology improvement (Table 4-15).

Table 4-15. Maximum yield of rice crop in the respondent Barangays for the past 30 years

Barangay and Municipality	Maximum yield $ha\text{-}harvest^{-1}$		
	80s	2000s	Remarks
Cawilan, Tubod	90 cavans	110 cavans	Increase in yield attributed to irrigation facility which started in 1985. The use of fertilizer was maximum due to cheaper prices before 1995. Fertilizer price increased after 1995, reducing usage to half.
Siana, Mainit	70 cavans	80 cavans	Before 1965, without an irrigation facility, the average yield was 30 cavans ha^{-1}. With irrigation facility, the yield increased to 70 cavans ha^{-1}. With tailings run off from mining operation, the yield decreased to 40 - 50 cavans ha^{-1} due to "labod".
Dayano, Mainit	80 cavans	108 cavans	All yields are with irrigation facility installed. The water source was perceived to be at critical level due to the establishment of a reservoir for potable water purposes. This concern is no longer valid given the potable water supply established by GRC.
Magpayang, Mainit	70 cavans	120 cavans	With good irrigation facility. Farmers applied packaged technology for rice. The problem was the high price of

Barangay and Municipality	Maximum yield ha-harvest^{-1}		
	80s	2000s	Remarks
			certified seeds and fertilizers. Fertilizer usage was reduced to half.
Pongtud, Alegria	70 cavans	100 cavans	With irrigation facility. Usually, limited planting from November to February due to "goob". Rat infestation is a constant problem if there is "goob". "Dogman", a lake grass species, is washed inland when there is "goob" affecting the rice fields.

- The residents of Siana narrated that when SURICON was operating, the yield of 70 cavans per hectare decreased to 40 to 50 cavans during tailings spill episodes. Sticky mud which they refer to as "labod" cover the fields.
- In barangays nearer Lake Mainit such as Magpayang and Pongtud, yields decrease when the lake overflows and inundates the rice fields. The stagnant water, termed "goob", attracts the rats.
- There are more owners than tenants in Cawilan (62 %) and Magpayang (54 %). The tenants dominate the rice planters in Siana (68 %), Dayano (75 %) and Pungtod (71 %).
- There is no irrigation facility in Dayano. The ricefields in Siana, Magpayang and Pongtud are irrigated. Cawilan has a small water impounding project where farms source water (Table 4-16).
- Three financing institutions that cater to the needs of farmers operate in the area. These are the Green Bank of Caraga, the Surigao Bank and the Surigao Enterprise Development Foundation (SEDF).

Table 4-16. Existing agricultural facilities in respondent Barangays

Barangays	FMR	Rice Mill	Multi-Purpose Pavement/ Dryer	Irrigation	Small Water Impounding Project	Loan assistance
Cawilan, Tubod	√	√	√	-	√	Green Bank of Caraga; SEDF and Surigao Bank
Siana, Mainit	√	√	√	√	-	
Dayano, Mainit	√	-	√	-	-	
Magpayang, Mainit	√	√	√	√	-	
Pungtod, Alegria	√	√	√	√	-	

- The farmers estimated the cost of agricultural inputs as P 10,000 per hectare in the 80s to 90s. This increased by 50 % to P 15,000 per hectare in the 2000s. The farmers noted that prices of fertilizer have doubled in January 2005, compared to 2002.
- The farmers identified the problems or causes of decreasing yield as well as the proposed solutions. These include:
    - Planting of trees to prevent flood and soil erosion
    - Stopping of mining operations to prevent the sedimentation of the fields with 'labod' or sticky mud tailings
    - Sanitation, baiting, and use of pesticides to prevent infestations of rodents, tungro, and black bug

- Use of guano which is abundant in Barangay Dayano to replace the expensive chemical fertilizers
- Revival of the seed growers association to address the insufficiency of certified seeds
- Stopping of small-scale mining operations to stop sedimentation and the depletion of water supply
- Construction of dikes, canals, and spillways to divert overflows from the lake and mining operations

Fishing

- In the direct impact barangays, the fishermen number 43. All of them fish in the Magpayang and Dayano Rivers. None of the 15 fishermen from Cawilan owns a banca. Of the 18 from Siana, only 5 possess non-motorized bancas. In Dayano, 2 out of ten fisherfolks have non-motorized bancas.
- The fishermen in Magpayang and Pongtud fish in Lake Mainit. Of the 35 fisherfolks in Magpayang, 10 have motorized bancas and 15 own non-motorized ones. In Pongtud, only 7 of 45 fishermen have no banca. The rest owns non-motorized bancas.
- Limas, fish traps, electric fishing, and pole and line are the fishing methods employed in the direct impact barangays. Limas entails temporarily constructing a dike to trap the fishes and then draining out the water manually. Although electric fishing is illegal, it is rampant in the area.
- In the indirect barangays, pole and line, strap fishing, and spear guns are used.
- Fish catch has been declining since the 80s (Table 4-17). In the direct impact barangays, daily fish catch used to range from 5 to 10 kilos. Now, the fishermen yield only 0.5 to 1 kilo per day. In Magpayang and Pongtud, harvest used to be 9 to 10 kilos daily in the 80s. Now, this is down to 2 to 3 kilos.

Table 4-17. Average fish catch by Barangay regardless of gears for the past 20 years

Barangay and Municipality	Average Fish Catch (kg fishing effort-day^{-1})		
	80s	90s	2000s
Cawilan, Tubod (river)	5	2	< 0.5
Siana, Mainit (river)	5	2	1
Dayano, Mainit (river)	10	5	1
Magpayang, Mainit (Lake)	9	6	2
Pongtud, Alegria (Lake)	10	6	3
San Juan, Alegria (Lake)	12	8	6

- The fisherfolks attribute the declining fish catch to the destruction of habitat, increase in population and rampant illegal fishing. Some fishermen also cited the mining operations as a major culprit. They said that when the tailings dam overflows, traces of toxic chemicals end up in the rivers and lake.
- To improve fish catch, the fisherfolks recommend the following:
  - Strict enforcement of fishery laws to stop electric fishing, use of fine mesh nets, and catching of goby fries. The goby used to be abundant in Lake Mainit. Its population is declining because even the fries are being caught.
  - Proper mine waste management
  - Strengthening of the fisherfolks association through provision of training and funding.

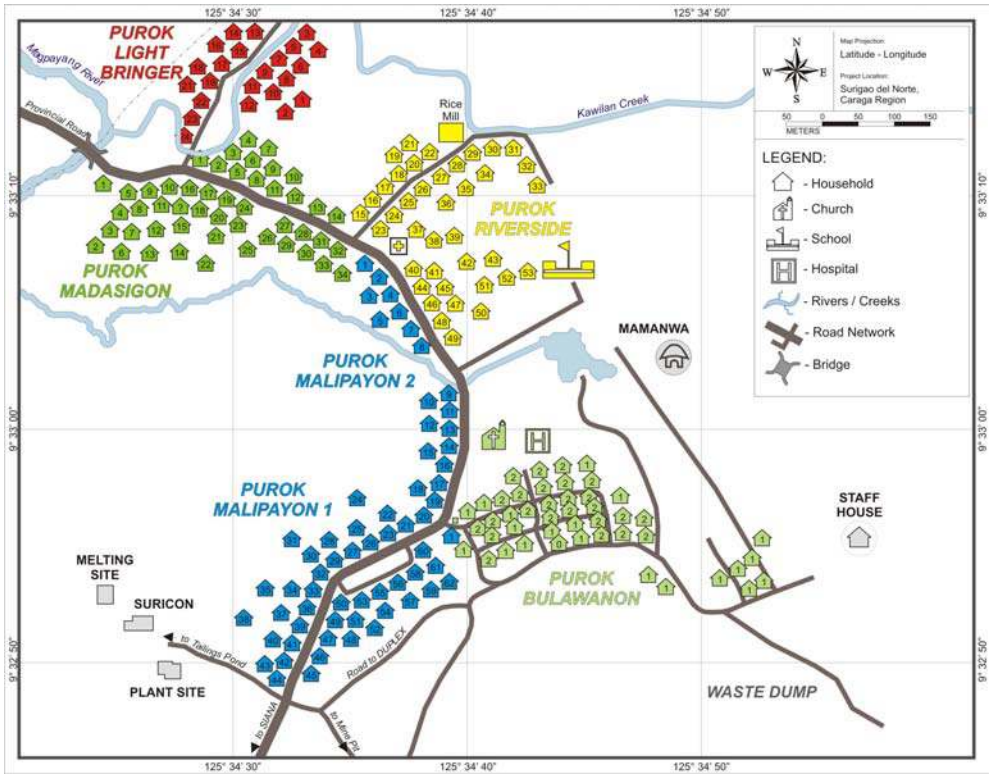


Figure 4-37. Social Map of Cawilan

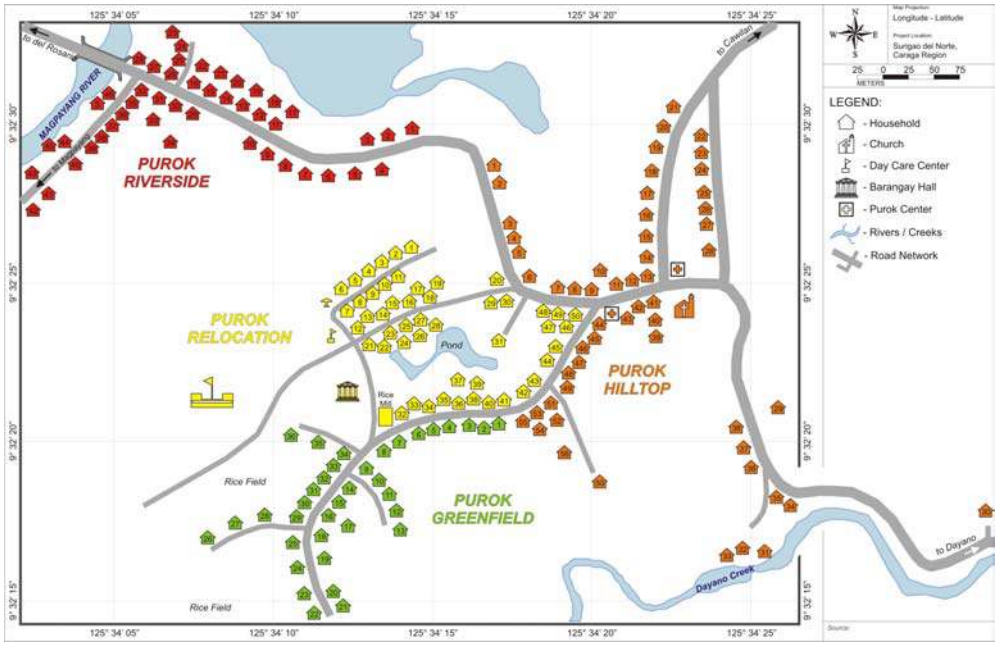


Figure 4-38. Social Map of Siana

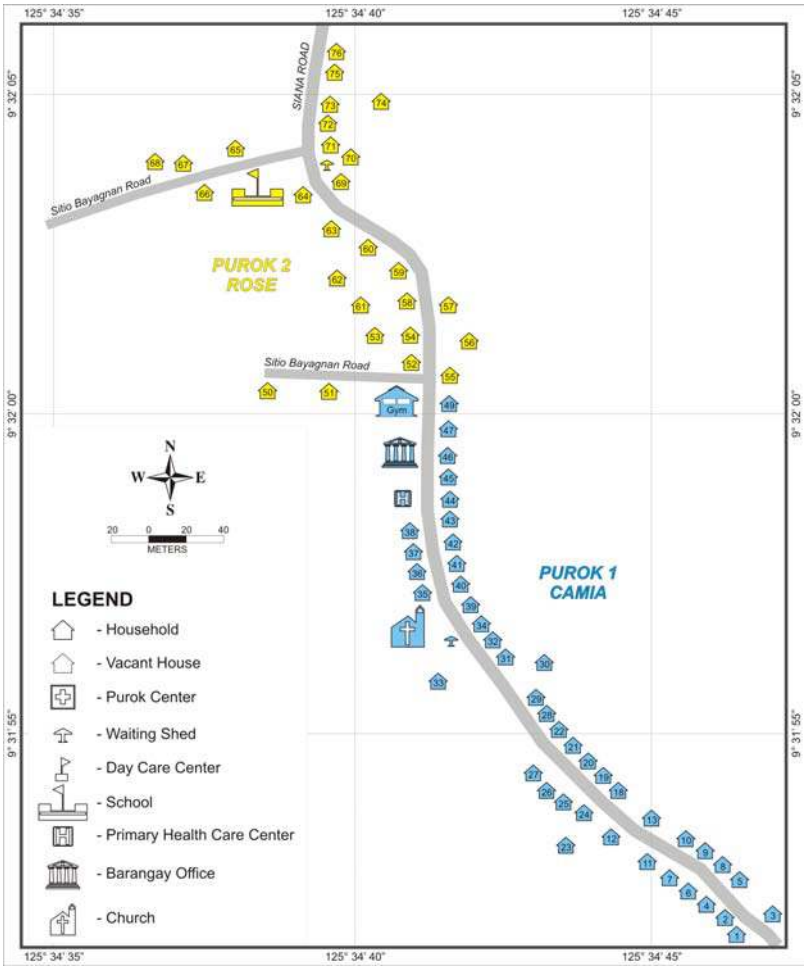


Figure 4-39. Social Map of Dayano

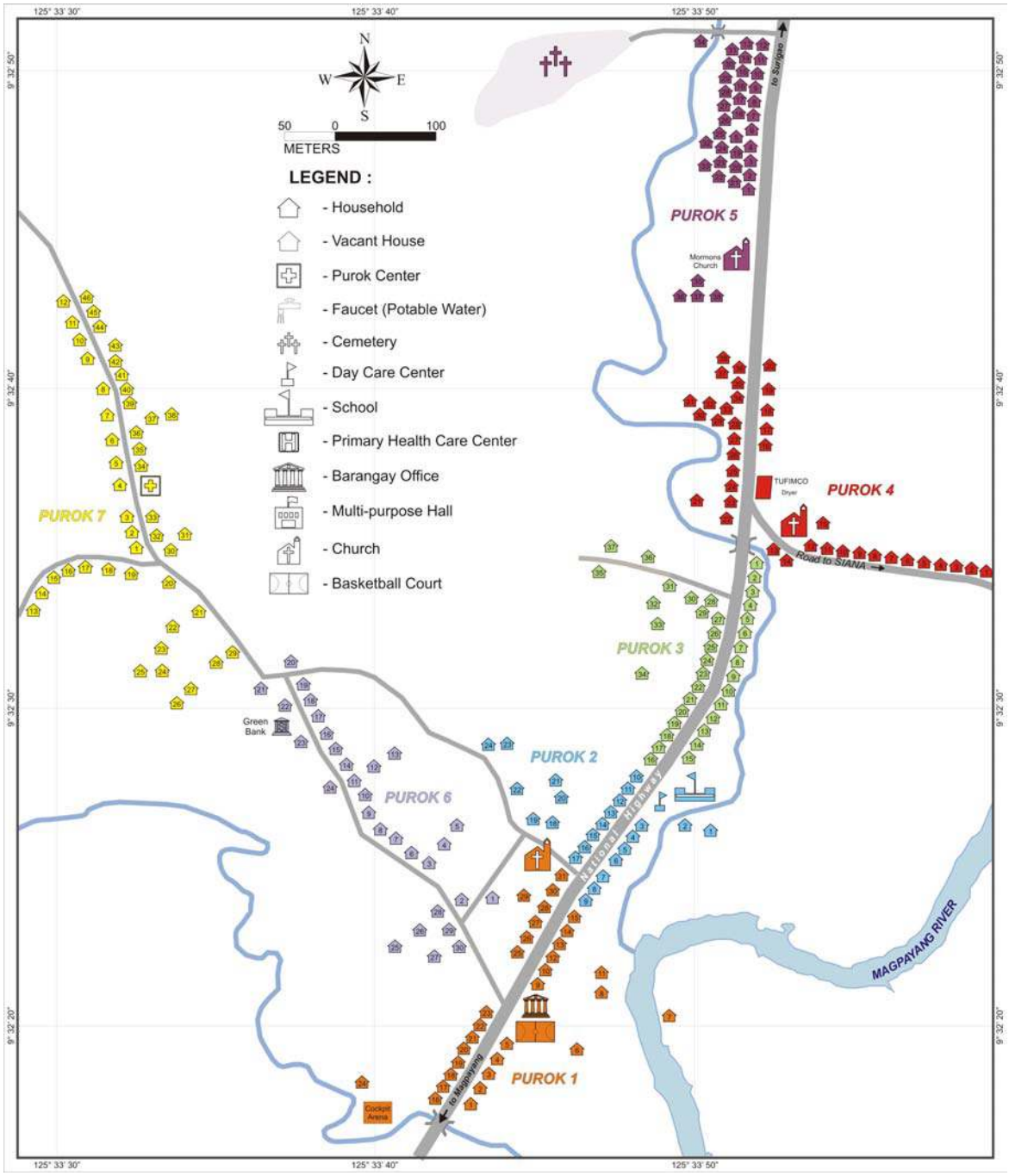


Figure 4-40. Social Map of Del Rosario

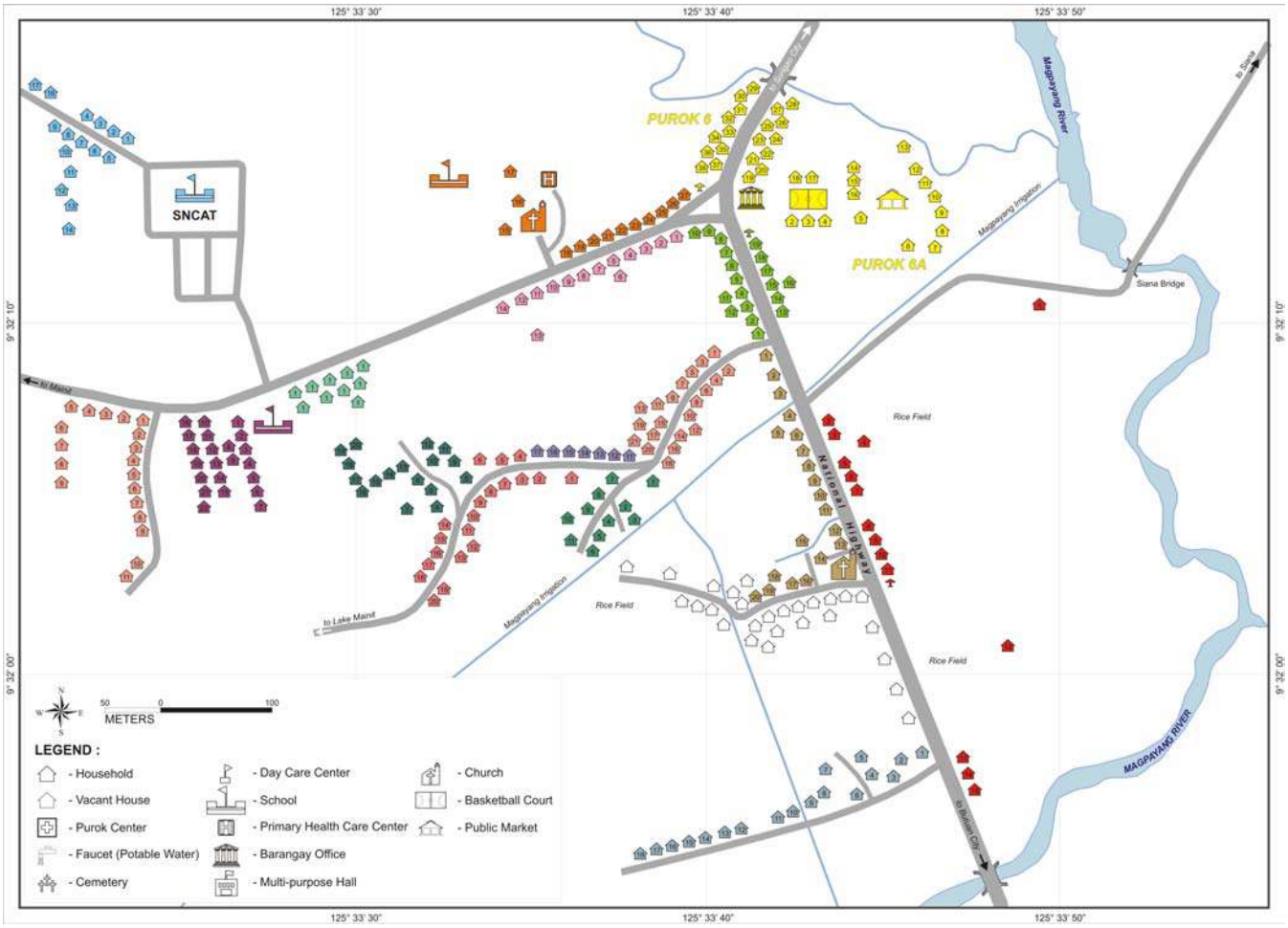


Figure 4-41. Social Map of Magpayang

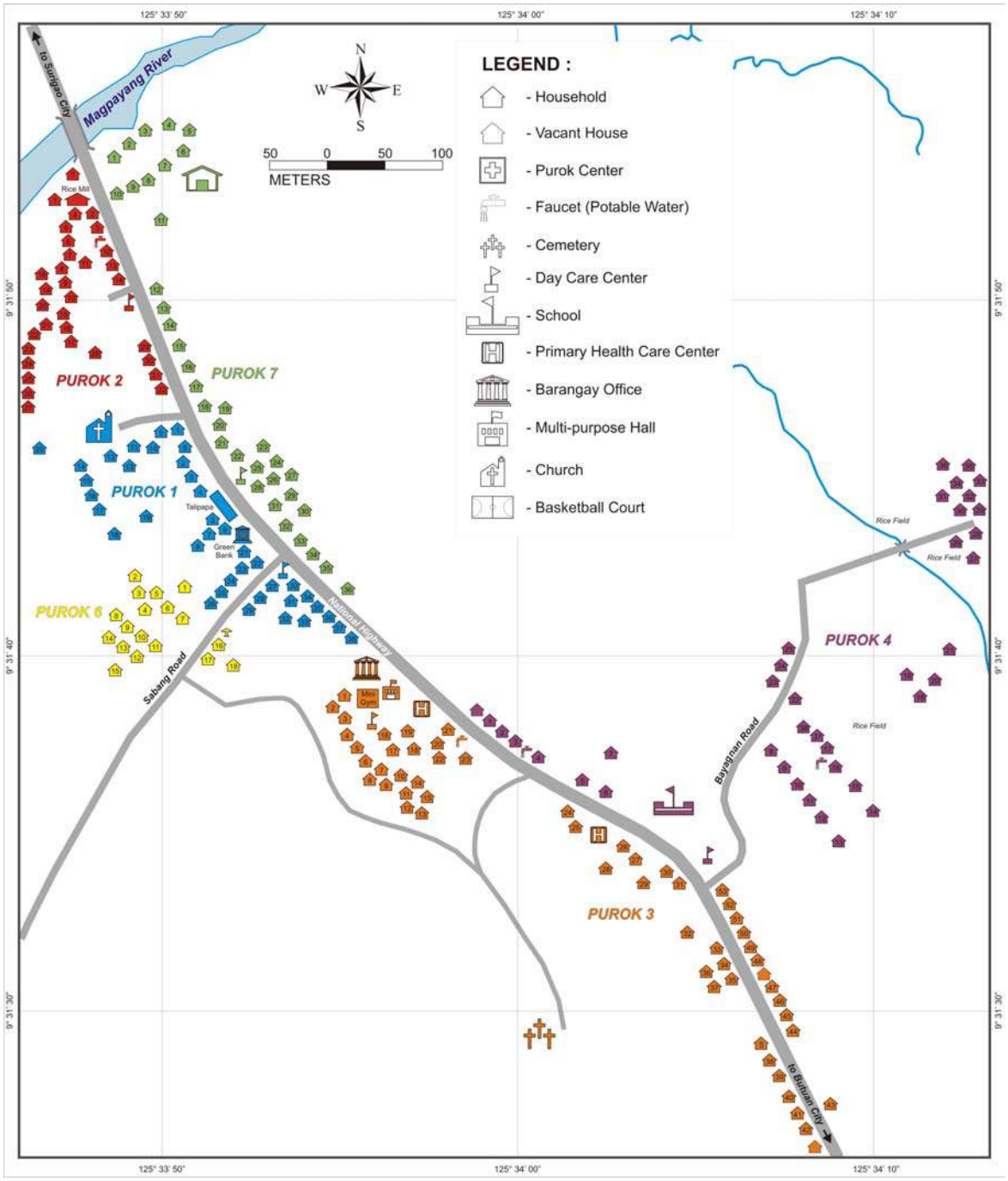


Figure 4-42. Social Map of Pongtud

Household Socio-economic and Perception Survey - Conducted from 30 April to 1 May 2005, the survey covered 186 households in the six impact barangays. Table 4-18 details the enumeration samples.

Table 4-18. Distribution of samples by barangay

Barangay	Type	Households	Sample Size	% of Households
Cawilan	Host and impact	247	52	21%
Dayano	Host and impact	73	15	21%

Barangay	Type	Households	Sample Size	% of Households
Siana	Host and impact	188	36	19%
Direct Impact Barangays		508	103	20%
Del Rosario	Impact	244	25	10%
Magpayang	Impact	306	33	11%
Pongtud	Impact	218	25	11%
Indirect Impact Barangays		768	83	11%
Total		1,276	186	15%

The 186 households surveyed consist of 1,016 members. This translates to an average household size of 5.46 which is almost 10 % higher than the Philippine average of 5.

Sample Design

The sample design of the Survey was guided by the objectives of the survey and sampling theory (Freund, 1988).

Among others, the Survey sought to assess the public approval of the Project. This was considered the overriding survey objective. The relevant Survey question, i.e., *Do you approve of the Project*?, required a straightforward answer of *Yes* or *No*. The statistical problem then becomes an estimation of proportion given two (2) possible outcomes. If we assume that for each independent trial or respondent survey, the probability of a *Yes* – the parameter to be estimated – has the constant value *p*, then the sampling distribution of the counts is the binomial distribution with the mean $\mu = np$ and standard deviation $\sigma = \sqrt{np(1-p)}$ where *n* is the sample size.

The binomial distribution can be approximated by a normal distribution when *np* and *n(1 - p)* are both greater than 5. This means that for $n = 50$, $0.10 < p < 0.90$. For $n = 100$, $0.05 < p < 0.95$. For $n = 200$, $0.025 < p < 0.975$. Considering the associated levels of *p*, the sample sizes of 50 and 100 were taken as initial estimates of sample size.

The sample size was finalized based on the following:

- Project approval is correlatable to Project impacts. Hence, it makes sense to stratify the respondents into the Direct Impact Area Barangays (DIAs) and the Indirect Impact Area Barangays (IIAs).

- The DIAs composed of three (3) barangays appear homogenous in terms of socio-economic circumstances. They also were exposed to the same set of environmental and social impacts when Surigao Consolidated Mining Company was still in operation. This homogeneity surfaced during the public consultations. Thus, no further stratification within the DIAs was made.

  The total number of DIA households was 508. A sample size of 100 would mean a sampling intensity of about 20 %.

- The IIAs composed of another three (3) barangays also seem homogenous in terms of socio-economic circumstances. They were also exposed to the same set of impacts but less severe compared to those of the DIAs when SURICON was still in operation. This was confirmed during the public consultations. Hence, no further stratification was made among the IIAs.

  The total number of IIA households was 768. A sample size of 50 means a sampling intensity of 6.5 %. This was adjusted to 10 % so that the intensity would be half of that for the DIAs.

Respondent Selection

Systematic sampling was employed to select the respondents for the survey. For the DIAs at a sampling intensity of 20 %, this meant sampling every fifth house on a side of a street. For the IIAs at an intensity of 10 %, this required sampling every tenth house.

Landmarks, usually the Barangay Hall, were selected as reference points for the start of the count. In case the selected household is not available, the next adjacent one is selected. Counting for the next respondent is referenced from the selected available household.

Population Distribution by Age and Gender

Figure 4-43 shows the distribution of the samples according to age and gender. There is an almost equal distribution of the sexes, *i.e.*, a ratio of 102.6 males per 100 females. Of the 500 females, half belongs to the reproductive age group of 15-49 years. Of this group, 43 % is between 15-24 years old. Filipino women are among those with the highest fertility rates in Southeast Asia at 3.5 births per woman.[3]

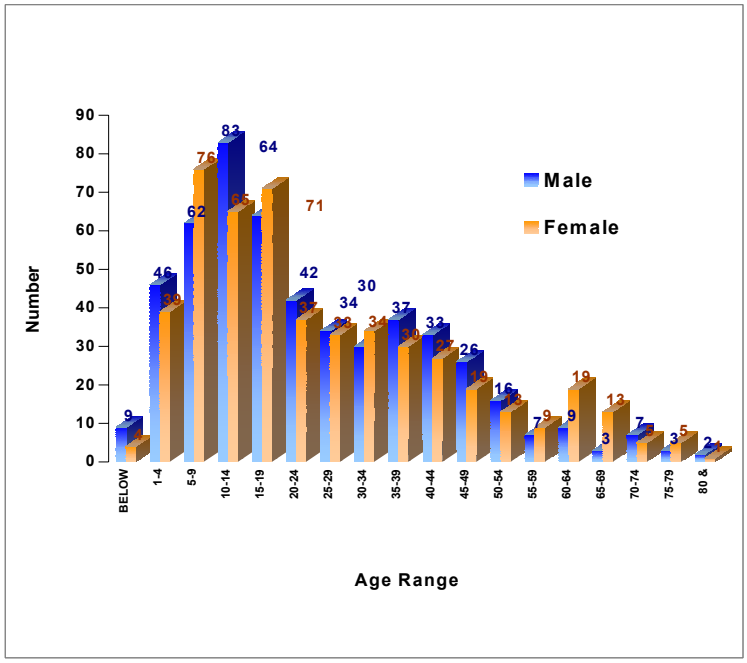


Figure 4-43. Population distribution by age and gender

Figure 4-44 shows almost the same age pattern for the impact barangays. The population is young. Half (51 %) is below 20. The infants (less than 1) comprise 1 %; the children (1-14), 37% and those of schooling age (5 – 24) 49 %. The median age is 19.

Those belonging to the 15-64 age group, also called the economically productive or working group, number 590 and comprise 58 % of the sample population. Of the non-working age group (42 %), 91 % are child dependents (0 – 14) and 9 % are adult dependents (65 and over). The dependency ratio is 100:72, *i.e.*, for every 100 persons belonging to the working group, there are 72 dependents.

[3] Source: WHO Country Health Information Profiles 2005

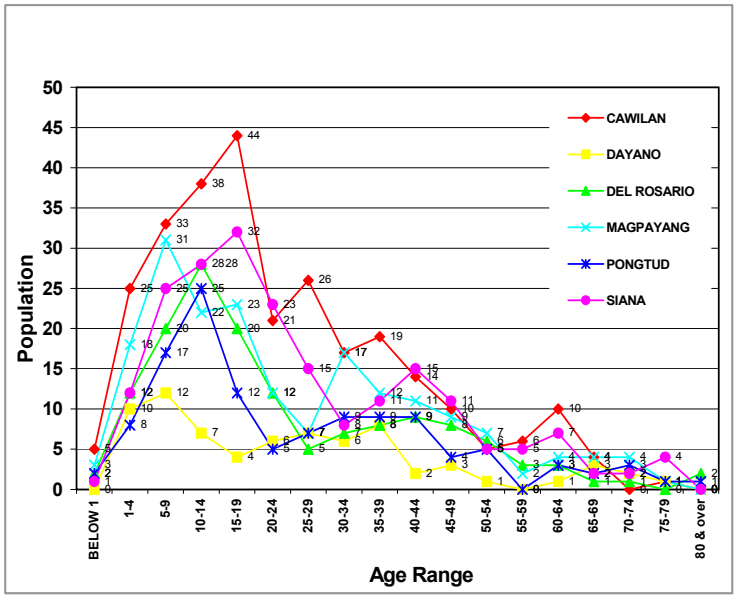


Figure 4-44. Population distribution by age by barangay

Educational Profile

Figure 4-45 presents the educational profile of the samples aged 5 years old and above. The females are more educated than the males. This trend is consistent with the trend in the Philippines.

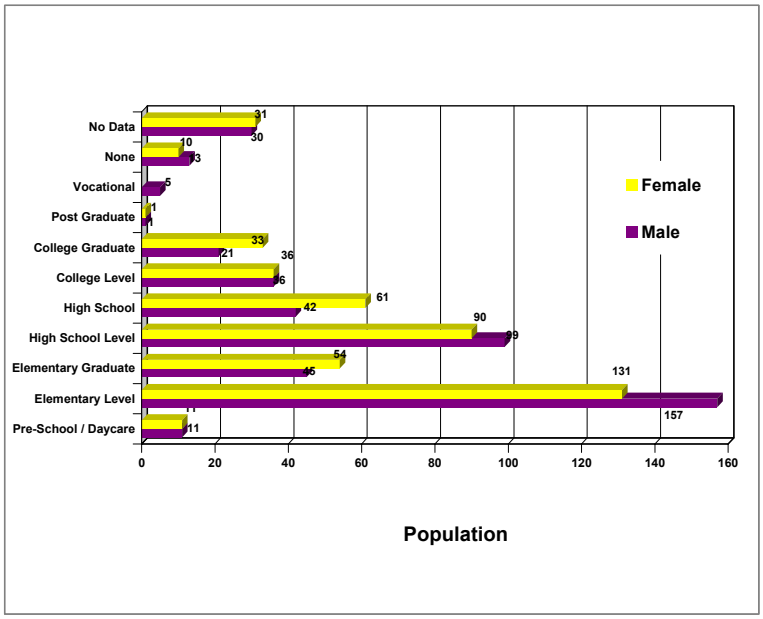


Figure 4-45. Highest educational attainment

As indicated in Table 4-19, the educational attainment of the samples does not vary significantly from the educational statistics for the CARAGA Region published in the 2004 Annual Poverty Indicators Survey.

Table 4-19. Educational attainment of samples (2005) vs. CARAGA Region (2004)

Highest Grade Completed	TOTAL	Impact Areas (2005)	CARAGA Region (2004)	Difference
Pre-School / Daycare	22	2.40%	2.10%	0.30%
Elementary Level	288	31.37%	30.10%	1.27%
Elementary Graduate	99	10.78%	12.20%	-1.42%
High School Level	189	20.59%	19.30%	1.29%
High School Graduate	103	11.22%	12.60%	-1.38%
College Level	72	7.84%	9.70%	-1.86%
College Graduate or Higher	56	6.10%	6.60%	-0.50%
Vocational	5	0.54%	0.10%	0.44%
None	23	2.51%	7.40%	-4.89%
No data	61	6.64%		6.64%
Total	918	100.00%	100.10%	-0.10%

Sources: APIS 2004 and household survey of impact barangays, May 2005

Religious Profile

Eight out of ten persons in the impact barangays are Roman Catholics. Iglesia ni Cristo, United Church of Christ in the Philippines, Born Again Christians, Church of the Latter Day Saints and United Peoples Church (UPC) each have a 2% share of the sample population.

Land Tenure

Figure 4-46 shows the house and lot tenure in the project area. Seven out of ten households own their residential house and lot. Some (15 %) are leasing while others (12 %) are allowed to occupy the houses of relatives and friends rent-free.

House and lot ownership is highest in Dayano (93 %) and lowest in Cawilan (63 %). A third of the households in this barangay said that they are leasing their residential units from Suricon. These are the former company staff houses located in Purok Bulawanon.

Of the 102 households engaged in farming, 43 (42 %) do not own the lots that they cultivate. The tillers are either lessees (67 %), tenants (14 %), caretakers (4 %), contract farmers (4 %) or laborers (10 %). Rental in the form of a 25% share of the harvest is the most common arrangement for rice lands. For crops such as cassava and camote, the harvest is normally divided equally between the landowners and the farmer.

Housing Construction

Strong materials for roofing include GI sheets and tiles. Light materials are cogon, nipa, bamboo and the like. As reflected in Figure 4-47, nearly half (47 %) of the houses of the samples have GI sheet roofing and nearly a third (27 %) have cogon or nipa roofing. Houses that have mixed roofing materials constitute 26 %.

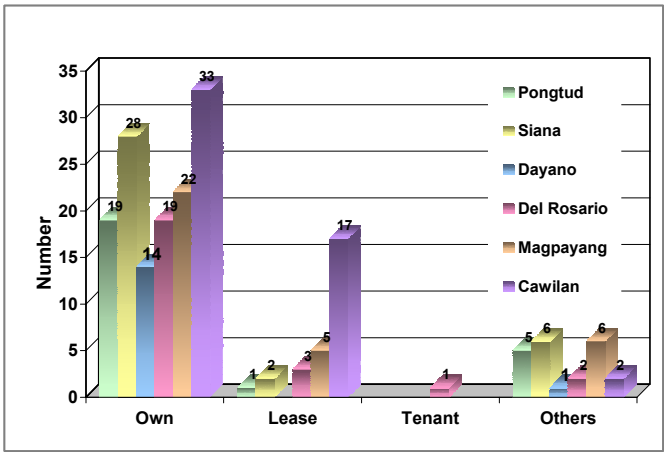


Figure 4-46. Residential house and lot tenure

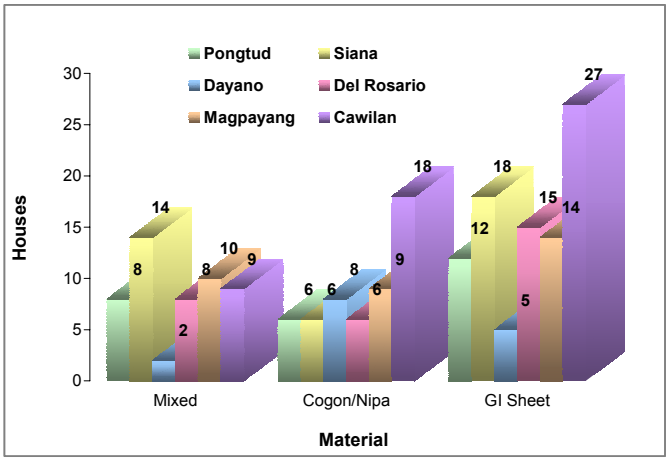


Figure 4-47. Roofing materials

Concrete and brick stone are classified as strong walling materials. Wood, bamboo amakan, lawanit and coco lumber are light materials. Of the samples, 41 % have strong walls and 58 have walls with light materials. There is one house with no walls and another one with tarpaulin walls.

Only four (4) samples reported tiled floors. At the extreme, there are 30 houses with bare earth as flooring. Four out of ten houses have cement floors, three out of ten have wooden floors, and one in ten have bamboo floors.

Household Appliances and Work Tools

Among the household conveniences, the color TV is the most visible in the homes of the impact community, *i.e.*, available in 102 out of 186 or 55 % of the samples. This is followed by the casette recorder (30 %) and refrigerator (25 %).

Table 4-20. Household Appliances

Appliance	Cawilan	Dayano	Siana	Del Rosario	Magpayang	Pongtud	Total
Color TV	25	5	24	13	20	15	102
Casette Recorder	13	2	13	7	10	8	53
Refrigerator	8	1	11	9	12	6	47

Appliance	Cawilan	Dayano	Siana	Del Rosario	Magpayang	Pongtud	Total
Stereo/ Component	9	2	8	4	11	9	43
Transistor Radio	4	4	6	9	7	4	34
Washing Machine	11	2	5	2	7	2	29
BW TV	2		4	1	1	3	11
CD player						9	9
Electric Fan			1		2	5	8
Rice cooker					2	1	3
Oven toaster						2	2
Electric Iron						1	1
Ceiling fan						1	1
Video 5					1		1
Others		2		1			3
Total	72	18	72	46	73	66	347

As the project area is predominantly agricultural, most households have jungle bolos and grass cutters (karet). A few have hand tractors and carabaos; two residents own tricycles with sidecars; one household owns a chainsaw. Other work tools include carpentry and masonry tools such as hammer, hacksaw and shovel.

Cooking Fuel, Water Sources, and Sanitation

Majority (56 %) of the samples use wood and charcoal as cooking fuel. A third use LPG; a tenth cook with Kerosene gas and 3% use electricity.

The Level 2 system or community faucet is the predominant water source (Figure 4-48). Three fourths (62 %) of the households obtain water from these communal faucets. Nearly a third (31 %) have piped water (Level 3). Fourteen houses (7 %) get water from jetmatic pumps and wells (Level 1).

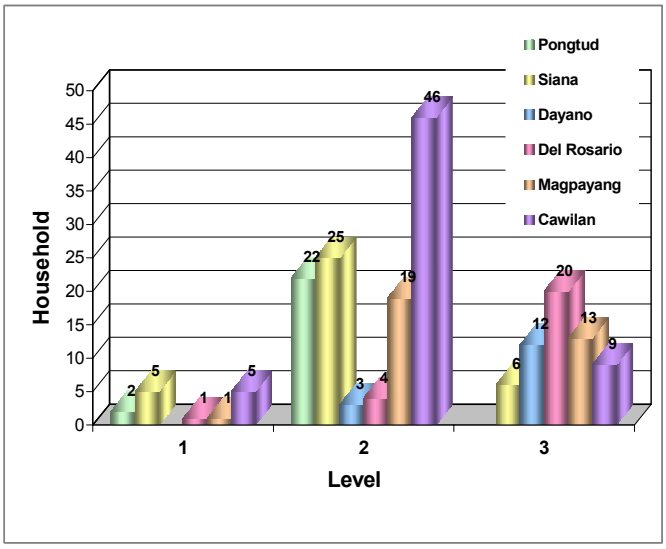


Figure 4-48. Water source

Figure 4-49 shows the types of toilet of the sample population as of May 2005. Overall, the percentage of homes with sanitary toilets (flush and water sealed) is 85 %. Those without toilets comprise 8 %. Cawilan has the highest proportion of households without toilets. One in five houses in this barangay has no toilet.

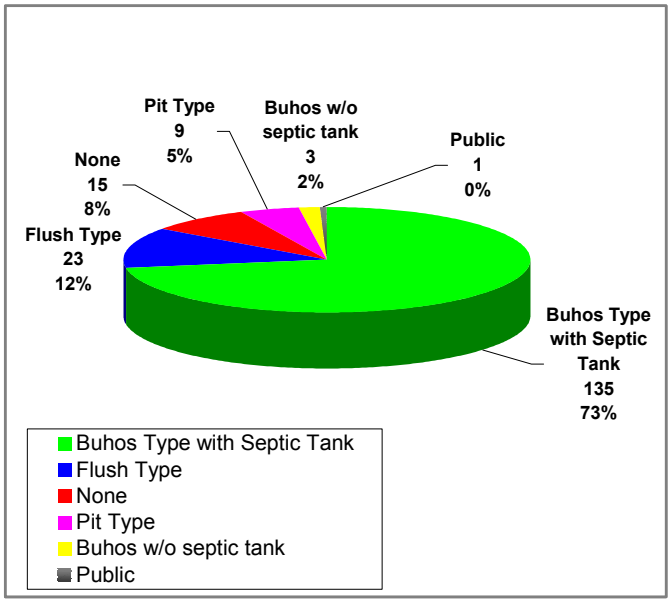


Figure 4-49. Toilet

Burning is the predominant garbage disposal method practiced by 6 out of 10 households in the project area (Figure 4-50). Three in ten households compost their solid wastes. The rest throw them in open pits, rivers and creeks. Of the six barangays, only Magpayang is serviced by the Municipal Waste Truck.

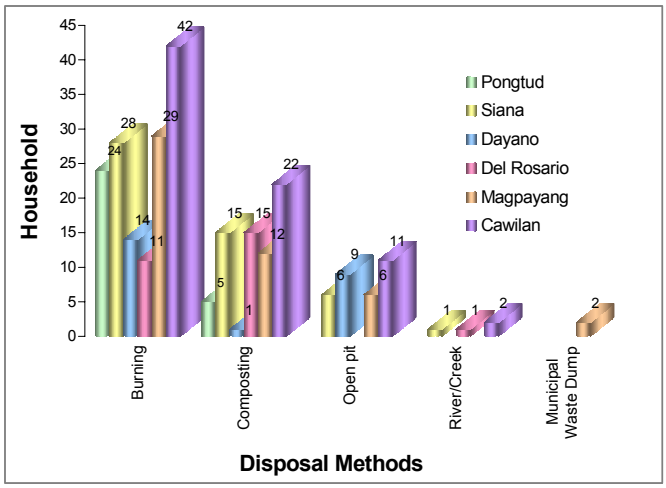


Figure 4-50. Garbage disposal

Household Income and Poverty

Figure 4-51 is the income profile of the samples. More than half (54 %) earns less than P 5,000 a month. Three in ten households subsist on less than P 100 per day. The lowest monthly household income is P 600; the median income is P 4,456; the average income is P 6,189, and the highest is P 32,000.

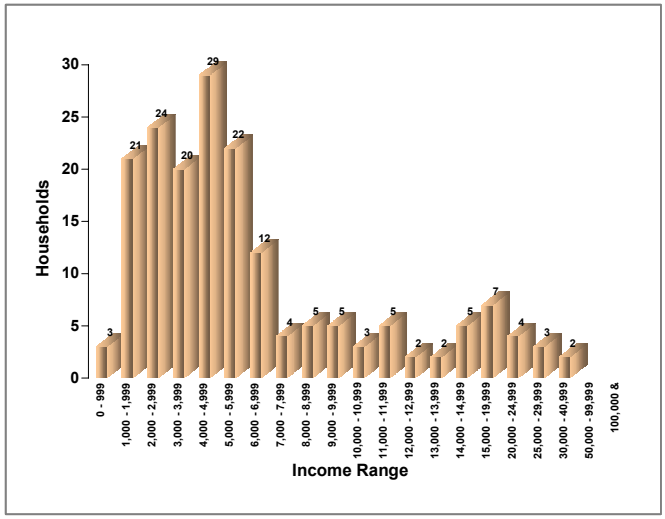


Figure 4-51. Monthly household income

The Annual Per Capita Poverty Threshold Level (APCPTL) is the amount required to satisfy a person's food and non-food basic needs. If a person's income is below this level, he is considered poor. The Annual Per Capita Food Threshold Level (APCFTL), also called subsistence threshold or food poverty line, refers to the minimum cost of the food items that provide 100 % of the recommended dietary allowance (RDA) for protein and energy equivalent of 2,000 kcal and 80 % adequacy for the other nutrients per person. The National Statistical Coordination Board (NSCB) computes these amounts for all the provinces in the Philippines yearly. They are used in determining poverty incidence.

For 2005, the APCPTL and APCFTL for all areas in Surigao del Norte are P 14, 533 and P 10,066, respectively. Using the sample population's average household size of 5.46, the monthly take-home pay required to attain the APCPTL and APCFTL are P 6,613 and P 4,580, respectively. At least half of the sampled households are living below the Food Threshold Level and approximately 70 % exist below the Poverty Level.

The occupational profile detailed in Table 4-21 is reflective of the educational attainment in the Project area. Majority of the jobs involve manual labor with farming as the predominant occupation and income source, *i.e.*, two-fifths. The government and private companies employ 86 people, representing 30 % of the income earners.

Table 4-21. Occupational profile, impact barangays, May 2005

Occupation	Cawilan	Dayano	Siana	Del Rosario	Magpayang	Pongtud	TOTAL
ABLE SEAMAN					1		1
ASSISTANT COOK			1				1
AUTO PAINTER		1					1
BODYGUARD				1	1		2
BRGY. COUNCIL (KAGAWAD)				1			1
BRGY. COUNCIL/BHW			1				1
BRGY. OFFICIAL		1					1
BRGY. SECRETARY			1			1	2
BRGY. TREAS/FARMER	1						1
BRGY. TREASURER						1	1

Occupation	Cawilan	Dayano	Siana	Del Rosario	Magpayang	Pongtud	TOTAL
BUSINESS	1				4		5
BUSINESS-SEWING			1				1
CARPENTER	4		1	2	2		9
CARPENTER/MASON			1				1
CHAINSAW OPERATOR			1				1
CLERK 2				1			1
COCONUT PLANTER						1	1
COLLECTOR				1			1
COOK					1		1
CUTTING STONE		1					1
DAY CARE WORKER			1				1
DRESSMAKER				1			1
DRILLING	1						1
DRIVER		1	3	2	3	1	10
DRIVER/WELDER				1			1
ELECTRONIC				1			1
ELECTRONIC-CASHIER			1				1
ELECTRONICS			1				1
EMPLOYEE			5				5
FACTORY WORKER – DRESS	2						2
FARMER	40	11	16	10	12	15	104
FARMER/CARPENTER			1				1
FARMER/FISHERMEN					1		1
FARMER/MASON						1	1
FARMER/PALAY(RICE) BUYER						1	1
FISHERMAN						2	2
FISHERMAN/LABORER					1		1
FOREMAN		1					1
GOLD FLASHER	1						1
GOV'T EMPLOYEE			3	3	4		10
HELPER						1	1
HELPER DRILLING		2					2
HOUSEKEEPER, W/CHILDREN IN ABROAD					1		1
HOUSEKEEPER/ PENSIONEER(SSS)						1	1
HOUSEKEEPER/FARMER	2				1	1	4

Occupation	Cawilan	Dayano	Siana	Del Rosario	Magpayang	Pongtud	TOTAL
HOUSEKEEPER/LAUNDRYWOMAN						1	1
HOUSEKEEPER/LENDING					1		1
HOUSEKEEPER/MAKER-BIBINGKA	1						1
HOUSEKEEPER/PALAY BUYER(RICE BUYER)						1	1
HOUSEKEEPER/PENSIONER	1						1
HOUSEKEEPER/PENSIONER W/COCONUT FARM	1						1
HOUSEKEEPER/PIGGERY			1				1
HOUSEKEEPER/SARI-SARI STORE					2		2
HOUSEKEEPER/SEWING		1					1
HOUSEMAID	2		1		5		8
JANITOR	1						1
LABORER	1	1			3		5
LABORER (BANLAS)	5						5
LAUNDRYMAN		1					1
MANAGER				1			1
MANICURIST					2		2
MASON	2		3	1			6
MASON/CARPENTER		1					1
MASSAGER (TRAINED HILOT)		1					1
MINER				1		1	2
OFW						1	1
OPERATOR MECHANIC	1						1
PALAY(RICE) BUYER						1	1
PENSIONER			1		1		2
PENSIONER/TRICYCLE			1				1
PREACHER OF GOD & CHRIST					2		2
PRIVATE EMPLOYEE			1	1			2
RESEARCH DIRECTOR					1		1
RICE DRYER (MAGBUYARAYAY HUMAY)					1		1
SALES LADY					1		1
SALES REPRESENTTIVE				1			1
SARI-SARI STORE	1						1
SCRAP(BALBAG)	2						2
SCRAP/FARMER	1						1

Occupation	Cawilan	Dayano	Siana	Del Rosario	Magpayang	Pongtud	TOTAL
SECRETARY					1		1
SECURITY GUARD					2		2
SEWING				1			1
SK CHAIRMAN					1		1
STOREKEEPER						1	1
STUDENT/FARMER			1				1
SURVEYOR			1				1
TEACHER				3	5		8
TECHNICIAN				1			1
TRICYCLE DRIVER	2				1		3
TURTLE OPERATOR			1				1
UTILITY WORKER		1	3				4
VENDOR					1		1
WELDER			2	2	1		5
WORKER			1				1
TOTAL	73	24	55	36	63	32	283

Eight out of ten wives are fulltime housekeepers. A tenth work fulltime as teachers, Barangay Officials, employees, canteen operators, vendors and dressmakers. Some (8 %) engage in part-time small businesses such as livestock raising, sari-sari stores, vending and sewing to augment the family income.

Of the 186 households surveyed, 102 are engaged in farming. Rice is the predominant crop planted by 74 farmers. The total area exclusively planted to rice is 42 ha. The average area is 0.6 ha. Other crops planted include coconut, banana, rootcrops, mango, santol, and vegetables.

Nine out of ten households raise livestock for consumption and supplemental income. Poultry and hog are the preferred animals. A few raise goats, carabaos, and cows.

Household Expenditures

Figure 4-52 is the household expense pie of the sampled households. It contains only the basic items. Nearly three-fifths of the budget goes to food; education accounts for 17%. These two together already comprise three-fourths of the total expenditure. The remaining fourth goes to medicine, transportation, clothing, electricity, rent, water and others (soap, toothpaste, cooking fuel).

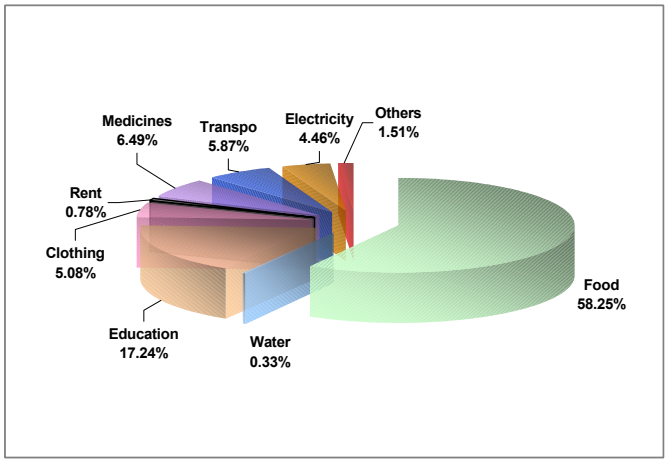


Figure 4-52. Monthly household expenditure

Social Problems

Theft, alcoholism, and gambling are the three major problems besetting the community (Figure 4-53). These are all economic related. People steal because they have no money to spend and there are no livelihood opportunities in the area. The men drink to forget their problems. Gambling affects both men and women. The most common form is Tong-its, a card game similar to poker. People would risk their food money in the hope of winning.

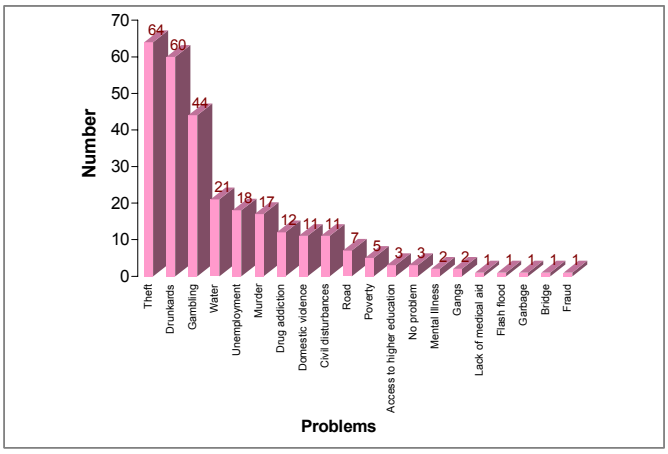


Figure 4-53. Social problems

Project Approval

The overall project approval rate is 84 % (Table 4-22).

Of the 102 households surveyed in the direct impact barangays, 88 or 86% approve of the project. At 99 % confidence, the error is at most

$$E = z\alpha_{/2} \cdot \sqrt{\frac{p(1-p)}{n}}$$

$$E = 2.575 \cdot \sqrt{\frac{0.86 \times 0.14}{102}}$$

$$E = 0.09$$

The endorsement rate of the indirect impact barangays is 80 %. At 99 % confidence, the error is at most

$$E = 2.575 \cdot \sqrt{\frac{0.80 \times 0.20}{70}}$$

$$E = 0.12$$

Table 4-22. Project Approval

Barangay	Project Approval		Total	Percentage	
		No		% Yes	% No
Cawilan	44	8	52	85%	15%
Dayano	15	0	15	100%	0%
Siana	29	6	35	83%	17%
Total Direct Impact Barangays	**88**	**14**	**102**	**86%**	**14%**
Del Rosario	25	0	25	100%	0%
Magpayang	23	9	32	72%	28%
Pongtud	8	5	13	62%	38%
Total Indirect Impact Barangays	**56**	**14**	**70**	**80%**	**20%**
TOTAL	**144**	**28**	**172**	**84%**	**16%**

The major reasons for approving the project are employment (60 %) and community development (28 %). The overriding concerns for disapproving it are environmental destruction (57 %) and negative health impacts (11 %).

Table 4-23. Reasons for Approving and Disapproving Project

Reasons for YES/NO	Result	%
Reasons for YES		
Employment	87	60%
Community development	40	28%
No damage to land and water resources	8	6%
Decision of the majority	2	1%
If approved by the government	1	1%
If promises of GRC will be fulfilled	6	4%
Total	**144**	100%
Reasons for NO		
Environmental destruction	16	57%
Cannot work at the GRC	2	7%
Relocation of people	1	4%
Health hazard	3	11%
No reason	6	21%
Total	**28**	100%

Figures 4-54 to 4-66 are Trellis graphs of selected subsets of the household survey dataset. They display the relationship between two variables – one of which is always Project approval - conditioned on one or more other variables. The Trellis graphs will be scrutinized to explain the community acceptance or rejection of the Siana Gold Project.

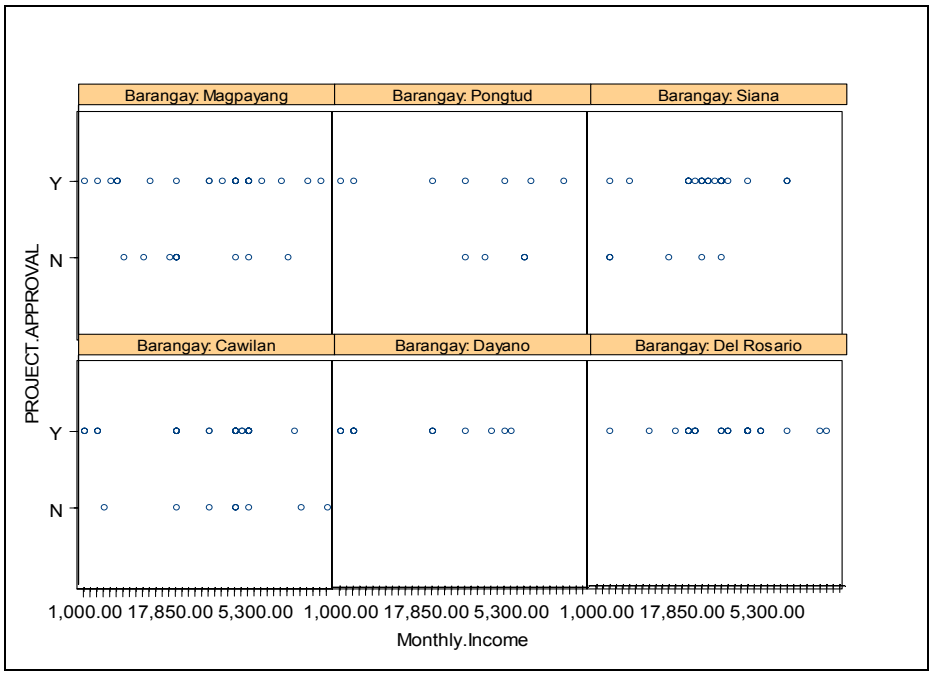


Figure 4-54. Monthly income and Project approval conditioned on the Barangay

From Figure 4-54, Brgys. Dayano and del Rosario respondents, though coming from various income groups, support the Project. The other Barangays are generally similar with slight differences in the spread of income groups that oppose the Project. Conditioning the monthly income-Project approval relationship on the Barangay is not very helpful.

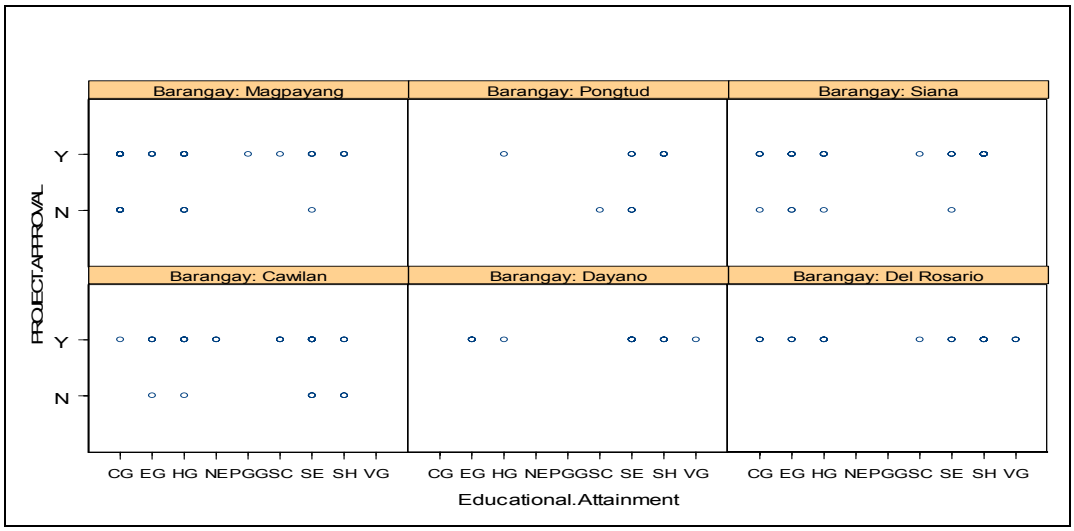


Figure 4-55. Educational attainment and Project approval conditioned on the Barangay

In Figure 4-55, CG is College graduate, EG – Elementary graduate, HG – High school graduate, NE – no education, PGG – post-graduate degree holder, SC – some college units, SE – some elementary, SH – some high school units, and VG – Vocational graduate. Brgy. Pongtud respondents have a lower educational attainment compared to those from other

barangays. The respondents from other barangays display similar educational profiles. Just like the preceding graph, the education-Project approval relationship conditioned on the Barangay does not show any clustering.

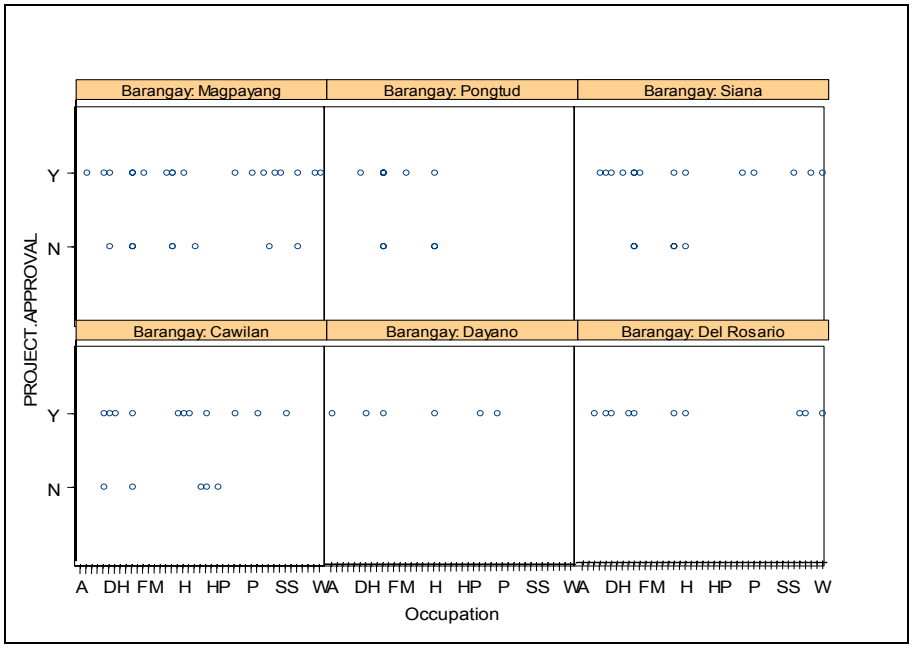


Figure 4-56. Occupation and Project approval conditioned on the Barangay

From Figure 4-56, A is Auto painter, DH – Drilling helper, FM – Farmer and mason, H – Housekeeper, HP - Housekeeper and pensioner, P – Pensioner, SS – Sari-sari store, and W – Welder. Brgys. Dayano, del Rosario, and Pongtud respondents have fewer occupations compared to the respondents from the other three (3) barangays. Figures 4-59 to 4-66 will scrutinize more closely any bias for or against the Project based on occupations.

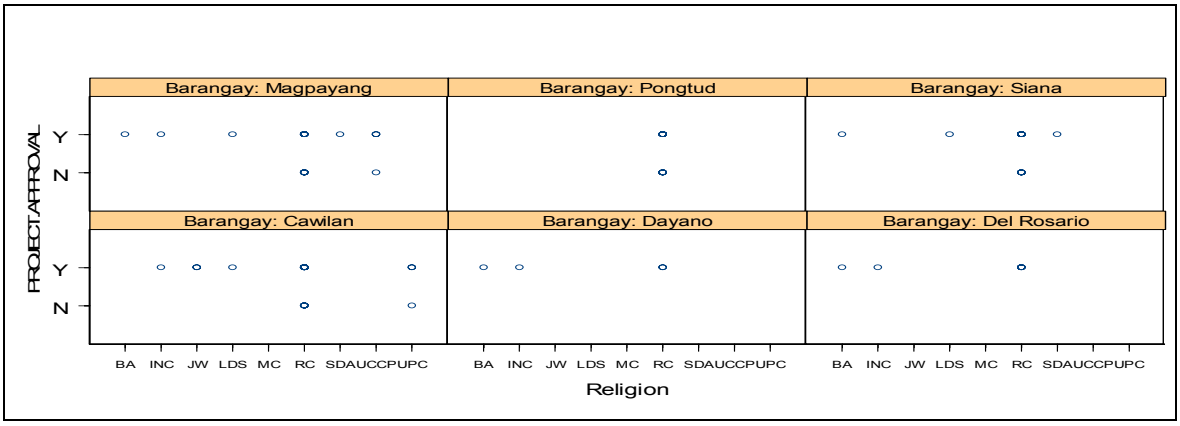


Figure 4-57. Religion and Project approval conditioned on the Barangay

BA is Born again, INC – Iglesia ni Cristo, JW – Jehovah's Witnesses, LDS – Latter-day Saints, MC – Methodist Church, RC – Roman Catholic, SDA – Seventh-day Adventist, UCCP – Union of Christian Churches of the Philippines, UPC – United People's Church. Again, Brgys. Pongtud, Dayano, and del Rosario respondents come from a few religious affiliations. Respondents from the other Barangays are more diverse. Based on the Trellis graph, no Project bias stemming from religion is apparent.

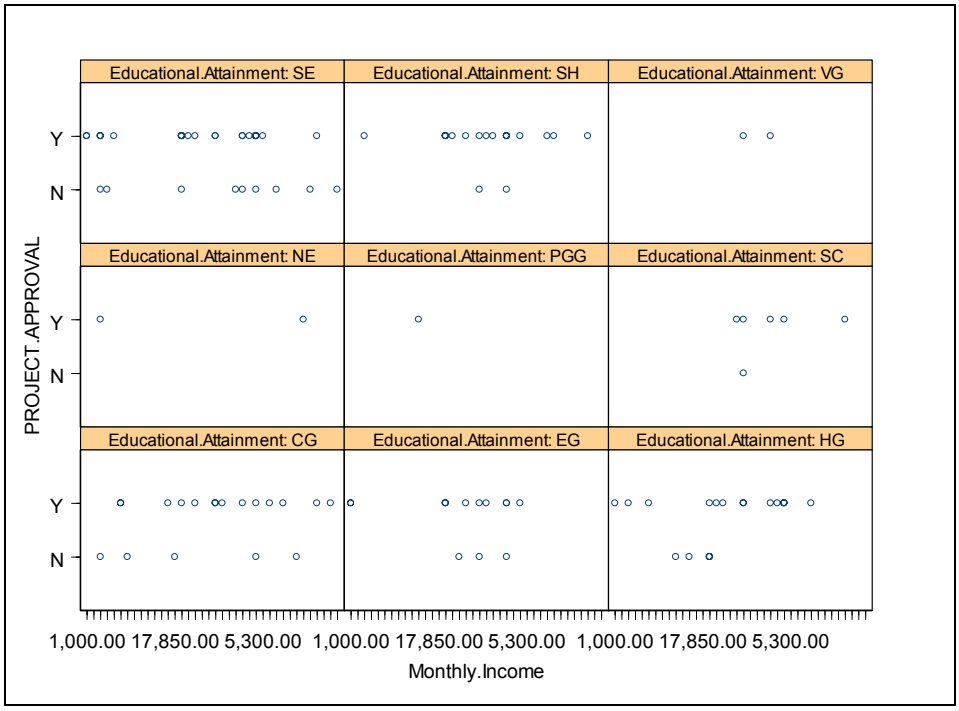


Figure 4-58. Monthly income and Project approval conditioned on educational attainment.

As shown in Figure 4-58, all respondents with no formal education favor the Project regardless of income. Many respondents with some elementary grade schooling do not approve of the Project. With additional schooling, i.e., elementary graduate, some high school units, high school graduate, some college units, and vocational schooling, the number of respondents opposing the Project reduces. The opposition increases for the college graduates. This underscores the importance of an IEC program to target the College graduates especially.

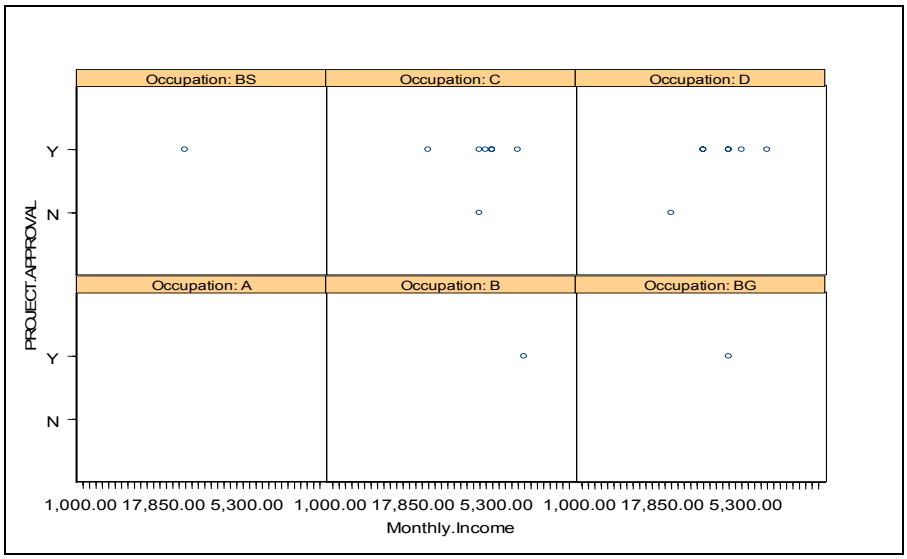


Figure 4-59. Monthly income and Project approval conditioned on occupations BS – business sewing, C – carpenter, D – driver, A – auto painter, B – business, and BG – bodyguard.

The respondents' approval of the Project is strongly correlated to employment and livelihood. However, based on Figure 4-59, there are still a few carpenters and drivers who do not approve of the Project.

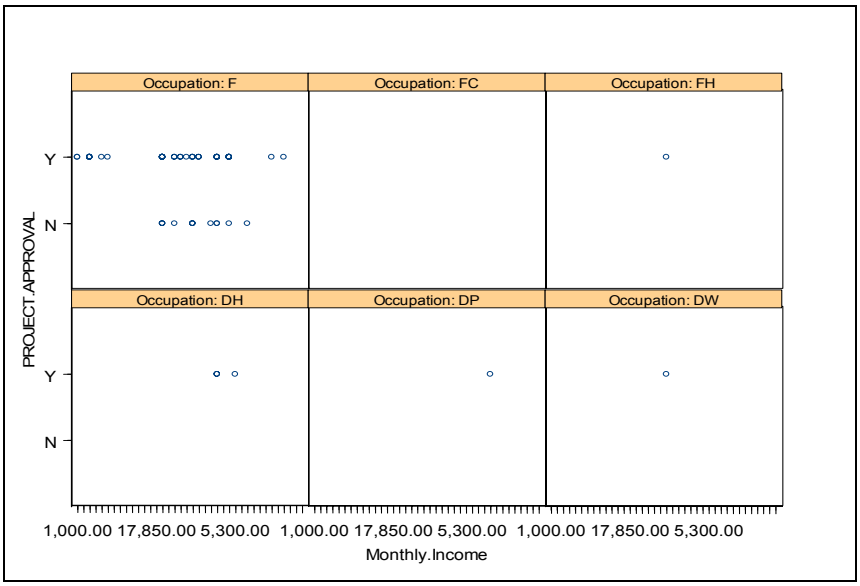


Figure 4-60. Monthly income and Project approval conditioned on occupations F – farmer, FC – farmer and carpenter, FH – farmer and housekeeper, DH – drilling helper, DP – driver and pensioner, and DW – driver and welder.

Of the six (6) occupational groups profiled in the Trellis graphs of Figure 4-60, only a few of the farmer respondents do not approve of the Project. The monthly incomes of these respondents are not in the low or high end but in the middle. They appear satisfied with their present farming incomes.

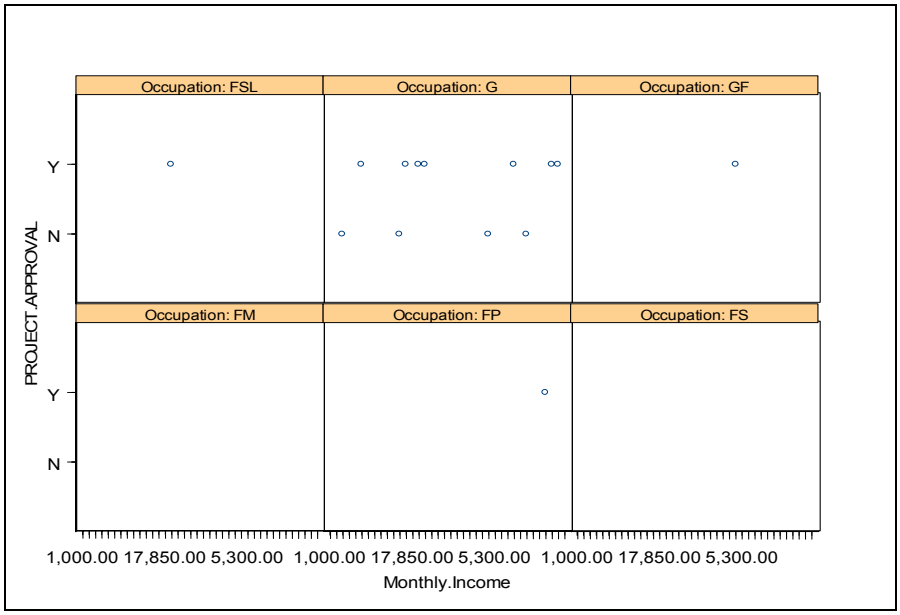


Figure 4-61. Monthly income and Project approval conditioned on occupations FSL – fisherman and laborer, G – Government employee, GF – Government employee and farmer, FM – farmer and mason, FP – farmer and pensioner, and FS – fisherman.

As shown in Figure 4-61, only the Government employees group has a few who oppose the Project. Their incomes are spread across the spectrum.

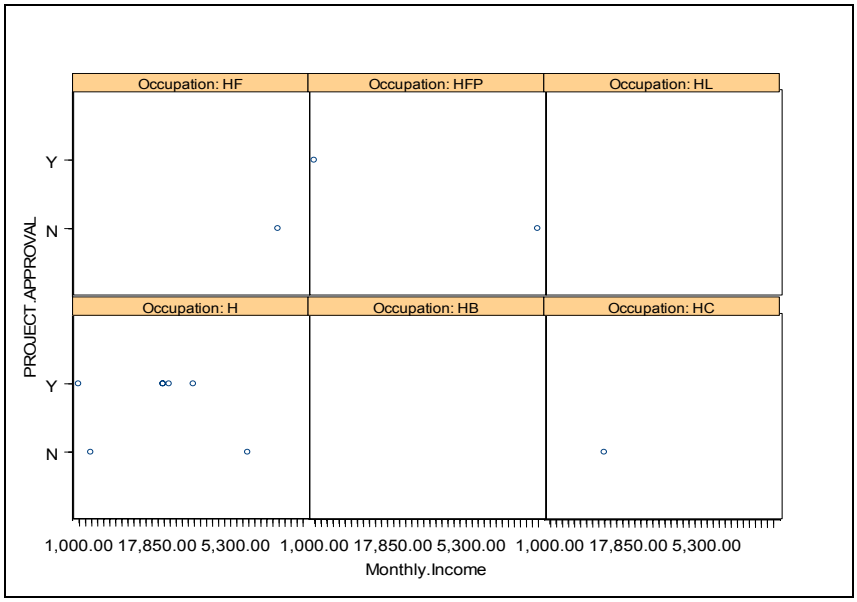


Figure 4-62. Monthly income and Project approval conditioned on occupations HF – housekeeper and farm owner, HFP – housekeeper and farm owner and pensioner, HL – housekeeper and laundry, H – housekeeper, HB – housekeeper and bibingka maker, and HC – housekeeper with children abroad.

Unique to the housekeepers' groups shown in Figure 4-62 is the high correlation of Project opposition to high income. This is understandable since Project approval is strongly linked to need.

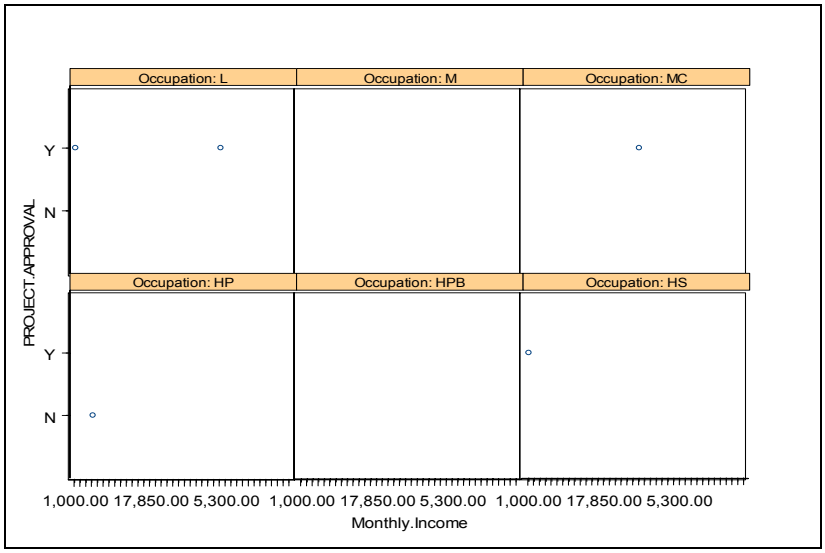


Figure 4-63. Monthly income and Project approval conditioned on occupations L – laborer, M – mason, MC – mason and carpenter, HP – housekeeper and pensioner, HPB – housekeeper and palay buyer, and HS – housekeeper and sewing.

The Trellis graphs of Figure 4-63 further highlight the economic inducements of the Project. The housekeeper and pensioner who does not like the Project is obviously contented with the present condition.

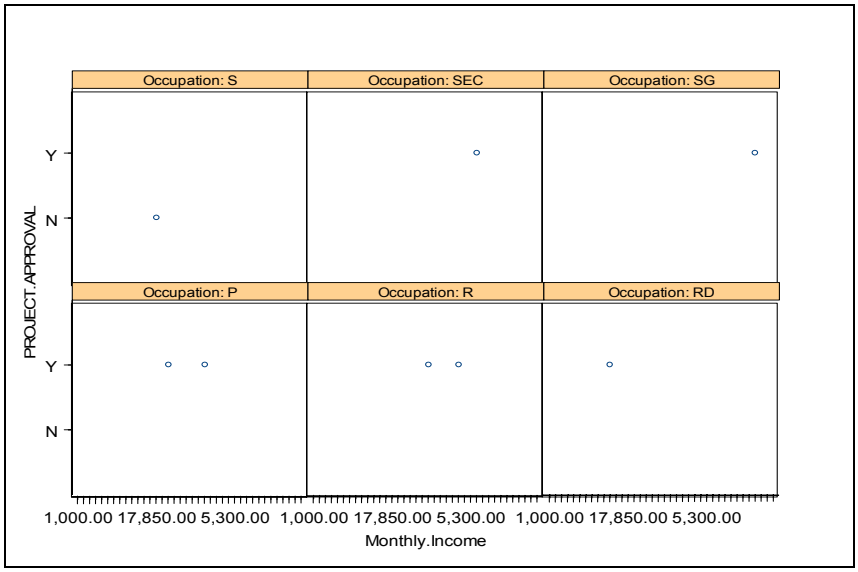


Figure 4-64. Monthly income and Project approval conditioned on occupations S – seaman, SEC – Secretary, SG – security guard, P – pensioner, R – recycling, and RD – research director

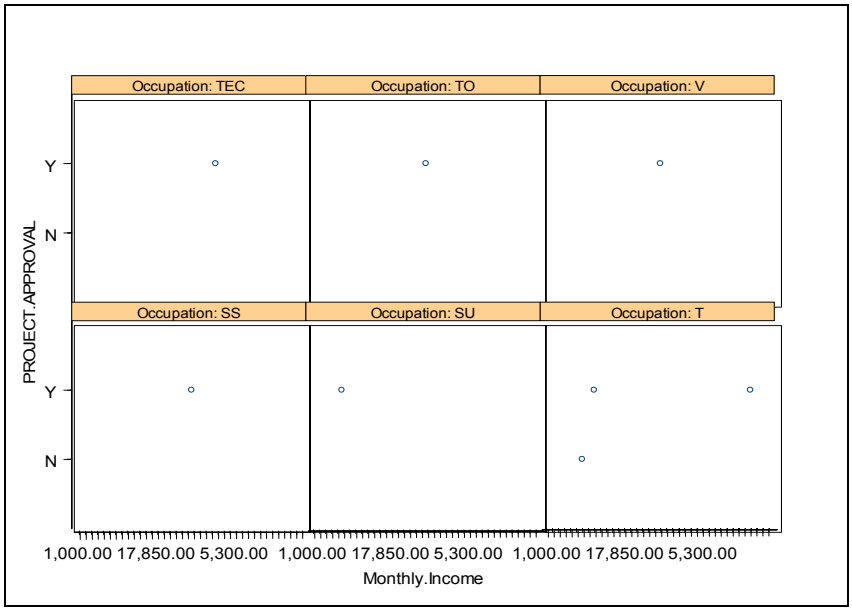


Figure 4-65. Monthly income and Project approval conditioned on occupations TEC – technician, TO – turtle operator, V – vendor, SS – sari-sari store, SU – surveyor, and T – teacher.

From Figure 4-64, the seaman apparently does not see any need for the Project. The other occupational groups, including the pensioners, approve of the Project.

All six (6) occupational groups shown in Figure 4-65, including the turtle operator but excluding the teachers, approve of the Project. Apparently, they value the employment and livelihood opportunities to be created.

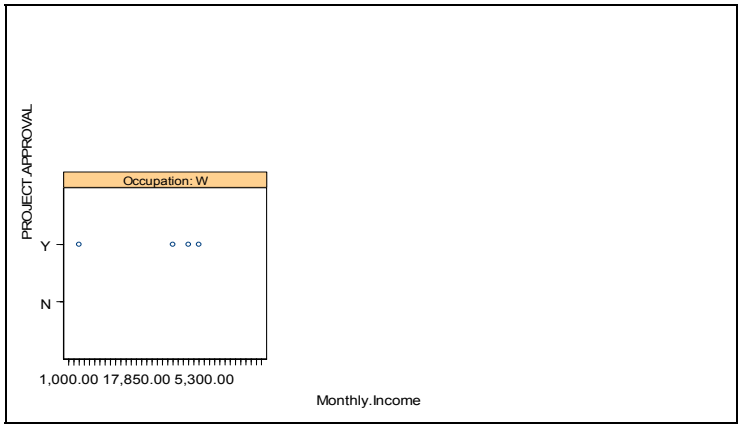


Figure 4-66. Monthly income and Project approval conditioned on occupation W – welder

Finally, the welders' group unanimously approve of the Project (Figure 4-66).

Rural Health Units - The Municipalities of Tubod, Mainit and Alegria serve the health needs of the community through the Barangay Health Stations (BHS) and the Rural Health Units. The BHS are satellites of the RHU. They are manned by Rural Health Midwives who report to the Municipal Health Officer, the RHU head. All RHUs in the impact municipalities offer the same services. These are: immunization for infants, family planning, pre-natal and post-natal care, and Operating Timbang (Weighing).

Table 4-24 lists the health personnel of the Tubod, Alegria and Mainit Rural Health Units. The BHWs provide the primary health care in the impact barangays. Each BHW has a "catchment" that normally consists of 20 families. He assists the community by keeping records of immunization of children, monitoring the pre- and post- natal care of pregnant mothers, assisting in delivery, identifying TB and leprosy suspects and reporting them to the RHU, getting samples of sputum from TB positive patients and having them analyzed at the laboratory, assisting the community in health, environment and safety related matters, and conducting Minimum Basic Needs and other surveys for the local government.

Table 4-24. Municipal health personnel, Tubod, Alegria, and Mainit

Parameter	Tubod	Mainit	Alegria
Households (2004)	**2,295**	**4,751**	**2,290**
Doctor of Medicine (Municipal Health Officer)	1	1	1
Dentist	1		1
DOH Representative	1		1
Nurse	1	1	1
Midwife	3	8	4
Medical Technologist	1	1	1
Sanitary Inspector	1	3	1
Dental Aide		1	
Total	9	17	10

Source: RHUs

All RHUs have the following facilities: examination Room, dental Room, laboratory capable of urinalysis, fecalysis, blood typing, sputum analysis for Pulmonary Tuberculosis, and Katokatz Analysis for Schistosomiasis.

The RHUs are open from 8 A.M. to 5 P.M., Monday to Friday. The Municipal Health Officers are on call for twenty-four (24) hours. Consultation is free but the residents complain that medicines are not always available because of municipal budget constraints. Cases that require confinement are referred to the District Hospital or Caraga Regional Hospital.

Morbidity - Tables 4-25 to 4-27 detail the ten (10) leading causes of morbidity in the impact barangays. Majority of the leading causes of illness in the project area are communicable diseases such as Acute Respiratory Infection (ARI), Upper Respiratory Tract Infection (URTI), pneumonia, tuberculosis, skin diseases and influenza. Other diseases such as diarrhea, amoebiasis, helmenthiasis and parasitism are hygiene related. Hypertension, a non-communicable disease that has been affecting more and more people over the years, has overtaken TB as a leading cause of illness in the area.

Table 4-25. Ten leading causes of morbidity, Tubod, 2000 – 2004

Morbidity Cause	2001	Morbidity Cause	2002	Morbidity Cause	2003	Morbidity Cause	2004
Acute Respiratory Infection (ARI)	488	ARI	293	Upper Respiratory Tract Infection (URTI)	1096	ARI	560
Injuries	159	Injuries	185	Influenza	550	Influenza	261
Influenza	103	Influenza	180	Injuries	294	Injuries	158
Skin Diseases	74	Urinary Tract Infection (UTI)	131	Hypertension	167	UTI	147
UTI	49	Hypertension	117	Skin Diseases	141	Pneumonia	93
Pneumonia	42	Rheumatoid Arthritis	106	UTI	138	Skin Diseases	78
Parasitism	38	Skin Diseases	66	Peptic Ulcer	68	Bronchitis	66
Acute Gastroenteritis	31	Parasitism	62	Acute Gastroenteritis	66	Hypertension	64
Hypertension	30	Schistosomiasis	49	Pneumonia	55	Parasitism	63
TB all forms	22	Pulmonary TB	46	Parasitism	49	Pulmonary TB	48
		Peptic Ulcer	46				

Source: RHUs

Table 4-26. Ten Leading Causes of Morbidity, Mainit, 1997 – 2004

Causes	2002 – 2006		2007	
	No.	Rate	No.	Rate
1. URTI	2339	965.53	2963	1192.54
2. Bronchitis	458	189.06	277	111.48
3. Diarrhea	174	71.82	183	73.65
4. Hypertension	159	65.63	162	65.20
5. Wounds all kinds	126	52.01	159	63.99
6. UTI	126	52.01	121	48.69
7. Pulmonary Tuberculosis (PTB)	571	235.7	89	35.82
8. Schistosomiasis	118	48.71	72	28.97
9. Gastritis	107	44.16	69	27.77
10. Sexually transmitted diseases (STD)	16	7.84	50	20.12

Source: RHUs

Table 4-27. Ten leading causes of morbidity, Alegria, 1997 – 2004

Morbidity Cause	1998	Morbidity Cause	1999	Morbidity Cause	2000	Morbidity Cause	2001	Morbidity Cause	2002	Morbidity Cause	2003	Morbidity Cause	2004
URTI	342	URTI	914	URTI	646	URTI	377	ARI	337	ARI	346	ARI	420
Bronchitis	234	Bronchitis	284	Pneumonia	137	Wound	127	Parasitism	113	Wound/Injuries	88	Wound/Injuries	144
Acute Gastroenteritis	74	Diarrhea	155	Wound	134	Skin Diseases	119	Wound/Injuries	107	Community Acquired Pneumonia (CAP)	83	Diarrhea	43
Skin Diseases	71	Skin Diseases	121	Skin Diseases	94	Pneumonia	109	Schistomiasis	87	Helmenthiasis	75	CAP/Pneumonia	41
Pneumonia	68	Pneumonia	94	Schistomiasis	74	Schistomiasis	104	Diarrhea	44	Schistomiasis	59	Bronchitis	31
Injuries	50	Injuries	88	Parasitism	61	Parasitism	94	Skin Diseases	30	Diarrhea	41	Schistosomiasis	27
Asthma	35	Amoebiasis	66	Diarrhea	54	Diarrhea	59	CAP	30	Tuberculosis all forms	34	Helmenthiasis	26
Schistomiasis	34	Parasitism	59	Pulmonary Tuberculosis	48	TB all forms	30	TB all forms	28	Hypertension	25	Hypertension	26
Intestinal Parasitism	32	Tonsillitis	58	Bronchitis	47	Tonsillitis	14	Pneumonia	26	Hypersensitivity Reaction	24	Dogbite	25
UTI	29	Asthma	31	UTI	33	UTI	11	Filariasis	20	Dog Bite	22	URTI	24
	969		1870		1328		1044		822		797		807

Mortality - Tables 4-28 to 4-30 show the leading causes of death in the covered municipalities. Pneumonia, tuberculosis and septicemia remain the top ten killers. The other causes, however, are mostly non-communicable. They are dominated by lifestyle diseases such as cerebro-vascular accident or stroke, diseases of the heart, cancer and diabetes mellitus.

Table 4-28. Ten leading causes of mortality, Tubod, 2001 - 2004

Mortality Cause	2001	Mortality Cause	2002	Mortality Cause	2003	Mortality Cause	2004
Cancer all forms	8	Congestive Heart Failure (CHF)	9	Septicemia	10	CHF	5
Cerebro Vascular Accident (CeVA)	7	Septicemia	6	CHF	7	Pneumonia	4
Acute Renal Failure	6	Acute Renal Failure	5	CeVA	6	Cancer all forms	4
Septicemia	5	Cancer all forms	4	Cancer all forms	5	Septicemia	4
CHF	4	Accident	4	Myocardial Infarction	4	CeVA	4
Pneumonia	4	Pneumonia	4	Pneumonia	4	Tuberculosis	3
Tuberculosis	3	CeVA	3	Bleeding Peptic Ulcer	3	Liver Cirrhosis	2
Liver Cirrhosis	2	Myocardial Infarction	2	Pulmonary TB	3	Bleeding Peptic Ulcer	2
Myocardial Infarction	2	Bleeding Peptic Ulcer	2	Accident	2	Diabetes Mellitus	1
Accident (vehicular)	1	Diabetes Mellitus	2	Liver Cirrhosis	2	Accident	1
Severe dehydration	1	Stab Wounds	2				

Source: RHUs

Table 4-29. Ten leading causes of mortality, Mainit, 2002 – 2007

Mortality Cause	2002 - 2006		2007	
	No.	Rate	No.	Rate
1. Multiple Organ Failure	1.6	.66	11	4.42
2. Renal failure	1.6	.66	10	4.02
3. Cardio Vascular Accident (CaVA)	3,4	1.4	9	3.62
4. Chronic Obstructive Pulmonary Disease (COPD)	1	.41	8	3.21
5. Liver Cirrhosis	.6	.24	7	2.81
6. Myocardial Infarction	.6	.24	5	2.01
7. Gastro-intestinal (GI) Bleeding	.4	.16	5	2.01
8. Pneumonia	.2	.08	4	1.6
9. Tuberculosis	2.2	.9	4	1.6
10. Cardio Respiratory Arrest	11.8	4.87	4	1.6

Source: RHUs

Table 4-30. Ten leading causes of mortality, Alegria

1998		1999		2000		2001		2002		2003		2004	
Schistomiasis	8	CeVA	9	Pulmonary Tuberculosis	5	Multiple organ failure	4	Cardio Vascular Disease (CaVD)	4	CeVA	4	CAP	6
CaVD	7	Hypertensive Vascular Disease	6	CeVA	3	Liver cirrhosis secondary to Schistomiasis	4	Chronic renal failure	3	CHF	4	CaVD	5
Cancer all forms	6	Accidents	5	Multiple Gunshot Wound	3	CaVD	3	Multiple organ faioure	2	CAP	4	Cancer all forms	5
COPD	2	Old Age	4	Senility (old age)	2	Hepatoma	3	COPD-PTB	2	Pneumonia secondary to debilitation	3	CHF	5
Pulmonary Tuberculosis	2	Pneumonia	3	Multiple Organ Failure	2	Pulmonary Tuberculosis	2	CAP	2	Chronic Renal Failure	3	Reversible hypoglycemic shock secondary to multiple shot wound	4
Premature	2	Severe Pneumonia	2	Schistosomiasis to infected wound	2	Severe Pneumonia	2	Irreversible Hemorrhage shock secondary to gunshot/stab wound	2	Liver cirrhosis secondary to Schistomiasis	3	Lobar Pneumonia States	3
Vehicular Accident	2	Malnutrition	2	Chronic Renal Failure	2	Asphyxia	2	Severe malnutrition	1	Myocardial infarction	3	COPD	2
Pneumonia	2	Chronic Renal Failure	2	COPD	2	Multiple Gunshot wound secondary to hemorrhage	2	Pneumonia debilitation	1	Multiple organ failure	2	Irreversible blood loss secondary to punctual wound	2
Undetermined	2	Hemorrhage	2	Status asthmaticus	2	Chronic Renal Failure	1	Hepatic carcinoma	1	Hepatic Failure	2	Liver cirrhosis secondary to schistomiasis	2
Others	2	Pulmonary Disease	2	Diabetes	1	CA Ovarian	1	Acute Pancreatitis	1	Cardio respiratory arrest, irreversible blood loss, multiple gunshot of face, chest, arms and legs	2	Multiple injuries secondary to vehicular accidents	2

Source: RHUs

Endemic Diseases - Filariasis or elephantiasis is a parasitic infection transmitted by the flavirostris mosquitoes. They live in abaca and banana trees as well as pandan (pandanus) plants. This debilitating disease is endemic in Surigao del Norte. In 2002, it affected 20 people in Alegria.

Filariasis is considered the second leading cause of permanent disability among infectious diseases. There are 120 million people with the disease worldwide. The parasites multiply and live in the body for ten (10) years, actively reproducing for five (5) years. When they die, fibrous tissue forms around them in the lymphatic channels. The flow of the lymph is blocked causing gross irreversible chronic enlargement and deformity of the legs and feet, arms, testes, vulva or breasts.

Filarial infection can be acquired only from vector-borne infective larvae. Prevention of infection can be achieved in two ways, namely, by decreasing contact between humans and vectors or by decreasing the amount of infection the vector can acquire, or treating the human host. Efforts at filariasis control in populations through the reduction of the number of mosquito vectors have proven largely ineffective. Even when good mosquito control can be put into place, the long time-span of the parasite which is four (4) to (8) eight years means that the infection remains in the community for a long period of time, generally longer than the period intensive vector control efforts can be sustained.

The World Health Organization (WHO) recommends a yearly mass treatment of the 2-drug treatment regimen, *i.e.*, albendazole and either ivermectin or diethylcarbamazine (DEC), to all "at risk" populations for five consecutive years. Immunity to the disease is ensured if this treatment regime is adopted.

Schistosomiasis, also known as bilharzia, is the third cause of morbidity in Mainit. The 5-year average from 1997 to 2002 was 366. In 2003 and 2004, 630 and 163 were afflicted, respectively. In Alegria, this disease has occupied either the 5th or 6th place of the ten leading causes of morbidity since 1998. In Tubod, 2002 was the last year this disease appeared on the top ten causes of illness.

Schistosomiasis is a parasitic disease caused by the trematode flatworms (flukes) of the Japanese snail *(Schistosoma japonicum).* They are transmitted by amphibious Oncomelania snails. These snails are as big as palay grains.

Transmission occurs in freshwater when the intermediate snail host (Oncomelania snails) releases infective forms of the parasite. Larval forms of the parasites (known as cercariae), released by the snails, penetrate the skin of people in the water. The disease is contracted through contact with parasites released by the snails in stagnant freshwater. A person can get infected simply by contact with water (*e.g.*, washing, farming, fishing or swimming). The snails themselves become infected by another larval stage of the parasite, known as a miracidium, which develops from eggs passed out in the urine or faeces of infected people.[4]

Adult male and female schistosomes pair and live together in human blood vessels. The females release eggs, some which are passed out in the stools but some eggs are trapped in the body tissues. Immune reactions to eggs lodged in tissues are the cause of the disease. In intestinal schistosomiasis caused by S. japonicum, there is progressive enlargement of the liver and spleen, intestinal damage due to fibrotic lesions around eggs lodged in these tissues, and hypertension of the abdominal blood vessels. Bleeding from these vessels leads to internal hemorrhage. Without treatment, schistosomiasis leads to chronic infection, cirrhosis of the liver, and can be fatal. [5]

Those infected can be treated with the drug praziquantel, which is available in the RHUs of all impact barangays. This is effected in a single dose against all schistosoma species. According to the health personnel, reinfection is the problem since the farmers continue to work in schistosomiasis infested waters. Before, the DOH had molluscicide programs to kill the oncomelania snails. However, the molluscicide is harmful to humans so its use was discontinued.

The health authorities recommend yearly mass treatment of praziquantel to reduce the number of infected people. Treatment of water buffalo and other livestock, sources of infective parasite eggs should also be considered. Health education is also imperative. People should defecate only in sanitary toilets and not in the rice fields and other japonicum infested areas.

[4] Source: World Health Report 2002
[5] Ibid.

Malaria is caused by protozoan parasites of the genus ***Plasmodium.*** Four species of *Plasmodium* can produce the disease in its various forms: *Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale,* and *Plasmodium malaria.* ***P. falciparum*** is the most widespread and dangerous of the four. Untreated, it can lead to fatal cerebral malaria.[6] This species and the P. vivax are the most common in the Philippines.

The vector for malaria parasites is the female Anopheles mosquito. It can only transmit malaria if it has bitten a person with the disease. When it sucks the blood of an infected person, plasmodium develops in its gut. It passes on the parasite when it bites another person. Blood carries these parasites to the victim's liver where they invade the cells and multiply. After 9 to 16 days, the parasites return to the blood, penetrate the red cells and multiply again, progressively breaking down the red cells.[7] This process induces fever and anemia in the victim.

The malaria symptoms are chills and high fever, excessive sweating after high fever, and headache. To prevent the spread of malaria, DOH recommends the use of a mosquito net every night, use of protective clothing such as long sleeves and long pants if staying outdoors at night, screens on doors and windows, clearing of areas where the Anopheles mosquitos are found, trimming of overhanging plants, leaves, and grass along the stream banks, and use of larvae-eating fish to feed on the mosquito larvae (*e.g.*, tilapia).

Sulfadoxine and other malarial drugs are available. Treatment depends on the case. The public hospitals in endemic areas have doctors trained at treating malaria and other tropical diseases. Medicines are also available as these are provided by the World Health Organization.

Impacts

1. Relocation of 7 to 13 households in Brgy. Cawilan and 42 to 56 households in Brgy. Siana (Figure 5-1) - The figures will be finalized upon ground verification. Efforts will be made to minimize the displacement.

   The affected Siana residents will have to be transferred because of their proximity to TSF3 and the secondary waste rock dump. Those that will be displaced in Cawilan live close to the main waste rock dump. The families to be relocated are technically squatters because they do not have title to the houses and land that they occupy. Those from Cawilan live in the former SURICON Duplex-type Staff Houses.

   There are two proposed resettlement sites – one in Brgy. Cawilan and another in Brgy. Siana. The final choice of the site would depend on consultations and negotiations with those affected as well as the host community, or the area where the relocation site is located.

   A Resettlement Action Plan (RAP) shall be prepared in accordance with International Best Practice in particular, IFC Performance Standard No. 5. The resettlement shall also be coordinated with the Local Government to comply with Executive No. 708. The essential components of the RAP, as recommended by IFC in its Handbook for Preparing a Resettlement Action Plan, are the following:

   - Identification of project impacts and affected populations
   - Legal framework for land acquisition and compensation
   - Compensation framework
   - Description of resettlement assistance and restoration of livelihood activities
   - Detailed budget
   - Implementation schedule

[6] World Health Organization, Division of Tropical Diseases
[7] Ibid.

- Description of organizational responsibilities
- Framework for public consultation, participation and development planning
- Description of provisions for redress of grievances and
- Framework for monitoring, evaluation and reporting

2. Displacement of seasonal gold small-scale miners – Some 20 small-scale miner family groups operate seasonally and freely within the mine site. GRC has allowed them to carry out their mining activities in the meantime that the company is not yet operating. The miners have a standing arrangement with the company to voluntarily vacate the area when advised to do so.

   The positive impacts of the displacement of the miners include the cessation of sedimentation and contamination of soil and water with cyanide and other chemicals used by the miners as well as health and safety issues related to small-scale mining such as exposure to cyanide and physical danger to the miners. The displacement will also result in the reduction of water usage.

   The RAP will also cover the small-scale miners as they are also economically-displaced. Mitigating measures will include the hiring by GRC of those who may be qualified for applicable positions. The company will also recommend the hiring of those that cannot be accommodated to its contractors. Livelihood opportunities will be provided to those who could not be taken in either by GRC or its contractors.

3. Flooding along Dayano Creek and the adjacent rice fields - Farmlands and other properties might be inundated during the dewatering of the pit. However, if done properly, *i.e.,* at a rate of 780 $L\text{-}s^{-1}$ within the less rainy months of April to August and with the irrigation dam doors wide open, the farmers will benefit from the steady release of clean water from the pit.

4. Chemicals, especially CN – The residents are afraid that the fish kills and animal deaths suffered during the SURICON days may recur once GRC commences development works. GRC commits to put up physical systems that will fully contain any chemical spills such as an events pond in the reagents storage and mixing area, train personnel on chemicals and their management, implement management systems and procedures for chemicals handling, and operate a CN detoxification plant that will bring down the CN in the tailings to safe levels before discharge to the TSF.

5. Sedimentation and turbidity – Another recollection of the residents is the "labod" or sediments from the SURICON mine. GRC's commitment is minimized ground clearing and disturbances, scheduling of construction during the dryer months, surface runoff diversion from the disturbed areas, recovery and use of topsoil, spoils management, grading and sloping of work areas and channels, and use of sediment traps, settling ponds, and geotextile tubes.

6. Employment and livelihood opportunities – GRC will implement its agreement with the Brgy. Captains on unskilled employment. To add to the employment opportunities, the company will inventory local skills and enterprises vis-a-vis the company requirements. Training programs will be implemented to address the skills gaps. GRC will also assist local residents and suppliers provide the goods and services needed by the Project.

7. Management of vector-borne diseases – GRC will observe stringent health standards in the hiring of employees and contractors. Regular medical examinations of employees and contractors will be undertaken to prevent any outbreak of diseases in the community. The company will coordinate with the DOH for the implementation of programs for vector-borne diseases.

8. Vehicular accidents and other physical impacts such as landsliding, flyrocks, etc. – GRC will enforce a combination of no-access to the public in certain areas and designated pedestrian walkways and vehicular access at certain times of the day. Company vehicles will be required to observe speed limits and forced stops at certain points of the road. To prevent physical impacts, households at risk will be relocated.

9. Dust, noise, AMD, and heavy metals – GRC will implement the environmental management measures designed for the stressors.

10. Increased STD, drug use, alcoholism, spread of other communicable diseases , and human trafficking – GRC will administer awareness and preventive education programs for the workers, communities, and spontaneous settlers.

Culture

Methodology

The Cultural Study entailed the following:

- Review of literature on Mamanwa culture (Table 2-4)
- Key informant interviews involving a Mamanwa *datu* and an official of the NCIP Service Office in Bad-as, Placer, Surigao del Norte
- Focus group discussion with Mamanwa stakeholders on Mamanwa culture and cultural impacts of the Siana Project
- Observation of Mamanwa daily life in the direct impact area.

The interviews, discussion, and observation of Mamanwa life were completed from 6 to 8 January 2005.

Baseline Conditions

- **Ethnic Identity** – The Mamanwa is a Negrito group mainly found in the provinces of Surigao del Norte, Surigao del Sur, and Agusan del Norte in Northern Mindanao and, to a lesser degree, in the provinces of Leyte and Southern Leyte in Eastern Visayas. They are mostly concentrated in the areas around Lake Mainit in the border provinces of Surigao del Norte and Agusan del Norte. This lake region is most probably their traditional homeland. The term Mamanwa is an endonym, *i.e.*, it is the name that is used by the culture bearers themselves. The term "*mamanwa*" means "people of the forest", *banwa* being the term for "forest". Outsiders, especially Visayans and Manobos, refer to them as Conquista or Cong King, allegedly because the Mamanwas were the first ones to occupy the said region. The Mamanwas of Surigao, however, consider the names as derogatory. According to Datu Dominador Labao, a Mamanwa chieftain of Alegria, Surigao del Norte, the term "Cong King" is suitable for animals and not for human beings.

  The Mamanwas have a distinct ethnic identity due to their phenotypic difference from the rest of the peoples of Mindanao and their unique culture. Racially, *i.e.*, based on genetic frequencies, they belong to the Negritoid stock: the average height is four feet eight inches, they are prognathous, with broad flat noses, and their skin color ranges from reddish to dark brown in color (Winick, 1970).

  Traditionally, the Mamanwas were nomadic hunters-gatherers. In the last century, they became semi-sedentary horticulturists. They speak a language distinct from nearby ethnolinguistic groups, such as the Manobos and Surigaonons, and the other Negrito groups in the country.

- **Population** – There has been no official census of the Mamanwas. Based on the 1990 census of the Summer Institute of Linguistics, 5,152 are speakers of Minamanwa. Literacy rate in the mother tonque and second language is reportedly very low at 7 %.

  In Surigao del Norte, the Mamanwas are found in the municipalities of Alegria, Bacuag, Claver, Gigaquit, Mainit, San Francisco, and Tubod. Within the direct impact area of the Siana Project, some ten (10) Mamanwa

households reside in Purok Bulawanon, Brgy. Cawilan in 2005. As of April 2008, the number of Mamanwa households in the purok has reportedly doubled.

- **Origin Myth and Belief System** – The Mamanwas attribute the creation of the earth to Magbabazà, their Supreme Being. In the beginning, according to the Mamanwas, there was only one kind of human being. Then lightning struck the earth and set it on fire, and those who were singed became black – the Mamanwa.

  The Mamanwas believe in a dual existence in life: the physical body and an invisible soul. In the worldview of the Mamanwa, trees, plants, and animals have *kalag (*souls) that are made of the same stuff as the soul of a human being. However, in contrast to a human soul, animals such as dogs, pigs, and monkeys only have small souls that cannot be exchanged with those of humans.

  The Mamanwa view holds that every living person has seven souls. In appearance, the seven souls are like *lambong* (shadows). Following the burial of the dead, Mamanwas show great anxiety and preoccupation with the soul of the dead because they believe that an offended soul has the power to cause illness and death. The expression "*kalagen ko*" is a warning to a careless person that he might get sick and die as a result of offending the soul of a kinsman who has died.

  The spirit world is comprised of Magbabazà – the Supreme Being – and several *diwata* (spirits). The latter may be helpful or harmful spirit beings.

  There have been several attempts by missionaries to convert Mamanwas into Christianity. In Brgy. Motorpool, Tubod, a Baptist mission established a non-formal school that teaches literacy and numeracy to the residents for one hour every Friday and Monday mornings. The mission holds Sunday masses. The Mamanwas of Motorpool attend these mission-initiated activities but admitted that they continue to believe in Magbabazà.

- **Early Settlements and Migrations** - The Mamanwas are the indigenous people of Northeastern Mindanao. Their primacy in occupying this area is recognized by other ethnolinguistic groups in the vicinity, the Manobos, Surigaonons, and Visayans, included. This is the reason why these groups refer to the Mamanwas as "Conquista" or "Cong King", *i.e.*, the Mamanwas were the first to conquer the territory.

  Many place names in Surigao are of Minamanwa origin while other place names have counterparts in the Minamanwa language. Lake Mainit, for example, is referred to by the Mamanwas as *danaw* (lake).

  Tubod, in particular, was originally Mamanwan territory. In the 1900s, however, migrants from Bohol, Leyte, and Camiguin settled in the area. When Surigao Consolidated Mining Corporation established its operations in Cawilan in 1935, the Mamanwas were reportedly driven away from the mine site. They transferred to the hinterlands because they feared that the migrants would offer them as *padugo* (human sacrifice) in exchange for success in locating the gold veins. It was only when the mine closed in 1954 did they go back to Cawilan although this time, the lands were already owned by Visayan migrants.

  Because the Mamanwas traditionally practiced shifting agriculture supplemented by hunting and foraging, their settlement pattern was semi-nomadic in nature. It is customary for Mamanwas to live in a certain locality for a given period of time and later transfer to another place. In Brgy. Motorpool, for example, the Mamanwas regularly shifted their residence from Mabuhay, Sison and back to Motorpool. The present Mamanwa enclave near the elementary school in Brgy. Cawilan was originally located in the mountainous area. They transferred to their new site because the Barangay Chairman wanted to integrate them with the barangay.

  Because the area has been theirs since time immemorial, there is an ongoing effort by the Mamanwas, through the assistance of the NCIP to claim approximately 42,000 ha within Alegria, Tubod, Bacuag, Claver, and Gigaquit as their ancestral domain. There is another ancestral domain claim for portions of Mainit and San Francisco.

- **Economic Activities** – Until a decade ago, the Mamanwas primarily subsisted on shifting cultivation supplemented by hunting, fishing, and foraging activities. At present, however, the Mamanwas in the direct impact area mostly rely on wage labor.

  The shift from horticulture to wage labor was the result of the Philippine military's efforts to discourage them from staying in the forested upland areas lest they be suspected as supporters of the New People's Army. Thus, the Mamanwa families resettled in the lowland areas and abandoned their farmhouses in the hinterlands. In the lowlands, however, there was very little land to till since the Visayans or Surigaonons owned most of the fertile lands. Thus, their only option was to engage in wage labor.

  In Brgy. Motorpool, most of the able-bodied Mamanwa males work as wood haulers for small-scale loggers. They pick up the sawn logs from the nearby mountain range and carry them down to the highway where the lumber is loaded in waiting trucks. They are paid based on the number of wooden planks transported.

  Some Mamanwa men and women work in coconut farms. Others are seasonal workers in copra farms in Brgy. Mabuhay, Sison. The seasonality of work contributed to the shifting residences of the Mamanwa families.

  Since 2002, several Mamanwa males from Alegria, Mainit, and Tubod have been employed by GRC. They work as security guards and utility men. GRC adopted a work rotation scheme to accommodate more Mamanwas.

  In Cawilan, the Mamanwa residents still plant bananas, sweet potatoes, and other root crops on backyard plots. Other income sources include wood gathering and gold panning at the tailings ponds and waste rock dumps of SURICON. Housewives make baskets from rattan and other vines when there are orders for these products.

Photo 4-24. An extended Mamanwa family, near the Mariano Darap Elementary School with Joel Pacatang (in hard hat), the local guide.

Photo 4-25. Close-up of a "Lit-ag", where the bait is tied to a rattan strip and held taut by a bent tree branch.

Photo 4-26. A kulasisi bird caught by the use of "Tugop", an adhesive exudates from the Antipolo tree.

Photo 4-27. Gold panning, an alternative livelihood among Mamanwa women.

Mamanwas still engage in hunting and trapping activities. Among the animals hunted are *buog* (wild boar), *usa* (deer), *manok* (wild chicken), wild pigeon, small birds, *kamahan* (monkey), *sawa* (python), and monitor lizard. Hunting is done with the aid of dogs or traps. Hunting is becoming a rare activity for two reasons: the decline in animal catch and the suspicion of military personnel.

Whenever possible, the Mamanwas go back to their *uma* (swidden farm) in the forest to cultivate *buzag* (sweet potato), *kalibri* (cassava), *mais* (maize), *humay* (upland rice), *saging* (banana), taro, and purple yam. Since sweet potato has been the traditional staple, at least six varieties are cultivated, namely the *painto*, *gracia*, *turok-banay*, *hinabang*, *kayapas*, *haradyas*, and *himelbas*. While in the forests, the Mamanwas also gather forest products, such as *baay* (poisonous tuber), *bahi* (sago palm), honey, rattan, and *bagon* (vine). Mamanwa foragers lament the fast diminishing forest resources.

- **Material Culture** – Mamanwa culture in Surigao del Norte has been highly acculturated due to the heavy borrowing of culture traits from the Visayans and Surigaonons. This process is true as well for material culture. Thus, several indigenous artifacts can no longer be found or are now rare.

  An example of a disappearing Mamanwa artifact is the *agong* (brass gong). This musical instrument plays an important role in the performance of shamanistic rituals. Many of the old *agongs* have already cracked and are no longer usable. To complicate the problem, there is no surviving Mamanwa blacksmith who can make *agongs*. The *agongs* can be purchased from the Manobos for P 20,000 each which the Mamanwas cannot afford. Consequently, many rituals can no longer be performed.

  Another artifact that has totally disappeared is the *sablo*, the Japanese long sword that a *bagani* (traditional warrior) usually possessed. This loss may be attributed to the decline in the practice of *ngazaw* (intertribal warfare) and the replacement of indigenous weapons with high-powered rifles.

  Traditional handicrafts that are still woven by Mamanwa women are the *alat* (rattan pack basket), *bangkil* (loosely woven rattan basket), *balugbog* (large rattan basket carried by shoulder or head straps), *ligo* (rice winnowing basket), and *banig* (sleeping mats made from pandan leaves).

  Mamanwa agricultural tools include the *lodzò* (bolo) and *dazopak* (garden trowel).

  At present, Mamanwa clothes are no different from those of rural Filipinos. They buy these clothes from the market. In the distant past, however, the men wore g-strings and the women skirts, both of which were made from bark cloth (Almeda, 1993). Spanish missionaries described the Mamanwas as wearing certain bracelets made of rattan of various colors and with garlands on their heads with bird feathers as plume. This type of ornamentation no longer exists.

  A typical Mamanwa *lagkaw* (house) in Cawilan is made of wood and raised on the ground by stilts. Some of the houses have walls. Most houses have *pawod* (sewn leaves of nipa palm) roofs; a few still maintain the more traditional *tikel* (rattan leaves). Vines are used to tie the different parts of the house together.

- **Culture Change** - As mentioned earlier, acculturation is rapidly taking place in Mamanwa society. In the process of borrowing from the culture of neighboring ethnic groups, the Mamanwas lost much of their indigenous culture.

  Even the original non-Austronesian language of the Mamanwas has been lost. The Minamanwa language has been borrowed from the neighboring Austronesian-speaking peoples, such as the Surigaonon, Butuanon, and Kamayo. The loss of original language is true for all Negrito groups in Southeast Asia. It is only the Andamanese of the Bay of Bengal that has maintained a non-Austronesian language.

  All Mamanwas are bilingual, *i.e.*, speaking both Minamanwa and Surigaonon or Sugbuanon. Because of bilingualism, a lot of loanwords from Surigaonon and Sugbuanon have seeped into the Minamanwa vocabulary. For example, some Mamanwas already use the Sugbuanon term "*bana*" to refer to a husband rather than the

original Minamanwa term "*akyeg*". With the rapid borrowing of foreign words, there is a danger that the Minamanwa language may eventually become extinct as was the case of three other Negrito languages, namely Katabaga, Dicamay Agta, and Tayabas Ayta.

Prolonged contact between Mamanwas and the Manobos of Agusan del Norte also contributed to the acculturation process. Inter-ethnic marriages between the Mamanwas and Manobos became more common, except in Kitcharao and Jabonga where the residents remain to be "purely" Mamanwa.

The Mamanwas borrowed a lot from the Manobo culture. The original Mamanwa homes were lean-tos. The house on stilts was borrowed from the Manobos. The Mamanwas mainly acquired their *agongs* through exchange with the Manobo. It may even be deduced that the concept of Supreme Being – Magbabazà – has been borrowed from the Manobo's Magbabaya.

The installation of *datus* (chiefs) and the establishment of "tribal councils" among the Mamanwa was introduced by the government's Office of Southern Cultural Communities (OSCC), now known as the NCIP. This was patterned after the Manobo's chieftainship and Council of Elders. Traditionally, however, the Mamanwa socio-political organization was based on acephalous bands.

The recruitment by the Communist Party of the Philippines-New People's Army (CPP-NPA) of Mamanwa fighters in the 1980s transformed the Mamanwa concept of *ngazaw* into a different context. In the past, *ngazaw* referred to inter-ethnic tribal warfare, such as that between Mamanwas and Manobos or Mamanwas and Visayans. The Mamanwa *ngazaw* party was composed of *baganis*, male warriors who were heralded because of their fighting experience and skills. With the recruitment of Mamanwa young men into the NPA, a new set of *baganis* arose. This time, their weapons were not bolos or *sablos* but armalite rifles. Their enemies were not those belonging to another tribe but members of the Philippine military, policemen, CAFGUs, and government spies. With the great split of the CPP-NPA in 1994, many Mamanwa NPAs separated from the communist guerillas and organized their own rebel army, called Bagani or Red Warriors. This group engaged in Robin Hood-type of activities, such as hold-ups and highway robberies, so as to distribute the spoils to the poor Mamanwas.

Of course, changes in the various components of a cultural system do not happen at the same pace. Based on ethnographic evidences, the material culture changes at a more rapid pace while ideational systems change at a slower pace.

Table 4-31 highlights the changes in Mamanwa culture since the 17th Century.

Table 4-31. Changes in Mamanwa Culture, by cultural domain, 17th Century to present

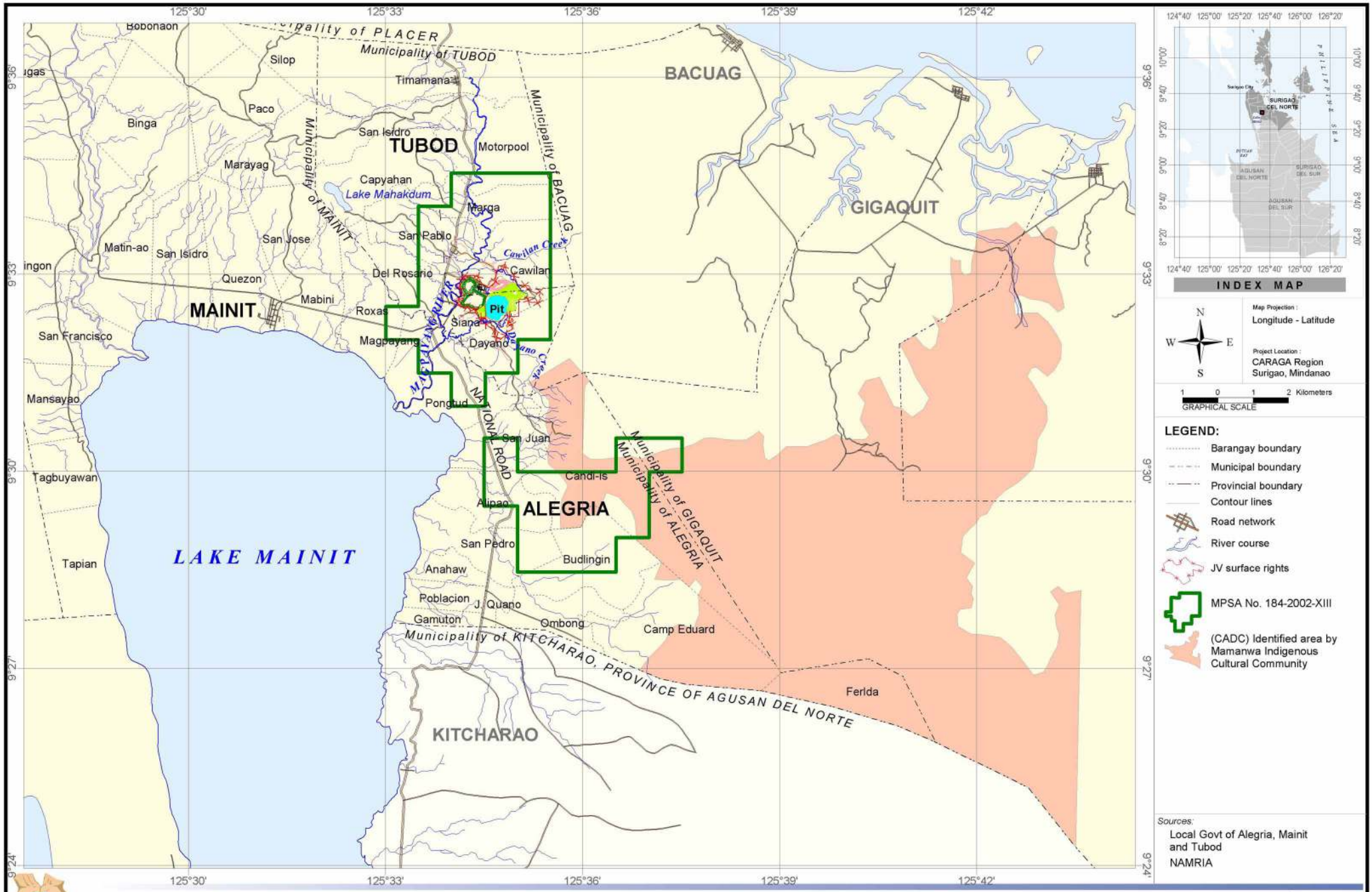
PERIOD	DOMAIN OF CULTURE			
	Economic	Social	Political	Ideational
17th Century	Mamanwa subsistence is based on hunting and gathering.	Nomadic way of life. Mamanwa society is stratified into different social ranks. Mamanwas practice polygyny.	Mamanwa bands are acephalous.	Mamanwas practice animism.
18th Century	Introduction of horticulture.	Culture contact between Mamanwas and Surigaonons.		Mamanwas lose their original non-Austronesian language due to linguistic assimilation with Surigaonon speakers.

PERIOD	DOMAIN OF CULTURE			
	Economic	Social	Political	Ideational
				Surigaonon speakers.
19th Century	Mamanwa rely mainly on shifting cultivation supplemented by hunting, fishing, and foraging.	Establishment of Mamanwa settlements because of the shift to a semi-sedentary lifestyle.		Disappearance of traditional Mamanwa body ornaments with the introduction of clothing materials from neighboring groups.
1900s			Minoritization of the Mamanwa due to the influx of migrants from Bohol, Leyte, and Camiguin.	
1910s		Shift from polygyny to monogamy due to lowland Christian influences.		Borrowing of the concept of Supreme God from the Manobos.
1920s		Rapid decline in Mamanwa population probably due to non-endemic diseases brought by migrant groups.		
1930s	Establishment of Surigao Consolidated Mining Corporation in Cawilan.	Mamanwas driven out of Cawilan due to mining operations.		
1940s		Intermarriage between Mamanwas and Manobos.		Introduction of the *sablo* (Japanese long sword) as symbolic representation of warrior rank.
1950s	Closure of SURICON mine.	Mamanwas returned to Cawilan.		
1960s	Visayan migrants acquire most of the lands in the area.	Increased incidence of intermarriage between Mamanwas and Visayan migrants.		Visayanization of Mamanwa culture due to increased contact with Visayans who have remained in the area despite the closure of the mines.
1970s	Decline in hunting and foraging activities with the depletion of forest resources.	Transformation to sedentary way of life.	Integration of Mamanwas within the barangay government.	

PERIOD	DOMAIN OF CULTURE			
	Economic	Social	Political	Ideational
1980s		Mamanwas have been forcefully evicted from Taganito to pave way for the construction of the mine. Transformation of the *bagani* (warrior rank) into communist guerillas.	Recruitment of Mamanwas into the communist movement. Transformation of Mamanwa headmen into "Tribal Chieftains" with the introduction of "Tribal Councils" by the OSCC.	Syncretization of Mamanwa religion because of religious conversion attempts by several Christian missions.
1990s	Transformation of economy from horticulture to wage labor because of discouragement by Philippine military. Type of jobs: wood haulers for small-scale loggers, coconut farmers.	Transformation of Mamanwa society from rank to class society. Increase in Mamanwa population due to more sedentary way of life.	Philippine military discourages Mamanwas from staying in upland areas to deny NPAs of their mass support. With the split in the NPA, some Mamanwas resort to Robin Hood-type of activities.	The rise of ethnic revivalism among some Mamanwas due to their negative experience with outside groups and as an impact of IPRA.
2000 to present	Integration of the Mamanwa into wage labor economy. Several Mamanwa males have been hired as security guards and utility men by Greenstone Resources.		Mamanwas apply for 42,000-hectare CADT in Alegria, Tubod, Bacuag, Claver, and Gigaquit and another CADT for Mainit and San Francisco.	

- **MOA between GRC and the Mamanwas** – Section 57 oF RA No. 8371 titled the "indigenous Peoples Rights Act of 1997" (IPRA) grants to indigenous people (IPs) "priority rights in the harvesting, extraction, development, or exploitation of any natural resources within the ancestral domains". It further provides that a non-IP may be allowed to develop and utilize the natural resources on the condition that there is a formal and written agreement with the IPs or that the community, according to its own decision-making process, has agreed to allow such operation.

  Figure 4-67 plots MPSA No. 184-2002-XIII and the Ancestral Domain Claim of the Mamanwa Tribe pursuant to IPRA. The overlap of the two occurs at the eastern portion of the southern block of the MPSA and outside of the 240-ha site of the Siana Gold Project. For the overlap area and following Section 57 of the IPRA, JCG and Greenstone Resources NL executed a Memorandum of Agreement with the Mamanwa Tribe on 23 November 2002. The MOA allows the former to explore within the overlap area upon satisfaction of various conditions for the IPs like the conduct of a festivity or "Kahimunan", employment, construction of houses, scholarship grants, assistance to the construction of school building, financial assistance to women and youth, and just and fair share from the proceeds of operations. The MOA does not cover the site of the Siana Project.



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MPSA No. 184-2002-XIII and the Mamanwa's Ancestral Domain Claim

Impacts

The Project will impact the Mamanwas in various ways:

1. Employment and livelihood – During exploration, GRC has employed Mamanwas in various capacities such as nursery maintenance, slope and soil stabilization, establishment of buffer zone, enrichment planting, and road works. During construction and operation, more jobs will become available to the Mamanwas of the impact barangays. The jobs include equipment operators, security guards, carpenters, mechanics, aides, and utility men. At mine closure, labor for the dismantling of equipment, clean-up works, and mine rehabilitation will be available.

   To ensure that the Mamanwas are capable of handling the job responsibilities, GRC needs to implement employee training programs well ahead of the Project requirement. GRC will also implement an SDMP to cater to the non-employable Mamanwas. The livelihood projects suitable to the Mamanwas are cash crop production, handicrafts, agroforestry, aquaculture, and animal dispersal.

2. Inter-ethnic relations – The Project is likely to hire personnel who are not familiar with the Mamanwa culture. To prevent conflicts and promote harmonious relationships among employees of different ethnicity, a cultural sensitivity program will be administered to both Mamanwa and non-Mamanwa employees and contractors.

3. Housing, settlement pattern, and social services – Work regularity will contribute to a more sedentary lifestyle for the Mamanwas. Hence, there is a need for improved social services in the Mamanwa community. These include access to education, electricity, tap water, and sanitary toilets. GRC should consider the provision of said services in the SDMP.

4. Lifestyle and standard of living – More disposable income for the Mamanwas will most likely accelerate the acculturation. Social preparation and culturally sensitive values formation programs should be implemented. A cultural awareness program implemented by anthropologists and social workers will help the Mamanwas preserve their culture and face the changes to their lives that the Project will bring.

5 ENVIRONMENTAL RISK ASSESSMENT

METHODOLOGY AND EXCLUSIONS

This Environmental Risk Assessment (ERA) follows Annex 2-7E of the Revised Procedural Manual for DAO No. 2003-30. It involves the following steps:

1. Risk screening to identify those hazardous materials which qualify for the risk study
2. Hazards analysis which characterizes the hazards in terms of adverse consequences and environmental pathway, *i.e.*, events and circumstances leading to a human fatality
3. Quantitative risk assessment which assigns probabilities to the release, exposure, and fatality scenarios and then computes the individual risk at certain locations following Covello and Merkhofer (1993)
4. Risk management which reiterates the necessary risk reduction or mitigation measures.

The ERA does not cover all mine closure risks which will be addressed by a separate study, *i.e.*, Final Mine Rehabilitation and Decommissioning Plan, and underground mine development and operation for which further detailed studies are required on hydrogeology, geotechnical engineering, and mining engineering.

RISK SCREENING

The Siana Gold Project will produce metals, *i.e.*, Au, Ag, Cu, Pb, and Zn, through a wet process. Under Annex 2-7E of the Revised Procedural Manual for DAO No. 2003-30, the Project is required to undergo a risk screening exercise.

The Project will use the following substances to generate the metals:

- Ammonium nitrate fuel oil explosive (ANFO)
- Diesel
- Lime
- Hydrochloric acid (HCl)
- Sodium hydroxide (Caustic soda, NaOH)
- Sodium cyanide (NaCN)
- Copper sulfate ($CuSO_4$)
- Sodium metabisulfite (SMBS)
- Activated carbon
- Zinc sulfate ($ZnSO_4$)
- Aerophine 3418A promoter
- Sodium isobutyl xanthate (SIX)
- Methyl isobutyl carbinol (MIBC)

In the process, it will also produce the following wastes:

- Waste rocks which are placed in the waste rock dump – The waste rocks contain Cu, Zn, Hg, Pb, and As (Table 8-1). The likelihood that the materials will generate AMD is low. At full capacity, the main waste rock dump will hold 9.6 million lcm and the secondary waste rock dump 0.3 million lcm.

- Tailings in the TSF – The tailings solids contain the same metals found in the waste rocks but may be elevated by 1 to 2 orders of magnitude (Table 8-1). The materials are NAF. At full capacity, TSF3 and TSF4 will contain 3.08 million t of tailings.

Another risk source is the open pit which suffered major pit wall failures in 1990 that led to the SURICON mine's premature closure and which has been flooded ever since.

From Tables 3-4 and 3-5, $CuSO_4$, NaCN, NaOH, HCl, SMBS, Aerophine 3418A, MIBC, and $ZnSO_4$ have significant hazard ratings. The same applies to ANFO and diesel for the mining operations. Table 5-1 further describes and evaluates each material in terms of Annex 2-7E's threshold inventory.

Table 5-1. Risk screening of chemicals

Materials	Annual Requirement (t)	Maximum Storage Capacity Onsite (t)	Level 1 (t)	Level 2 (t)	Category
$CuSO_4$	108	25	50	200	Toxic substance (low)
NaCN	700	**175**	5	20	Toxic substance (high)
NaOH	80	24	100	500	Unclassified (Type A)
HCl	100	**25**	5	20	Toxic substance (high)
SMBS	680	**170**	50	200	Unclassified (Type B)
Aerophine 3418A	1	1			
MIBC	14	4	5,000	50,000	Flammable substance
$ZnSO_4$	151	38			
ANFO	3,800	**950**	10	50	Explosive
Diesel	397,997 to 4,509,985	200	5,000	50,000	Flammable substance

Sources: GRC for the material requirements and site storage; Annex 2-7E of the Revised Procedural Manual for DAO 2003-30 for the others.

Based on Table 5-1 and Annex 2-7E, a quantitative risk assessment (QRA) is needed for NaCN, HCl, SMBS, and ANFO.

With respect to the wastes and the open pit, they do not fall under any of the hazardous materials categories of Annex 2-7E. However, by physical impact (from landsliding), they can result in human fatality. Hence, they too will be subjected to a QRA.

HAZARDS ANALYSIS

Sodium Cyanide

- **Technical Data** – NaCN (CAS No. 143-33-9, UN No. 1689) is a white deliquescent granular solid with almond odor. It is very stable when dry. Mositure will cause slow decomposition, releasing poisonous hydrogen cyanide (HCN) gas. It emits toxic fumes of CN and oxides of nitrogen when heated to decomposition.

The incompatibles are acids, nitrates, nitrites, chlorates, fluorine, magnesium, and strong oxidizers. It reacts with acids to liberate toxic and flammable HCN gas. Water or weak alkaline solutions can produce dangerous amounts of HCN in confined areas.

- **Toxicological Data** – The material is very toxic to aquatic and terrestrial life, *i.e.*, LD_{50} (rat, oral) 6,440 µg kg^{-1}.

- **Health Hazards** – When inhaled, NaCN is corrosive to the respiratory tract. It inhibits cellular respiration and may cause blood, central nervous system, and thyroid changes. It may cause headache, weakness, dizziness, labored breathing, nausea, and vomiting. This may be followed by weak and irregular heartbeat, unconsciousness, convulsions, coma, and death.

  NaCN is highly toxic when ingested. It is corrosive to the gastro-intestinal tract with burning in the mouth and esophagus, and abdominal pain. Larger doses may produce sudden loss of consciousness and death from respiratory arrest. Smaller but still lethal doses may prolong the illness for one or more hours.

  On contact, it is corrosive to the skin, causing severe pain and skin burns. NaCN may be absorbed through the skin with symptoms similar to those noted for inhalation. It is also corrosive to the eyes. Symptoms include redness, pain, blurred vision, and eye damage.

- **Project Use –** Leaching during Au processing. The waste of the leaching process is CN-laden tailings slurry. Prior to disposal to the TSF, the slurry will go through a two-reactor single stage SO_2-Air process. At the reactor, the slurry will react with SMBS and $CuSO_4$ solutions. Air is sparged into the reactor and the slurry pH maintained at 10 with the addition of lime slurry. The two (2) reactors will provide a total of 90 minutes residence time. WAD CN level in the tailings slurry at 150 mg L^{-1} will be reduced to less than 1 mg L^{-1} WAD CN before deposition to the TSF.

- **Storage and Process Area –** NaCN is supplied in 1-t bulk bags fitted with an integral pallet base. The Project's monthly consumption is 83 t. The material is stored in a separate building west of the process plant. The handling and storage equipment includes a carbon steel bag breaker, mixing tank with agitator, and 30 m^3 capacity storage tank (Figure 3-12).

- **Release Scenarios –** These include:

  1. During unloading at the pier, the container falls off the sea
  2. During the truck haulage from the pier to the storage area, the truck meets an accident and the container hits the ground
  3. During the stacking or withdrawal of the bulk bags, they fall to the ground
  4. During the preparation of solution in the working area, the polyethylene film bag falls to the ground or spills outside the mixing tank
  5. During the withdrawal of CN solution from the storage tank, the solution leaks from the pump or pipe
  6. Fire breaks out in the vicinity of the CN storage area
  7. After the CN destruction, CN in excess of the DENR standard remains in the tailings slurry
  8. The CN destruction circuit fails and the tailings leak out of the pump or the pipeline.

Hydrochloric Acid

- **Technical Data** – HCl (CAS No. 7647-01-0) appears as clear colorless or slightly yellow liquid with pungent odor. In its concentrated form, the acid is fuming. It is incompatible with most common metals, amines, metal oxides,

acetic anhydride, propiolactone, vinyl acetate, mercuric sulfate, calcium phosphide, formaldehyde, alkalies, carbonates, strong bases, sulfuric acid, and chlorosulfonic acid.

- **Toxicological Data** – HCl is extremely corrosive. Vapor inhalation can cause serious injury. Ingestion may be fatal. The liquid can cause severe damage to the skin and eyes. The threshold limit value (TLV) is 5 ppm.

- **Environmental Data** – The acid is lethal to fish from 25 mg L^{-1} up. It is toxic for aquatic organisms due to the pH shift.

- **Project Use** – For gold elution. It is also one of the reagents for CN destruction.

- **Storage and Process Area** – The acid is supplied in 200L HDPE drums. The handling and storage equipment includes a drum pump, mixing tank, acid dosing pump, and 1-m^3 capacity storage tank (Figure 3-12).

- **Release Scenarios** –

  1. During unloading at the pier, the container falls off the sea

  2. During the truck haulage from the pier to the storage area, the truck meets an accident and the container hits the ground

  3. During the stacking or withdrawl of the HDPE drums, they fall to the ground

  4. During the preparation of solution in the working area, the drum falls to the ground or spills outside the mixing tank

  5. During the withdrawal of HCl solution from the storage tank, the solution leaks from the pump or pipe.

Sodium Metabisulfite

- **Technical Data –** SMBS (CAS No. 7681-57-4) comes in white crystals or powder with a pungent SO_2 odor. It is freely soluble in water and glycerol and slightly soluble in alcohol. The material slowly releases SO_2 at ambient temperatures. Contact with acids produces toxic SO_2 fumes.

- **Toxicological Data** – The TLV time weighted average (TWA) is 5 mg m^{-3}. An accepted daily intake (ADI) is 0.7 mg sulfite kg-body-$weight^{-1}$.

- **Health Hazards –** Small amounts or low dose rates are regarded as practically non-harmful but may cause in some cases, sensitization. When swallowed in excessive amounts, SMBS may bring irritant or harmful effects. Large doses may produce violent colic, diarrhea, circulatory disturbance, depression of vital functions, and sometimes death.

  The dust may be discomforting to the eyes. It may cause burns, pain, and severe conjunctivitis. Corneal injury may develop with possible permanent impairment of vision if not promptly and adequately treated.

  SMBS may be mildly discomforting to the skin. Skin sensitization and allergic skin reactions may result from repeated exposures over long periods.

  If inhaled, the dust is discomforting and may be harmful. If excessive concentrations are inhaled, persons with impaired respiratory function and airway diseases such as emphysema or chronic bronchitis may incur further disability.

- **Project Use** – SMBS is the major reagent in the CN detoxification circuit. It is also used as Zn depressant in the Cu-Pb flotation circuit.

- **Storage and Process Area –** SMBS is supplied in 1-t bulk bags. The material is stored in a dedicated area across the process plant. The handling and storage equipment includes a bag breaker, 25-m^3 capacity mix/storage tank with agitator, buffer tank, and dosing pumps.

- **Release Scenarios –**

  1. During unloading at the pier, the container falls off the sea

  2. During the truck haulage from the pier to the storage area, the truck meets an accident and the container hits the ground

  3. During the stacking or withdrawal of the bulk bags, they fall to the ground

  4. During the preparation of solution in the working area, the bulk bag falls to the ground or spills outside the mixing tank

  5. During the withdrawal of SMBS solution form the storage tank, the solution leaks from the pump or pipe.

Ammonium Nitrate Fuel Oil

- **Technical Data** – The hazardous ingredients are ammonium nitrate (CAS No. 6484-52-2) and fuel oil (CAS No. 68476-34-6). It comes as white free-flowing solid prills with fuel oil odor, either bulk or packaged. With a flash point of more than 49°C, it can explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in large quantities. The material is incompatible with corrosives, *i.e.*, strong acids and strong bases or alkalis.

- **Health Hazards** – The effects of overexposure are eye irritation, redness and tearing**;** skin irritation; dizziness, nausea, or intestinal upset.

  During blasts, noxious gases such as NO_x and CO are emitted. In open pit operations, remote-controlled detonation, clearing of the area prior to blasts, and waiting for the gases to dissipate safety to the atmosphere before returning to the blast areas minimize human exposure to the gases. The same is done for underground operations, although the dissipation of the gases takes much longer.

- **Project Use –** ANFO is the main blasting material for rock breakage in the open pit.

- **Storage and Process Area** – The explosives are brought to the Project site in a container van. The vehicle is grounded and equipped with exhaust spark arrestors and wooden floorings. A red flag and a fire extinguisher of ABC dry chemical type are provided. The explosives are placed away from the vehicle's fuel supply. Detonators, inflammable or combustible goods, radioactive materials, and those which emit poisonous gas or fumes are not transported together with the explosives.

  At the pier, the container is offloaded and brought to the explosives magazine area at the Project site (Figure 3-5). The area is enclosed by a 2-m high chain wire perimeter fence. The blasting agents, *i.e.*, ANFO, packaged explosives, and detonators, are stored in three (3) separate reinforced concrete magazines. Each magazine is provided with a steel door, padlock, and padlock steel protector. Warning signs such as "No Smoking" and "Danger-Explosives" are conspicuously placed along the entrance and access road.

  Only licensed and certified persons will handle the storage, retrieval, and use of explosives. Before each blast, guards will secure and completely seal off the area for blasting. A warning siren will be activated 5 minutes before the blast.

- **Release Scenarios** – During truck haulage from the Surigao City pier to the Project site, the truck may meet an accident. A spark or fire may cause the ANFO to explode.

Waste Rock Dump

- **Technical Data** – Two waste rock dumps are planned. One is located to the immediate northeast of the pit with a capacity of 7.9 million bcm; another is to the immediate southwest of the pit ramp exit with a capacity of 0.8 million bcm. The dumps are designed with batter angles of 30^{o} and 10-m to 15-m berms at various vertical intervals (Figure 3-11). The overall slope angle is 15^{o}. Figure 3-14 shows the proposed surface runoff plan for the main waste rock dump.

  The acid-base accounting of waste rock samples found AMD to be limited to Domain 600 primarily and Domains 100 and 400 secondarily. To ensure that PAF materials are correctly identified, NAG pH=4 tests on blasthole cuttings of said Domains will be undertaken. The PAF materials are then deposited within the inner portions of the waste dump.

- **Immediate Environment** – Figure 5-1 shows on the Ikonos image the planned Project facilities and the adjacent houses of Brgys. Cawilan, Siana, and del Rosario.

- **Failure Modes** – The worst-case scenario for the waste rock dump is a slope failure which would bring the waste rocks cascading into the nearby barangays of Cawilan and Siana, process plant area, TSFs, or the open pit. Physical impact and inundation can kill people and destroy private properties and Project facilities. Depending on the volume and impact that hits the TSFs, tailings overflow or a dam breach may occur.

  Edge dumping, excessively pushed waste rocks to the edge, slopes steeper than the design angles, poor surface runon management that may result in erosion or even landsliding, water saturated waste rock dump, presence of continuous large volumes of clay-rich materials within the dump, scouring of dump edge by flows from the TSF3 emergency spillway, or a strong seismic event, working singly or in combination, are some of the possible causes.

Tailings Storage Facility

- **Technical Data** – Prior to disposal to the TSF, the CN-laden tailings slurry will go through a two-reactor single stage SO_2-Air process to reduce the CN concentration to safe levels.

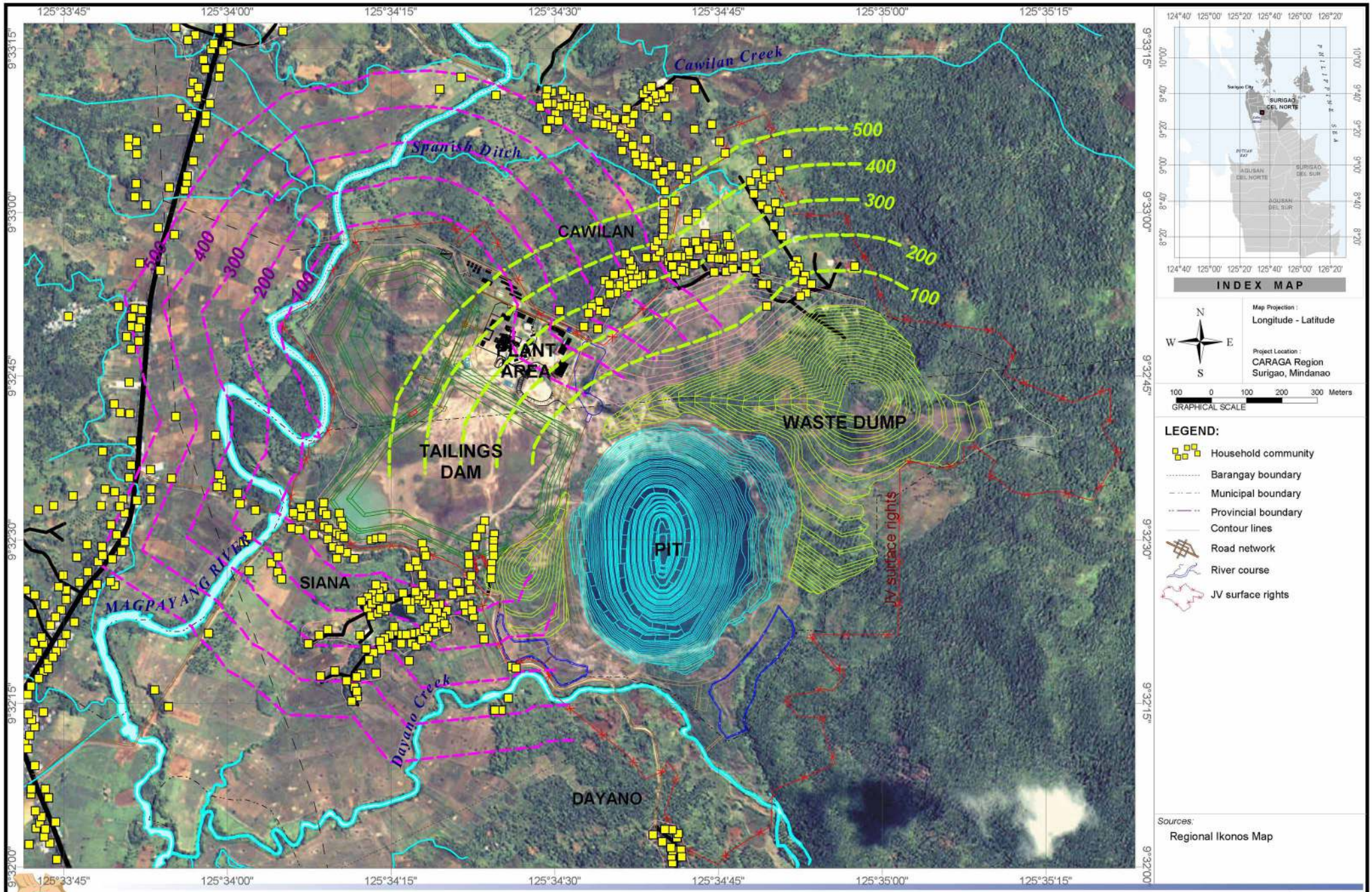
  TSF3 and TSF4 will be built using the upstream method to a combined storage capacity of 3.08 million t. Both were designed based on the results of geotechnical, hydro-meteorological, and hydrogeological studies and following the guidelines and recommendations of ANCOLD on FoS and design storms.

  The perimeter embankments will be constructed with an inner compacted clay (or other low-permeability material) zone and an outer shell of non-acid generating waste rockfill. The nominal downstream (external) batter slopes are 1V:3H; the upstream (internal) embankment batter slopes of TSF3 and TSF4 are 1V:2.5H, respectively (Figure 3-7). Upon completion, the crests of both facilities will have an elevation of 65 m which is roughly 15 m taller than the existing crests of Tailings dams 1 and 2 and 10 m taller than that of Tailings dam 3.

  The construction plan provides for an early installation of drainage system to facilitate the drying of the old tailings and seepage cut-off trench; removal of organic rich soils and deep ripping and compaction of tailings at the embankment footprint; and in areas of soft tailings, placement of high-strength geotextile over the tailings and covering with a layer of granular fill.

  For tailings water and surface runon management, decants will be provided adjacent to the dividing embankment of TSF3 and TSF4. To discharge stormwater from rainfall in excess of the design storm, emergency spillways will be provided – for TSF4, at the dividing embankment and for TSF3, along the southern perimeter (Figures 3-5, 3-6 3-8, and 3-9, and 3-10). The design storm is a 6-hour storm event ranging from 750 mm (for the 1:10,000 years ARI) to 1,160 mm (the PMP).

- **Immediate Environment** – Figure 5-1 shows the immediate environment of the TSFs.



bmp

Houses downslope of proposed waste containment sites

EIS of the Siana Gold Project

Figure No. **5-1**

- **Failure Modes** – The failure modes are embankment failure due to strong seismic event, liquefaction, or seepage; dam overtopping; embankment erosion, sloughing and settlement; and tailings overflow or dam break due to failed materials from the waste rock dump.

QUANTITATIVE RISK ASSESSMENT

Risk is a two-dimensional spatial concept which involves the possibility of an adverse outcome and uncertainty over the occurrence, timing, or magnitude of that adverse outcome. The individual risk at location (x,y) or IR(x,y) is computed as (Covello and Merkhofer, 1993):

$$IR(x,y) = \sum_{i,j} R_i E_{ji}(x,y) F_j$$

Where R_i is the probability of release scenario *i*, $E_{ji}(x,y)$ is the probability of exposure scenario *j* occurring to an individual in a geographic cell at location (x,y) given release scenario *i*, and F_j is the probability that exposure scenario *j* will result in a fatality.

The failure modes and effects analysis, an engineering reliability technique, uses the Bayesian approach to estimate probabilities. The estimation is simplified by providing qualititative likelihood categories for failure modes. For each category, a corresponding probability assessment is attached. Table 5-2 presents the likelihood categories and values.

Table 5-2. Suggested probability values

Subjective Category	Probability of Occurrence
Negligible	$< 10^{-6}$
Very low	10^{-6} to 10^{-4}
Low	10^{-4} to 10^{-2}
Moderate	10^{-2} to 10^{-1}
Significant	$> 10^{-1}$

Source: Dushinisky and Vick, 1996.

The failure modes and effects analysis also provides a simplified method of assessing the severity of outcomes. The range of possible failure consequences is divided into four mutually exclusive categories:

Table 5-3. Suggested consequence categories

Consequence Level	Description
Safe	Negligible; no effect on system or safety.
Marginal	Failure will cause some environmental damage but no major or long-term damage.
Critical	Failure will degrade the environment or cause injury, and if immediate action is not taken, major or permanent damage, serious injuries, or deaths will occur.
Severe	Failure will produce major and irrecoverable environmental damage or multiple deaths or injuries.

Source: Dushinisky and Vick, 1996.

NaCN, HCl, and SMBS

Table 5-4 estimates the IRs for NaCN, HCl, and SMBS given the release scenarios determined in the preceding Section. The assumptions, *i.e.*, the risk management measures, which form the basis of assessing the probability values, are indicated. Any change in the assumptions, *i.e.*, non-implementation of a risk management measure or implementation of an additional management measure, will alter the IR assessment.

As shown in the Table, the estimated IRs for NaCN range from 10^{-10} to 10^{-17}, the IRs for HCl from 10^{-13} to 10^{-20}, and the IRs for SMBS from 10^{-14} to 10^{-21}. For all reagents, the scenario with the highest IR is a truck accident during haulage from the pier to the Project site.

ANFO

The release scenario is accident during truck haulage which causes the ANFO to explode. Explosion effects may be estimated through the formula:

$$Z = R / \sqrt[3]{W}$$

Where Z is the scaled distance in m, R is the distance in m from the source of the explosion, and W is the charge weight of TNT or equivalent weight of explosives in t. Through the TNT equivalent method, peak overpressure can be related to scaled distance. For example, a blast overpressure of 5 psi corresponds to a scaled distance of 56 m. An overpressure of such magnitude is expected to result in a 50 % chance of fatality for a person in a building or a 15 % chance of fatality for a person in the open. The scaled distance corresponding to 10 psi is 40 m. For such an overpressure, a 100 % fatality is likely.

Knowing the scaled distance Z and the charge weight of explosives stored, the radius of impact R may be computed using the equation. Given W per truck of 25 t, the computed radii of impact for the various levels of blast overpressure for the said charge are 117 m for a 100 % fatality and 163 m for a 15 % chance of fatality for a person in the open. Table 5-5 estimates the IRs. They range from 10^{-10} to 10^{-11}.

Table 5-4. Estimation of individual risks for NaCN, HCl, SMBS, and ANFO

Scenario	Location	Individual Risk	Assumptions	Prob {Release}[1]	Prob {Exposure}	Prob {Fatality}
Sodium Cyanide						
During unloading, the container falls off the sea.	Surigao City Pier	10^{-17}	• No deliveries during inclement weather. • NaCN pellets in polypropylene bulk bag, hermetically sealed in a polyethylene film bag which lines the inside of a wooden intermediate bulk container (IBC). The IBC is fitted with an integral pallet base to enable handling by conventional forklift. The IBCs are inside sealed metal shipping containers. • No incompatibles are inside the container. • Access to the port area during unloading of chemicals is restricted to trained workers.	$10^{-6} \times 10^{-5} = 10^{-11}$	10^{-6}	1
During the truck haulage, the truck meets an accident and the container hits the ground.	From Surigao City pier to Project site, along the road	10^{-10}	• No deliveries during inclement weather and flooding. • Vehicle speed is restricted. • NaCN in IBC hauled in sealed metal container. • Special training, PPE, and emergency kit for truck crew and emergency personnel.	$10^{-5} \times 10^{-4} = 10^{-9}$	10^{-1}	1
During the stacking or withdrawal of bulk bags, they fall to the ground.	CN storage area	10^{-13}	• Training and PPE for forklift operator. • Good working conditions • Bunding and grading for collection of spills at the containment or events pond (Figure 3-12). • The area is free of CN incompatibles. • Availability of eye wash, shower, and emergency kit.	$10^{-5} \times 10^{-3} = 10^{-8}$	10^{-5}	1
During the preparation of solution, the polyethylene film bag falls to the ground.	CN mixing area	8×10^{-11}	• Training and PPE for forklift operator. • Good working conditions • Bunding and grading for collection of spills at the containment or events pond (Figure 3-12). • The area is free of CN incompatibles. • Availability of eye wash, shower, and emergency kit.	$10^{-5} \times 0.8 = 8 \times 10^{-6}$	10^{-5}	1

Scenario	Location	Individual Risk	Assumptions	Prob {Release}[1]	Prob {Exposure}	Prob {Fatality}
CN solution leaks from the pump or pipe.	Process plant and TSF areas	10^{-15}	• Good R&M for the pump and pipes. • Pipes are color-coded, protected from foot or equipment movement, and built in sections with emergency shut-off valves. • A lined bund which is an embankment around the perimeter of the storage tank can contain 100 % of storage capacity. • Any spill from the pump reports to a containment or events pond that is regularly unloaded at the end of every shift or sooner if required. • Plant personnel are trained and equipped with PPE.	$10^{-5} \times 10^{-5} = 10^{-10}$	10^{-5}	1
CN gas is released during fire.	CN storage and mixing areas	10^{-13}	• No-open-flame policy and restricted access. • Combustibles, *e.g.*, diesel storage tanks, are a safe distance away. • Established fire-fighting policies on materials handling, segregation, and distances • No water, acid, or carbon-based fire extinguisher will be used as such substances are incompatible with CN. • Emergency action and evacuation plan during fires in place.	$10^{-5} \times 10^{-3} = 10^{-8}$	10^{-5}	1
CN destruction fails and tailings leak out of the pipe.	Process plant and TSF areas	10^{-11}	• Good R&M program for the CN destruction circuit and tailings pipes. • Free CN content of treated tailings analyzed every start and middle of shift. • Pressure within tailings pipeline and TSF discharge from the pipe monitored every start and middle of shift. • Tailings pipeline placed in bund or trench to contain leaks • TSF embankments are backsloped to convey any pipe leak into the tailings pond.	$10^{-4} \times 10^{-1} = 10^{-5}$	10^{-6}	1
CN destruction fails and tailings water flows out of the pond.	Dayano Creek and Magpayang River	10^{-11}	• Good R&M program for the CN destruction circuit and tailings pipes. • Free CN content of treated tailings water analyzed every	$10^{-4} \times 10^{-4} = 10^{-8}$	10^{-3}	1

Scenario	Location	Individual Risk	Assumptions	Prob {Release}[1]	Prob {Exposure}	Prob {Fatality}
			start and middle of shift. • Free CN content of tailings water near TSF decant and water at Ponds A and B analyzed every shift. • At the tailings pond, residual CN level will decrease due to natural degradation and dilution.			
Hydrochloric Acid						
During unloading, the container falls off the sea.	Surigao City Pier	10^{-20}	• No deliveries during inclement weather. • HCl in 200L HDPE drums contained in a sealed metal shipping container. • No incompatibles are inside the container. • Access to the port area during unloading of chemicals is restricted to trained workers.	$10^{-6} \times 10^{-5} = 10^{-11}$	10^{-6}	10^{-3}
During truck haulage, the truck meets an accident and the container hits the ground.	From Surigao City pier to Project site, along the road	10^{-13}	• No deliveries during inclement weather and flooding. • Vehicle speed is restricted. • HCl in HDPE drums hauled in sealed metal container. • Special training, PPE, and emergency kit for truck crew and emergency personnel.	$10^{-5} \times 10^{-4} = 10^{-9}$	10^{-1}	10^{-3}
During the stacking or withdrawal of the HDPE drums, they fall to the ground.	HCl storage area	10^{-16}	• Training and PPE for forklift operator. • Good working conditions • Bunding and grading for collection of spills at the containment or events pond (Figure 3-12). • The area is free of HCl incompatibles. • Availability of eye wash, shower, and emergency kit.	$10^{-5} \times 10^{-3} = 10^{-8}$	10^{-5}	10^{-3}
During the preparation of solution in the working area, the drum falls to the ground or spills outside the mixing tank	HCl mixing area	8×10^{-14}	• Training and PPE for forklift operator. • Good working conditions • Bunding and grading for collection of spills at the containment or events pond (Figure 3-12). • The area is free of HCl incompatibles. Availability of eye wash, shower, and emergency kit.	$10^{-5} \times 0.8 = 8 \times 10^{-6}$	10^{-5}	10^{-3}

Scenario	Location	Individual Risk	Assumptions	Prob {Release}[1]	Prob {Exposure}	Prob {Fatality}
HCl solution leaks from the pump or pipe.	Process plant	10^{-18}	• Good R&M for the pump and pipes. • Pipes are color-coded, protected from foot or equipment movement, and built in sections with emergency shut-off valves. • A lined bund which is an embankment around the perimeter of the storage tank can contain 100 % of storage capacity. • Any spill from the pump reports to a containment or events pond that is regularly unloaded at the end of every shift or sooner if required. • Plant personnel are trained and equipped with PPE.	$10^{-5} \times 10^{-5} = 10^{-10}$	10^{-5}	10^{-3}
Sodium Metabisulfite						
During unloading, the container falls off the sea.	Surigao City Pier	10^{-21}	• No deliveries during inclement weather. • SMBS crystals in 1-t bulk bags shipped inside sealed metal shipping containers. • Access to the port area during unloading of chemicals is restricted to trained workers.	$10^{-6} \times 10^{-5} = 10^{-11}$	10^{-6}	10^{-4}
During the truck haulage, the truck meets an accident and the container hits the ground.	From Surigao City pier to Project site, along the road	10^{-14}	• No deliveries during inclement weather and flooding. • Vehicle speed is restricted. • SMBS in bulk bags hauled in sealed metal container. • Special training, PPE, and emergency kit for truck crew and emergency personnel.	$10^{-5} \times 10^{-4} = 10^{-9}$	10^{-1}	10^{-4}
During the stacking or withdrawal of bulk bags, they fall to the ground.	SMBS storage area	10^{-17}	• Training and PPE for forklift operator. • Good working conditions • Bunding and grading for collection of spills at the containment or events pond (Figure 3-14). • The area is free of SMBS incompatibles. • Availability of eye wash, shower, and emergency kit.	$10^{-5} \times 10^{-3} = 10^{-8}$	10^{-5}	10^{-4}
During preparation of solution in the working area, the bulk bag falls to the ground or spills	SMBS mixing area	8×10^{-15}	• Training and PPE for forklift operator. • Good working conditions • Bunding and grading for collection of spills at the	$10^{-5} \times 0.8 = 8 \times 10^{-6}$	10^{-5}	10^{-4}

Scenario	Location	Individual Risk	Assumptions	Prob {Release}[1]	Prob {Exposure}	Prob {Fatality}
the ground or spills outside the mixing tank.			containment or events pond (Figure 3-12). • The area is free of SMBS incompatibles. • Availability of eye wash, shower, and emergency kit.			
SMBS solution leaks from the pump or pipe.	Process plant	10^{-19}	• Good R&M for the pump and pipes. • Pipes are color-coded, protected from foot or equipment movement, and built in sections with emergency shut-off valves. • A lined bund which is an embankment around the perimeter of the storage tank can contain 100 % of storage capacity. • Any spill from the pump reports to a containment or events pond that is regularly unloaded at the end of every shift or sooner if required. • Plant personnel are trained and equipped with PPE.	$10^{-5} \times 10^{-5} = 10^{-10}$	10^{-5}	10^{-4}
ANFO						
During the truck haulage, the truck meets an accident causing a spark which may ignite the truck's fuel supply and lead to an ANFO explosion.	From Surigao City pier to Project site, along the road	10^{-10} (Within 117 m from crash site) 1.5×10^{-11} (Beyond 117 m and less than 163 m from crash site)	• No deliveries during inclement weather and flooding. • Vehicle speed is restricted. • ANFO properly secured in bags and hauled in sealed metal container. • No detonators, combustibles, and flammables are stored together with the explosives. • The metal wall and frame of the container protect the load from impact. • Special training, PPE, and emergency kit for truck crew and emergency personnel.	$10^{-5} \times 10^{-5} = 10^{-10}$	1	1 (Within 117 m from crash site) 0.15 (Beyond 117 m and less than 163 m from crash site)

Note:

[1]Prob{Release} is the product of Prob{Occurrence of Release Scenario} and Prob{Material Being Released given the Release Scenario} as shown.

Table 5-5. Damage caused at different incident levels of thermal radiation

Incident Flux (kW m^{-2})	Damage to Equipment	Damage to People
37.5	Damage to process equipment	100% lethality in 1 minute; 1% lethality in 10 seconds
25.0	Minimum energy to ignite wood at indefinitely long exposure without a flame	100% lethality in 1 minute. Significant injury in 10 seconds.
12.5	Minimum energy to ignite wood with a flame; melts platic tubing	1% lethality in 1 minute. First-degree burns in 10 seconds
4.0		Causes pain if duration is longer than 20 seconds but blistering is unlikely.
1.6		Causes no discomfort for long exposure.

Source: World Bank, 1988

Waste Rock Dump

The failure modes include:

- Edge dumping or waste rocks excessively pushed to the edges of the waste rock dump
- Slide due to slopes which are steeper than the design angles
- Poor surface runon management that may result in erosion and even landsliding
- Water saturated waste rock dump due to the presence of continuous large volumes of clay that weakens the structure and causes a slide
- Scouring of dump edge by flows from the TSF3 emergency spillway and
- Slide due to a strong seismic event.

Table 5-6 is the failure modes and effects analysis for the waste rock dump. The bases of the assessment are the Memorandum titled "Further Waste Dump Stability Assessment" of PETER O'BRYAN *& Associates* dated 25 August 2008, Memorandum titled "Siana Gold Project Proposed Revisions to the Feasibility Study" of GHD Pty Ltd dated 1 October 2008, and the Memorandum titled "Conceptual Site Runoff Version 2 – Incorporating New Waste Dump Design Siana Gold Project" of Meyer Water and Environmental Solutions dated 7 September 2008.

From Table 5-6, six (6) of the seven (7) failure modes, whose consequences may be critical, have probabilities greater than 10^{-6}. This underscores the need for the detection methods and compensating provisions, listed in Table 5-6, that have to be undertaken before and during construction and operations.

Tailings Storage Facility

The failure modes to be evaluated are:

- Embankment failure due to a strong seismic event
- Embankment erosion, sloughing, or settlement
- Foundation failure due to liquefaction

- Foundation failure from dam seepage and
- Dam overtopping.

Table 5-6 displays the results of the evaluation. As shown, liquefaction and seepage with consequences assessed as critical to severe have probability ratings greater than 10^{-6}. To address the risks, a slope stability re-assessment during the detailed design works and laboratory tests on fresh tailings should be conducted during operations to verify the assumed tailings shear strength parameters.

As in the waste rock dump, there are houses immediately downstream of TSF3 and TSF4. To avoid human injury and fatality and damage to property, a buffer or exclusion zone needs to be established.

Open Pit

The failure modes for evaluation are:

- Weak bearing capacity of the pit ground due to insufficient drying
- Failure of pit wall due to groundwater pressure in combination with steep dipping cross cutting structures and
- Failure of pumps and dewatering bores to prevent flooding in the pit.

Table 5-6 displays the results of the failure modes and effects analysis. All failure modes are seen to result in critical consequences. Of the three (3) modes, the last two have probability ratings of 10^{-4}. The detection methods and compensating provisions listed for the two (2) failure modes are critical.

Table 5-6. Failure modes and effects analysis for the waste rock dump, TSF, and open pit

Component	Failure Mode	Effects	Consequence		Likelihood		Detection Methods	Compensating Provisions
			Level	Confidence	Level	Confidence		
Waste rock dump								
Waste rocks	Roll-down or slide due to edge dumping or excessively pushed waste rocks to the dump edges	Waste rocks cascade down the slopes and hit the open pit, houses of Purok Hillside of Brgy. Siana and Puroks Malipayon and Bulawanon of Brgy. Cawilan, mine service area, TSF3, and Pond B.	Critical	High	Very Low 10^{-5}	High	A technician is assigned to the waste rock dump to ensure the correct placement of waste rocks.	Houses located adjacent to the main and secondary waste rock dumps will be relocated. SURICON's old waste rock dump will act as buffer for Brgy. Cawilan. Safety bunds or catch fences will be installed along the pit edge.
	Slide of water saturated dump containing continuous large volumes of clay-rich materials	Failed materials will hit the open pit, houses of Purok Hillside of Brgy. Siana and Puroks Malipayon and Bulawanon of Brgy. Cawilan, mine service area, TSF3, and Pond B.	Critical to severe	High	Low 10^{-4}	Medium	A technician is assigned to the waste rock dumps to ensure the staggered placement of clay-rich materials. A piezometer is installed to monitor the phreatic surface at the waste rock dumps.	
	Slide due to a strong seismic event	The failed waste rocks will inundate the ope pit, houses of the three (3) Puroks, mine service area, TSF3, and Pond B.	Severe	High	Low 10^{-4}	Medium	Partial settlement of dump and cracks within the embankment.	
Erosion protection	Armor is eroded; the exposed surface erodes	The effects are sediment, mud, or gullying.	Marginal	Medium	Low 10^{-3}	Medium	Daily inspection of armor rocks and fixing or replacement when necessary.	Armor can be re-installed.
Surface water management	A block in the drain or bund prevents the diversion of runoff away from the dump	Water saturates and weakens the dump, causing either a mudflow or landslide.	Critical to Severe	Medium	Low 10^{-4}	Medium	The size, alignment, and lining of drainage channels need to be assessed very carefully during the detailed design works. Regular inspection of perimeter drains and bunds especially during heavy rains.	

Component	Failure Mode	Effects	Consequence		Likelihood		Detection Methods	Compensating Provisions
			Level	Confidence	Level	Confidence		
	A block in the drain or settling pond causes runoff to spill out and to weaken the dump or to flood the open pit	The effects are sediments, mud, or gullying of the structure and flooding of the open pit.	Marginal to Critical	Medium	Low 10^{-4}	Medium	The size, alignment, and lining of drainage channels as well as the ingress and egress of settling ponds need to be assessed very carefully during the detailed design works. Regular inspection of slopes, scoop drains, and bunds especially during heavy rains.	
	Scouring of secondary dump edge by flows from the TSF3 spillway	Sediments or landslide impacting the houses of Purok Hillside of Siana, Pond B, and Dayano Creek	Marginal to Critical	Medium	Low 10^{-3}	Medium	For consideration in the detailed design works: Alignment of TSF3 emergency spillway and channel vis-à-vis the secondary waste rock dump. Size and alignment of spillway channel to handle the predicted spillway flow. Adequate buffer space between the emergency spillway channel and the secondary waste rock dump.	Orientation of the TSF3 emergency spillway and channel away from the secondary waste rock dump. Provision of adequate space between emergency spillway channel and the secondary waste rock dump.
TSF								
Dam embankment	Slope failure due to strong seismic event	The effects will depend on stage of TSF construction, volume of tailings impounded, and location of breach. At risk are are the open pit, process plant area, Brgys. Cawilan and Siana, Dayano Creek, and Magpayang River	Severe	High	Very Low 10^{-6}	Medium	A re-assessment of slope stability under static and seismic conditions will be conducted by GHD as part of detailed design works. Tension cracks, settlement of certain portions of the embankment, piezometer readings	The secondary waste rock dump immediately southeast of TSF3 will strengthen the dam structure in that section.

Component	Failure Mode	Effects	Consequence		Likelihood		Detection Methods	Compensating Provisions
			Level	Confidence	Level	Confidence		
	Erosion failure	Some materials will be eroded but this will not jeopardize the embankment.	Marginal	High	Low 10^{-3}	High	Rill or gully marks along the slope; sediment plume downslope	
Foundation	Liquefaction	This will be due to a large seismic event with liquefaction likely confined to recently deposited (surficial) tailings. The effects will depend on stage of TSF construction, volume of tailings impounded, and location of breach.	Severe	High	Very Low 10^{-4}	Medium	A re-assessment of slope stability under static and seismic conditions will be conducted by GHD as part of detailed design works. This re-assessment is critical since the TSF will be built using the upstream method. In this method, waste rocks and othermaterials will be placed on top of deposited tailings to raise the dam embankment. Laboratory tests should be carried out on the fresh tailings to verify the shear strength parameters.	
	Seepage	The effects will depend on stage of TSF construction, volume of tailings impounded, and location of breach.	Critical to Severe	Medium	Very Low 10^{-5}	Low	Sediment-laden seepage through the embankment	The inner core of the dam embankment is clay. A seepage cut-off trench is excavated beneath the embankment.
		The dam structure may not be compromised but tailings water may seep through the tailings solids and contaminate the bedrock fractured aquifer.	Marginal to Critical	Medium	Very Low 10^{-5}	Medium	The pitwater may be sampled regularly for heavy metals and CN. Any tailings seepage to Magpayang River and Dayano Creek will be captured by the regular environmental monitoring program.	Mining One's investigation suggests the movement of groundwater in the deeper aquifers towards the open pit from the north and west (where the TSFs will be located).
Dam spillway	Dam overtopping	The effects will depend on stage of TSF construction, volume of tailings impounded, and location	Severe	High	Very Low 10^{-6}	Medium	The size, lining, and alignment of the TSF emergency spillways will be determined during the	Emergency personnel may be placed on alert during heavy rains or storms.

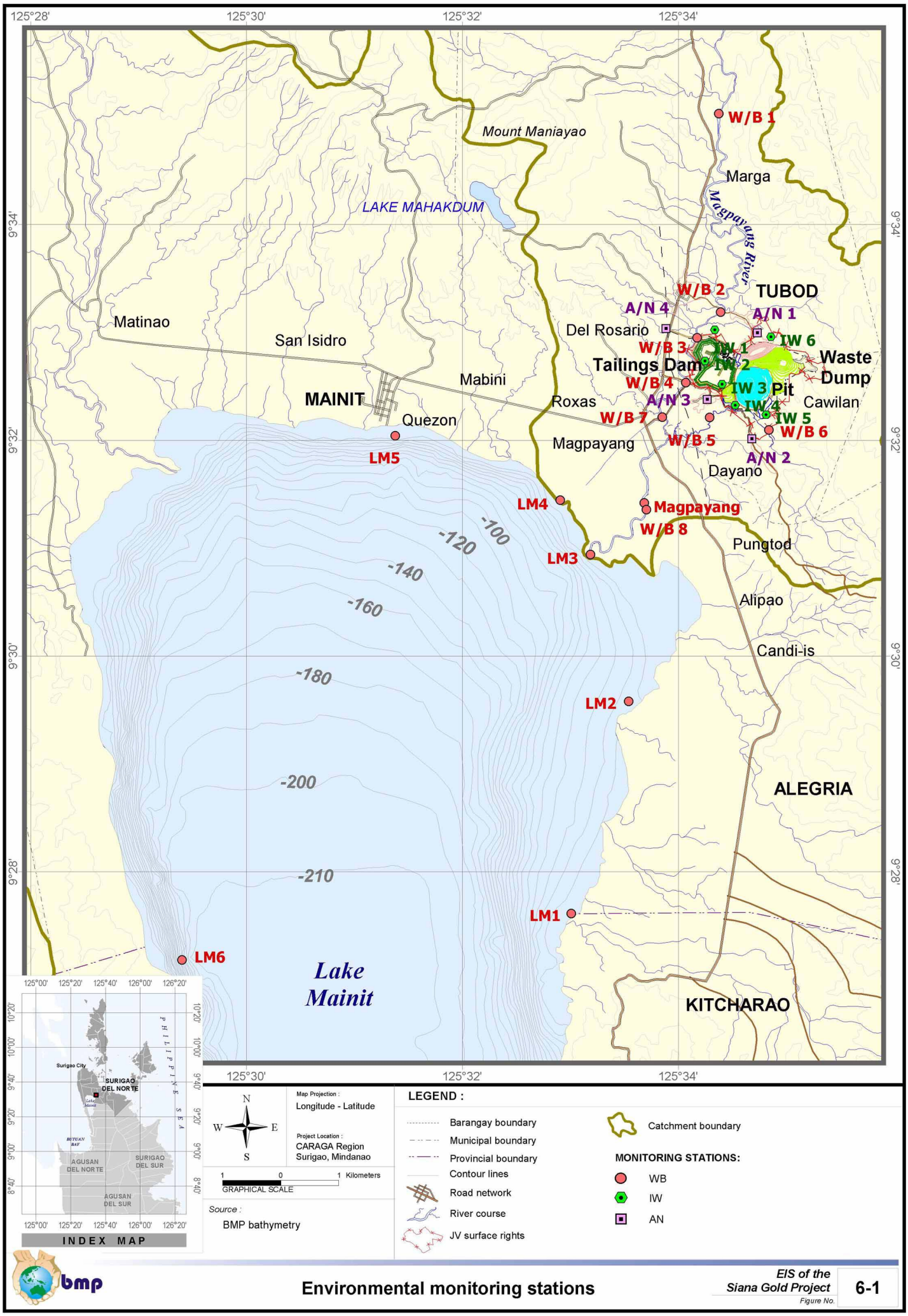
Component	Failure Mode	Effects	Consequence		Likelihood		Detection Methods	Compensating Provisions
			Level	Confidence	Level	Confidence		
		of breach.					detailed design works. Heavy rainfall.	
Open pit								
Pit ground	Weak bearing capacity of the pit ground due to insufficient drying.	The worst-case effects are loss of equipment and personnel	Marginal to Critical	High	Very Low 10^{-5}	Medium	Soil and rock investigation by boring or test pits.	
Pit wall	Failure of pit wall due to groundwater pressure in combination with steep dipping cross cutting structures. The dewatering bores either malfunction or are inadequate to depressurize the pit walls.	Loss of equipment and personnel	Critical to Severe	High	Low 10^{-4}	Medium	Monitoring of groundwater bore conditions and discharges.	Pond C which will be built to the southeast of the open pit may need to be lined with impermeable material.
Surface water management	Failure of pumps and dewatering bores to prevent flooding in the pit.	Loss of equipment and personnel	Critical to Severe	High	Low 10^{-4}	Medium	Deployment of emergency personnel to monitor drains, ponds, pumps, and pit water level during heavy rains.	Redundant set of pumps provided.

6 ENVIRONMENTAL MANAGEMENT PLAN

IMPACTS MANAGEMENT PLAN

Table 6-1. Impacts management plan

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
All Project Phases	Land					
	• Visual aesthetics	Solid waste	• Segregation of waste into biodegradable and non-biodegradable • Composting or disposal of wastes to recyclers • Dumping of non-recyclable and non-biodegradable waste in the landfill	Earthworks, civil works, and equipment maintenance contractors and GRC	P 0.3 million – construction cost of material recovery facility P 0.7 million pa – operating cost P 0.7 million – construction cost of Project landfill if one will be required	Cost will be part of the EPEP for submission to MGB and for monitoring by MMT.
	Water					
	• Water quality • Freshwater biology	Turbidity (non-toxic stressor for freshwater biology)	• Minimized ground clearings and disturbances • Scheduling of construction during dryer months	Earthworks contractor and GRC	P 13 million - Cost of stormwater drainage, settling pond, and geotextile tubes	Cost will be part of the EPEP for submission to MGB and for monitoring by MMT.
			• Surface runoff diversion from disturbed areas		Other measures are part of earthworks contract	Ground clearing clearance procedure for enforcement and monitoring by GRC



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Environmental monitoring stations

EIS of the Siana Gold Project

Figure No. 6-1

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Recovery and use of topsoils • Spoils management • Grading and sloping of work areas and channels • Use of settling ponds and geotextile tubes to filter surface runoff			
		Oil and grease (toxic stressor)	• Training on proper oil handling • Oil spills containment • Collection and containment of used oil	Earthworks, civil works, and equipment maintenance contractors and GRC	Part of earthworks, civil works, and equipment maintenance contract	For monitoring by GRC and MMT
		Sewage (non-toxic stressor)	• Sewage treatment plant for each building	GRC	P 3.6 million	Cost will be part of the EPEP for submission to MGB and for monitoring by MMT.
	People					
	• Socioeconomics	Direct and indirect employment, national and local taxes, and community programs	• Inventory of available skills and local suppliers and contractors and identification of gaps based on Project requirements	GRC	P 0.5 million for inventory and training programs P 0.8 million for SDMP community consultation and planning	Cost will be part of EPEP for submission to MGB and for monitoring by MMT. The number, origins, and ethnicity of directly and indirectly employed by the Project for monitoring by MMT.
			• Training programs for			

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			local residents to address gaps • Implementation of employment policy agreed upon by the Chairmen of direct impact and indirect impact barangays • Preference to qualified local suppliers and contractors • Transparent consultative mechanisms for the identification , prioritization, and implementation of SDMP projects			
	• Mamanwa culture	Acculturation and discrimination	• Inclusion of qualified Mamanwas from the impact barangays in priority hiring • Improvement of social services for the Mamanwa community • Education of workers on Mamanwa culture and need for ethnic tolerance	Earthworks, civil works, and equipment maintenance contractors and GRC	P 50,000 for cultural awareness program	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Education of Mamanwa workers on other people's culture including the corporate culture • Cultural revival activities			
	• Occupational safety and health	Excessive exposure to the elements, musculo-skeletal stress, physical injuries, loss of hearing, respiratory diseases, exposure to hazardous reagents such as NaCN, NaOH, and HCl	• Stringent policies and programs of GRC on occupational safety and health • General employee induction and regular safety training	Earthworks, civil works, and equipment maintenance contractors and GRC	The budgets for safety activities of contractors are integrated into their contracts. For GRC, the annual budget of their Mine Safety Office is P 1.8 million.	The activities are part of the Mine Safety and Health Program for submission to and monitoring by MGB.
			• Safety inspections and toolbox meetings • Regular medical examinations • PPEs • First-aid and mine rescue trainings			
	• Public health	Vector- and water-borne diseases, traffic hazards, respiratory diseases, spread of diseases by migrant workers, heavy metals, AMD, hazardous reagents	• Coordination with the Department of Health (DOH) for implementation of programs for vector-borne diseases	GRC	P 4.5 million for capital cost of water treatment and distribution system P 0.8 million for operation of community water system pa P 300,000 for medical check-ups pa	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Continuation of GRC's community water treatment and distribution system			
			• Vehicle speed limits, safety signages, pedestrian walkways and restriction from mine access and haul roads • Observance of buffer zone from TSF and waste rock dump perimeter • Management measures for dust, noise, AMD, and reagents			
			• Hiring and regular medical check-up for all employees and selected samples from the impact barangays • Relocation of potentially impacted households	Earthworks, civil works, and equipment maintenance contractors and GRC	Part of earthworks, civil works, and equipment maintenance contract	For monitoring by GRC and MMT
Construction						
Surface earthworks and civil works – roads, accommodations, plant, warehouse, shops, installations, etc	Land					

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
installations, etc.	• Terrestrial biology	Loss of wetland habitat of the Philippine Duck	• Minimized ground clearings and disturbances • Recovery and use of topsoils	GRC	P 1 million for enrichment planting	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.
			• Enrichment planting to include fruit trees along edges of the property • Ban on wildlife hunting and gathering of duck eggs within the property • Inclusion of flora and fauna protection programs in the SDMP			
	Air	Dust and noise	• Training on proper equipment use • Water sprays • Enclosures, barriers, and buffer zones surrounding TSF embankment and waste rock dump perimeter • Use of less noisy and shielded equipment • Proper maintenance of equipment • Dust and noise PPEs to workers	Earthworks, civil works, and equipment maintenance contractors and GRC	Part of earthworks, civil works, and equipment maintenance contract	For monitoring by GRC and MMT

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Relocation of potentially impacted households	GRC	P 0.75 million for land acquisition P 12.1 million for house construction	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.
Pit dewatering	Land					
	• Terrestrial biology	Loss of wetland habitat of the Philippine Duck	• Enrichment planting to include fruit trees along edges of the property • Ban on wildlife hunting and gathering of duck eggs within the property • Inclusion of flora and fauna protection programs in the SDMP	GRC	P 1 million for enrichment planting	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.
	Water					
	• Hydrology	Change in Dayano Creek channel geometry, flooding	• Monitoring and control of pit dewatering flow rates during high-rainfall periods	GRC	P 19.2 million for dewatering	
			• Opening of diversion structures of the dam to divert water to the ricefields			
	• Water quality • Freshwater biology	Turbidity, dissolved solids, and flow	• Monitoring and control of pit dewatering flow rates during high-rainfall periods	GRC	P 0.5 million pa for water monitoring	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Discharge of pumped out pit water into a settling pond and then geotextile tubes prior to discharge to Dayano Creek • Regular monitoring of pit water quality at the settling pond prior to discharge and stoppage of dewatering and water treatment necessary			
	People					
	• Socioeconomics	Loss of water source for potable community water supply	• Installation of 5 dewatering bores near the eastern edge of the pit • Use of water pumped out from the bores to feed the community water supply	GRC	P 0.8 million pa for operation of water treatment plant	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.
		Flooding along Dayano Creek	• Monitoring and control of pit dewatering flow rates during high-rainfall periods • Opening of diversion structures of the dam to divert water to the ricefields	GRC		
Pit development and build-	Land					

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
up of TSF and waste rock dump	• Geomorphology	Physical instability of pit	• Geotechnical drilling, surface mapping, and site walkovers for the sound design of pit slopes	Design and open pit contractors and GRC	P 38.1 million for pit geotechnical and design works	For monitoring by GRC, MGB, and MMT
			• Use of dewatering bores to depressurise pit walls • Use of suitable mine support • Regular stability monitoring • Emergency plan for slope failure			
		Physical instability of TSF	• Geotechnical site investigation and engineering design for an operating basis earthquake (OBE) of 0.25g and maximum design earthquake (MDE) of 0.60g prior to earthworks • Slope stability re-assessment and review of emergency spillway as part of detailed engineering design	Design and TSF contractors and GRC	P 8.6 million for TSF geotechnical, hydrological, and design works P 1 million for QC and stability inspections	For monitoring by GRC, MGB, and MMT

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Design implementation with strict quality control (QC) • Regular stability inspections and monitoring • Placement of catch fences along the edge of the Siana Barangay Road south of TSF3 • Emergency planning and testing		P 1 million for catch fences	
		Physical instability of waste rock dump	• Engineering design of waste rock dump including slopes, surface drains, and ponds • Design implementation with strict quality control (QC) • Regular stability monitoring including the phreatic surface • Staggered placement of clay-rich materials in the waste dump • Placement of safety bunds or catch fences along the edge of the open pit • Emergency planning and testing	Design and waste rock dump contractors and GRC	P 0.2 million for waste rock dump geotechnical and design works	For monitoring by GRC, MGB, and MMT

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
	Water					
	• Hydrology	Flooding of open pit	• Hydrological and hydrogeological studies to determine annual pit flows from groundwater and rainfall • Installation of pit perimeter drainage to keep surface runoff away from the pit	Hydrology design and open pit contractors and GRC	P 5.8 million for pit hydrological and hydrogeological studies P 65 million initial capital cost of pumps and pit bores P 21.3 million for pumps and bores replacement P 26.7 million for annual pumping costs	For monitoring by GRC, MGB, and MMT
			• Operation of dewatering bores east of the pit perimeter complemented by in-pit pumping • Flood monitoring during heavy rains • Emergency plan for pit flooding			
		Overtopping of TSF embankment	• TSF water balance studies and design for a decant, spillway, and freeboard of 3m to accommodate a 6-hour design storm between 1:10,000 years average return interval (ARI) and PMP of 1:10,000,000 years ARI	Hydrology design and TSF contractors and GRC	Part of TSF geotechnical, hydrological, and design works	For monitoring by GRC, MGB, and MMT

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Maintenance of small water pond • Flood monitoring during heavy rains • Emergency planning and testing			
		Flooding and erosion at the waste rock dump area	• Stormwater control and drainage system • Flood monitoring during heavy rains • Use of settling ponds and goextile bags • Flood monitoring during heavy rains • Emergency planning and testing	Hydrology design and waste rock dump contractors and GRC	P 2.15 million for minesite water balance studies	For monitoring by GRC and MMT
	• Water quality • Freshwater biology	Turbidity, heavy metals, and AMD	• Collection of surface runoff including pumped out pit water into a settling pond • Regular monitoring of pond water prior to discharge to geotextile tubes and Dayano Creek • If required, pH treatment at the pond	GRC	P 13 million - Cost of stormwater drainage, settling pond, and geotextile tubes	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
		AMD at waste rock dump	• Geochemical testworks and characterization of waste rocks • NAG pH=4 tests on blasthole cuttings as required of Domain 600 primarily and Domains 100 and 400, secondarily; classification of waste rocks from the open pit based on acid-generating potential and placement of materials in a manner to prevent acid generation.	Open pit and waste dump contractors and GRC	P 0.8 million for waste rock geochemical characterization works P 0.4 million for rock AMD analyses	For monitoring by GRC and MMT
			• Stormwater drainage and erosion and sediment control system consisting of settling pond and geotextile tubes • Regular monitoring of pH at settling pond and pH treatment if required			
	Air	Dust and noise	• Training on proper equipment use • Water sprays	Pit, TSF, waste rock dump, and equipment maintenance contractors and GRC	Part of pit, TSF, waste rock dump, and equipment maintenance contracts	For monitoring by GRC and MMT

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Enclosures, barriers, and buffer zones • Proper maintenance of equipment • Use of less noisy and shielded equipment • Dust and noise PPEs to workers			
		Airblast and flyrocks	• Use of delays, reduced hole diameter and deck loading to reduce the maximum instantaneous charge • Complete isolation of the area prior to blasting. A siren is sounded 5 minutes before the blast for warning	Pit and blast contractors and GRC	Part of blasting contract	For monitoring by GRC, MGB, and MMT
Gold cyanidation plant commissioning and subsequently, flotation plant commissioning	Water					
	• Water quality • Freshwater biology	Turbidity (non-toxic stressor) and pH, NaOH, $CuSO_4$, HCl, diesel, and heavy metals (toxic stressors)	• Physical systems to fully contain chemicals, *e.g.*, events pond • Personnel training on chemicals and their management • Management system and procedures for chemicals handling	GRC	Cost of physical systems is part of civil works contract. For GRC, the annual budget of their Mine Safety Office is P 1.8 million.	The activities are part of the Mine Safety and Health Program for submission to and monitoring by MGB.
Underground	Land					

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
development works – Portal and decline, levels, raises, and electricals	• Geomorphology	Ground subsidence	• Detailed geotechnical and hydrogeological evaluation of overlying strata, faults, intrusions, weathering, and alteration • Subsidence prediction and formulation and implementation of subsidence control measures	Underground design contractor and GRC	P 2.2 million for geotechnical and hydrogeological studies	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.
	Water					
	• Hydrology	Drying of rivers and wells	• Detailed geotechnical and hydrogeological evaluation of overlying strata, faults, intrusions, weathering, and alteration • Prediction of hydrological impacts and formulation and implementation of hydrologic control measures	Underground design contractor and GRC	P 2.2 million for geotechnical and hydrogeological studies	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.
		Flooding of underground workings	• Hydrological and hydrogeological studies to determine annual pit flows from groundwater and rainfall	Underground contractor and GRC	P 26.7 million pa for pumping costs	For monitoring by GRC, MGB, and MMT

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Installation of pit perimeter drainage to keep surface runoff away from the pit • Operation of dewatering bores east of the pit perimeter complemented by in-pit pumping • Emergency plan for flooding			
	• Water quality • Freshwater biology	Turbidity, AMD, and heavy metals	• Discharge of pumped out underground water into a settling pond and then geotextile tubes prior to discharge to Dayano Creek • Regular monitoring of underground water quality at the settling pond prior to discharge	GRC	P 0.5 million for regular water monitoring	For monitoring of pond water quality by GRC and MMT
			• pH treatment of water if necessary • Discharge of compliant water into geotextile tubes for filtration of suspended solids			
Operations						
Open pit, TSF and waste	Land					

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
rock dump operations	• Geomorphology	Physical instability of open pit	• Use of dewatering bores to depressurise pit walls • Regular stability monitoring • Redesign of pit walls if required • Use of ground support on unstable slopes • Emergency plan for slope failure	Open pit contractor and GRC	P 5.1 million for pit dewatering bores	Pit walls and slopes and surfaces for monitoring by GRC and MMT
		Physical instability of TSF	• Construction of embankment with strict QC • Regular stability inspections, monitoring, and audit	TSF contractor and GRC	P 1 million pa for QC, stability inspections and audit	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.
			• Observance of buffer zone from edge of TSF embankment and waste rock dump • Emergency planning and testing			
		Physical instability of waste rock dump	• Construction of waste rock dump with strict QC • Regular stability inspections • Emergency planning and testing	Waste rock dump contractor and GRC	Part of audit cost for TSF	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
	Water					
	• Hydrology	Flooding of open pit	• Operation and maintenance of pit perimeter drainage to keep surface runoff away from the pit • Operation of dewatering bores east of the pit perimeter complemented by in-pit pumping • Flood monitoring during heavy rains • Emergency plan for pit flooding	Open pit contractor and GRC	P 26.7 million for annual pumping costs	Pit water level for monitoring by GRC, MGB, and MMT
		Overtopping of TSF embankment	• CN detoxification of tailings prior to discharge to tailings pond • Recovery of tailings water for use in process plant • Maintenance of small water pond • Flood monitoring during heavy rains • Emergency plan for TSF overtopping	TSF contractor and GRC	P 24.8 million capital cost of CN detoxification plant P 16.8 million pa for operation of CN detoxification plant	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
		Flooding and erosion at the waste rock dump area	• Maintenance of stormwater control and drainage system • Flood monitoring during heavy rains	Waste rock dump contractor and GRC	P 3 million pa for maintenance of stormwater and sediment control system	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.
			• Use of sediment traps, settling ponds, and geoextile bags • Emergency plan for flooding			
	• Water quality • Freshwater biology	Turbidity, NaCN, heavy metals, tailings, and AMD	<u>AMD control at waste rock dump</u> • Classification of waste rocks into PAF and NAF and placement of materials in a manner to prevent acid generation. • Stormwater drainage to keep clean water away from dirty water. • Collection of surface runoff and pumped out pit water into a settling pond • Regular monitoring of pH at settling pond and pH treatment if required	Waste rock dump and open pit contractors and GRC	P 1 million for waste rock analyses P 16.8 million pa for operation of CN detoxification plant P 0.5 million pa for water monitoring	Cost will be part of EPEP for submission to MGB and for monitoring by MMT.

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			Open pit • Collection of surface runoff including pumped put pit water into a settling pond			
			• Regular monitoring of pond water prior to discharge to geotextile tubes and Dayano Creek • If required, pH treatment at the pond			
			TSF • CN detoxification of tailings prior to discharge to TSF • Reuse of tailings water in the process plant • Use of decant and collection of tailings water in settling pond • Regular monitoring of pond water prior to discharge to geotextile tubes. The bags filter the tailings water and surface runoff prior to discharge to Dayano Creek.			

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
	Air	Dust and noise	• Training on proper equipment use • Water sprays • Enclosures, barriers, and buffer zones • Proper maintenance of equipment • Use of less noisy and shielded equipment • Dust and noise PPEs to workers	Pit, TSF, waste rock dump, and equipment maintenance contractors and GRC	Part of pit, TSF, waste rock dump, and equipment maintenance contracts	For monitoring by GRC and MMT
		Airblast and flyrocks	• Use of delays, reduced hole diameter and deck loading to reduce the maximum instantaneous charge • Complete isolation of the area prior to blasting. A siren is sounded 5 minutes before the blast for warning	Pit and blast contractors and GRC	Part of blasting contract	For monitoring by GRC, MGB, and MMT
Gold cyanidation plant	Water					

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
operations (combined with flotation plant subsequently)	• Water quality • Freshwater biology	Turbidity, pH, CN, heavy metals, and other reagents such as NaCN, $CuSO_4$, HCl,, NaCN, and diesel	• Physical systems to fully contain chemicals, *e.g.*, events pond • Personnel training on chemicals and their management • Management system and procedures for chemicals handling	GRC	Cost of physical systems is part of civil works contract. The annual budget of GRC's Mine Safety Office is P 1.8 million.	The activities are part of the Mine Safety and Health Program for submission to and monitoring by MGB.
Underground operations	Land					
	• Geomorphology	Ground subsidence	• Regular stability monitoring both surface and underground • Use of suitable mine supports • Filling of void with combination of waste material, tailings, and cement • Implementation of subsidence control measures • Emergency plan for cave-ins and subsidence	Underground contractor and GRC	To be estimated during feasibility study for underground mining	Cost will be part of EPEP for submission to MGB and for monitoring by MMT
	Water					

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
	• Hydrology	Drying of rivers and wells	• Monitoring of streamflows and well discharges • Implementation of hydrologic control measures • Filling of voids with combination of waste materials, tailings, and cement	Underground contractor and GRC	To be estimated during feasibility study for underground mining	Cost will be part of EPEP for submission to MGB and for monitoring by MMT
		Flooding of underground workings	• Installation of pit perimeter drainage to keep surface runoff away from the pit • Operation of dewatering bores complemented by in-pit pumping	Underground contractor and GRC	To be estimated during feasibility study for underground mining	For monitoring by GRC, MGB, and MMT
			• Emergency plan for flooding			
	• Water quality • Freshwater biology	Turbidity, AMD, and heavy metals	• Discharge of pumped out underground water into a settling pond and then geotextile tubes prior to discharge to Dayano Creek	GRC	P 0.5 million pa for regular water monitoring	For monitoring of pond water quality by GRC and MMT

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Regular monitoring of underground water quality at the settling pond prior to discharge • pH treatment of water if necessary • Discharge of compliant water into geotextile tubes for filtration of suspended solids			
Abandonment	Land					
	• Visual aesthetics	Wastes, non-blending of structures with background	• Haul out of stockpiles, reagents, oil and chemical spills, and waste	GRC		Initially, GRC will deposit P 5 million as Mine Rehabilitation Cash Fund. After the submission and approval of the project's Final Mine Rehabilitation and Decommissioning Plan (FMRDP), GRC will make additional deposits to accumulate the estimated closure costs.
			• Removal of cables, pipes, concrete, masonry, storage tanks, equipment, and structures that will not fit the post-mining land use or will not be needed by the barangays			

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Consistent with the post-mining land use, deep ripping of hardstands and recontouring of surfaces and slopes to blend structures with natural background			
	• Geomorphology	Physical instability of structures	• Slope, surface, and drainage modifications to suit minimum factors of safety (FOSs) and design rainfall at closure • Drying of tailings pond	GRC		
		Subsidence	• Monitoring of mining-related subsidence within the property and vicinities and implementation of control measures	GRC		
	• Land use	No post-mining land use	• Determination of the best post-mining land use of the 240-ha property considering local needs, socio-economics, and physical conditions of the site	GRC		

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
	• Terrestrial biology	Abandoned site is not conducive to the propagation of flora and fauna	• Consistent with the post-mining land use, deep ripping of hardstands and recontouring of surfaces and slopes to blend structures with natural background • Soil conditioning • Planting of endemic species including fruit trees • Reflooding of pit and underground workings as habitat for the Philippine Duck	GRC		
	Water					
	• Hydrology	Drying of rivers and wells	• Monitoring of water level and water quality changes in Dayano Creek, Magpayang River, and wells	GRC		Mine Rehabilitation Cash Fund of P 5 million initially and then supplemented to accumulate the estimated closure costs based on the FMRDP.
			• Implementation of corrective measures if required			
	• Water quality • Freshwater biology	Turbidity, metals in tailings, oil and grease, reagents	• Slopes and surfaces including dried tailings fully stabilized and covered with endemic floral and fruit-bearing species	GRC		

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
			• Drainage for design rainfall installed • Stockpiles, reagents, and wastes removed from the site			
	Air	Dust	• Consistent with the post-mining land use, recontouring of surfaces and slopes for long-term physical stability • Soil conditioning • Planting of endemic species			Mine Rehabilitation Cash Fund of P 5 million initially and then supplemented to accumulate the estimated closure costs based on the FMRDP.
	People					
	• Socioeconomics	Loss of jobs and community programs	• Retrenchment package	GRC		Mine Rehabilitation Cash Fund of P 5 million initially and then supplemented to accumulate the estimated closure costs based on the FMRDP.
			• Labor support programs such as job search, skills training and education program, enterprise awareness, and counselling • Possible transfer of social assets and services such as water supply and electricity			

Project Phase/ Environmental Aspect	Environmental Component Likely Affected	Potential Impact	Options for Prevention, Mitigation, or Enhancement	Responsible Entity	Cost	Guarantee/Financial Arrangements
		Damage to property from erosion, subsidence, tailings, and flooding	• Same management measures for physical stability, water quality, and freshwater biology	GRC		

SOCIAL DEVELOPMENT FRAMEWORK

Table 6-2. Social development plan

Concern	Responsible Community Member/Beneficiary	Government Agency/Non-Government Agency and Services	Proponent	Indicative Timeline	Source of Fund
Potable water and distributionsystem	Brgys. Cawilan, Siana, and Dayano	Brgy. Governments to assist in the maintenance of the system	GRC and Brgy. Governments	Ongoing	GRC
Health care	Brgys. Cawilan, Siana, and Dayano Brgys. Del Rosario, Magpayang, and Pongtud	Municipal Governments and DOH to assist through BHWs, maintenance of regular programs, and special national projects on health care	GRC, DOH, Municipal Governments, and Brgy. Governments	Ongoing for the direct impact barangays; indirect impact barangays for inclusion in future programs at levels to be finalized	GRC, DOH, and Municipal Government
Education	Brgys. Cawilan,Siana, and Dayano Brgys. Del Rosario, Magpayang, and Pongtud	DepEd to assist through their special national programs; international grant organizations will be tapped to complement GRC funds	GRC, DepEd, international grant organization, and Brgy. Governments	Ongoing for the direct impact barangays in terms of donation of school supplies and books and improvement of school facilities	GRC, DepEd, and international grant organization
Livelihood	Brgys. Cawilan, Siana, and Dayano Brgys. Del Rosario, Magpayang, and Pongtud	DTI, DA, DENR, Municipal Government, and international grant organizations will be tapped	GRC, DTI, DA, DENR, Municipal Governments, international grant organizations, Brgy. Governments, and people's organizations	As part of SDMP	GRC, DTI, DA, DENR, and international grant organizations

IEC FRAMEWORK

Table 6-3. Information, education and communication plan

Target Sector Needing Project IEC	Major Project Topics of Concern	IEC Scheme/Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
Direct impact and indirect impact barangays including Brgy. Officials and people's organizations	• EIA findings on baseline conditions, impacts, and environmental and social management plans including the protection of the area's flora and fauna • Costs and benefit of the Project from the community viewpoint • Community inputs and agreement	Large meetings by Barangay	• Powerpoint presentation in local dialect and English • Big tarpaulin colored posters highlighting major findings • Handouts on EIA findings and cost-benefit in local dialect	Once prior to Public Hearing	P 60,000
Municipal Government headed by the Municipal Mayor	• Highlights of EIA findings including the protection of the area's flora and fauna • Costs and benefits of the Project from Municipal Government viewpoint • Municipal Government inputs and agreement	Small meetings by Municipality	• Powerpoint presentation in local dialect and English • Big tarpaulin colored posters highlighting major findings • Handouts on EIA findings and cost-benefit in local dialect	Once prior to Public Hearing	P 15,000
Lake Mainit Development Alliance officials and representatives	• EIA findings on baseline conditions, impacts, and environmental and social management plans including the protection of the area's flora and fauna • Costs and benefit of the Project from LMDA's	Small meeting	• Powerpoint presentation in local dialect and English • Big tarpaulin colored posters highlighting major findings • Handouts on EIA findings and cost-benefit in local dialect	Once prior to Public Hearing	P 5,000

Target Sector Needing Project IEC	Major Project Topics of Concern	IEC Scheme/Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
	viewpoint • Community inputs and agreement				
Direct impact and indirect impact barangays including Brgy. Officials and people's organizations	• Major conditions of the ECC • Updates on the Project especially Project Managers, schedules, hiring, training • Any disruptions to the community • Needed assistance from the barangay and Officials • Establishment of a Community Technical Working Group (CTWG) by Municipality • Establishment of information and complaints desk	Large meetings by Barangay	• Powerpoint presentation in local dialect and English • Handouts on ECC conditions in local dialiect and English and GRC contact person and details	Once after the grant of ECC	P60,000
Municipal Government headed by the Municipal Mayor	• Major conditions of the ECC • Updates on the Project especially Project Managers and schedules, • Needed assistance from the barangay and Officials • Establishment of CTWG by Municipality • Establishment of information and complaints desk	Small meetings by Municipality	• Powerpoint presentation in local dialect and English • Handouts on ECC conditions in local dialiect and English and GRC contact person and details	Once after the grant of ECC	P 15,000
Lake Mainit Development	• Major conditions of the ECC	Small meeting	• Powerpoint presentation in	Once after the grant of ECC	P 5,000

Target Sector Needing Project IEC	Major Project Topics of Concern	IEC Scheme/Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
Alliance officials and representatives	• Updates on the Project especially Project Managers and schedules • Needed assistance from the barangay and Officials • Establishment of CTWG by Municipality to include LMDA • Establishment of information and complaints desk		local dialect and English • Handouts on ECC conditions in local dialiect and English and GRC contact person and details		
CTWG	• Updates on Project schedules, hirings, and community complaints • Expected changes in community life • Type and location of environmental monitoring stations to be established • Reiteration of information and complaints desk	Small-meetings	• Powerpoint presentation in local dialect and English • Handouts with map showing location of Project facilities to be built, areas in the community to be impacted and type of impact, and environmental monitoring stations	One month before construction	P 20,000
CTWG	• Updates on Project schedules and accomplishments, hirings, and community complaints • Expected changes in community life • Results of environmental monitoring and actions planned or taken	Small-meetings	• Powerpoint presentation in local dialect and English • Handouts with map showing location of Project facilities to be built, areas in the community to be impacted and type of impact, environmental monitoring stations, and results of monitoring	Quarterly or as needed	P 80,000

Target Sector Needing Project IEC	Major Project Topics of Concern	IEC Scheme/Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
	• Reiteration of information and complaints desk		monitoring		
Direct impact and indirect impact barangays including Brgy. Officials and people's organizations	• Updates on Project schedules and accomplishments including those for the ECC, hirings, and community complaints • Expected changes in community life • Results of environmental monitoring and actions planned or taken • Reiteration of information and complaints desk	Large meetings	• Powerpoint presentation in local dialect and English • Handouts with map showing location of Project facilities and status, areas in the community to be impacted and type of impact, environmental monitoring stations, and results of monitoring	Once a year before year-end	P 60,000
Municipal Government headed by the Municipal Mayor	• Updates on Project schedules and accomplishments including those for the ECC, hirings, and community complaints • Expected changes in community life • Results of environmental monitoring and actions planned or taken • Reiteration of information and complaints desk	Small meetings	• Powerpoint presentation in local dialect and English • Handouts with map showing location of Project facilities and status, environmental monitoring stations, and results of monitoring	Once a year before year end	P 15,000

EMERGENCY RESPONSE POLICY AND GUIDELINES

DAO No. 2000-98 promulgates the Mine Safety and Health Standards of the DENR. Section 49 of the Order requires mining proponents to prepare an Emergency Response Preparedness Program (ERPP) prior to commencement of mining operation. The ERPP contains, among others, the following:

- Identification of hazards
- Assessment of perceivable risks that may lead to an emergency
- Controlling measures to prevent or deal with the emergency which include organization, facilities, vehicles, equipment, alarm systems, emergency procedures, employee training, quarterly simulation to test the measures, regular review of the measures, and revisions in case of changes in operation, condition, or rules and regulations.

GRC will submit to the MGB the ERPP prior to the commencement of construction. The following discusses the salient features of the ERPP.

Scope of ERPP

Based on current assessments, the ERPP needs to cover the following emergencies:

1. Oil spills
2. Chemical (hazardous materials) spills
3. Fire
4. Landslide or slope failure
5. Severe weather
6. Earthquakes and
7. Mine accidents.

Emergency Response Team

The emergency response team (ERT) to be established prior to construction will consist of the following:

- Emergency Coordinator who in emergency situations is responsible for implementing appropriate actions to ensure the safety of employees, visitors, and residents in the Project site and vicinities,
- Alternate Emergency Coordinator who assists the Coordinator and replaces the latter during his absence,
- Control Room Operator who receives information about an emergency situation and relays this information to the Coordinator and other members of the Team. He also notifies external organizations such as local disaster coordinating councils, MGB, EMB, etc. about the emergency.
- Safety Engineer who provides technical support to the Coordinator.

The Coordinator creates, from within the GRC employees and contractors, the following emergency support units:

- Fire fighting unit

- Rescue and recovery unit
- Hazardous materials unit
- Earthworks unit.

The Emergency Coordinator will identify, link up, and agree on protocols with external emergency organizations and the local disaster coordinating councils at the Barangay, Municipal, and Provincial levels.

Emergency Response Training

All employees and contractors will undergo basic training program on emergency response as part of their induction. The program covers:

- General plan procedures
- Specific departmental procedures
- Evacuation procedures
- Incident discovery
- Notifications
- Operation of fire extinguisher and
- Basic first aid.

It will enable all to identify conditions which can lead to an emergency situation.

All personnel currently involved in operating a process and those before being involved in operating a newly assigned process shall be trained in an overview of the process and in the operating procedures. The training focuses on specific safety and health hazards, emergency operations including shutdown, and safe work practices applicable to the employees' job tasks.

Members of the Emergency Response Team and support units will undergo additional training.

Refresher training is conducted annually. When employees change areas or departments, they get training from the department supervisor on their new emergency responsibilities and procedures.

A record will be prepared for each employee which contains the training received, name of trainer, date of training, means used to verify that the employee understood the training, assessment of the employee, and training recommendations.

Personal Protective and Other Equipment

Personal protective equipment (PPE) meeting the NFPA and OSHA standards must be provided, maintained, and used. The protection must be against physical, chemical, and thermal hazards. PPEs include respiratory protective equipment, chemical protective clothing, and thermal protection. These should be selected based on the chemicals to be stored and handled at the Project site.

Fire suppression equipment consisting of fire hydrants and pump, sprinkler and foam system, and portable fire extinguishers suited to the chemicals on site must also be provided.

Notification Procedures

The Emergency Coordinator initiates and terminates emergency situation. A state-of-the-art system of public notification that targets employees, contractors, local disaster coordinating councils, and other emergency organizations is needed.

Evacuation and Personnel Accountability

The emergency situation may require the evacuation of all or certain sections of the Project facility as well as sitios along the receiving Magpayang River and Dayano Creek. An early warning system will effect a safe and timely evacuation.

Primary and secondary evacuation points need to be designated for every working area of the facility and potentially impacted sitios. During evacuation, employees and residents leave their area by the designated route to their assigned evacuation point. If the primary evacuation point becomes impassable, employees and residents proceed to the designated evacuation point.

Upon arrival at the evacuation point, the employee reports directly to his Supervisor. The Supervisor reports missing personnel and last location to the Emergency Coordinator. For the sitios, sitio leaders who account for the sitio members to the Barangay Chairman are designated.

Emergency Procedures

Emergency procedures are formulated for each of six (6) emergency conditions. The procedures target the ordinary Project employees or contractors, control room operator, emergency response team, and Emergency Coordinator. Table 6-4 provides the basic elements of the procedures.

Table 6-4. Basic elements of the emergency procedures

Emergency	General Note	Employees or Contractors	Control Room Operator	Emergency Response Team	Emergency Coordinator
Oil spills	Two types of oil spill and emergency response are distinguished: incidental release and emergency release.	Depending on personnel training, control measures such as plugging the source of oil or installing spill booms or diversions may be implemented. The Control Room Operator is immediately advised of the nature of the problem, exact location, and severity of the problem.	Based on information provided, he decides the type of the oil spill. He then notifies the ERT. An emergency release requires the notification of external emergency organizations.	The first arriving Team member gives his initial assessment of the situation to the Control Room Operator. He effects control measures with the help of other employees. After the leak is stopped and the slick contained, oil recovery procedures commence.	He ensures that the necessary control measures of spill stoppage, containment, and recovery are initiated. He updates the local disaster coordinating council and other external emergency organizations of the spill. After the cleanup and removal of spilled oil, he assesses the damage impact.
Chemical spills	As in oil spills, two types of chemical spill and emergency response are distinguished: incidental release and emergency release.	Upon detection of the spill, the employee instructs all to evacuate the area. He confines the release by closing the door to the area. He advises the Control Room Operator of the nature of the problem and exact location of	He obtains from the caller the exact location and nature of the problem. He notifies the ERT. If the situation is serious, he calls in the fire departments of the municipalities. He sends somebody to meet the fire truck.	The hazardous materials unit of the ERT should be trained to handle the confinement, containment, and decontamination of hazardous materials releases. Their first objective is to secure the area and effect an	He responds to all reported chemical releases and directs the actions of the ERT and Project employees and contractors. He ensures that necessary actions such as evacuation, accountability of

Emergency	General Note	Employees or Contractors	Control Room Operator	Emergency Response Team	Emergency Coordinator
		chemical release. If the situation is serious, he activates the alarm and begins evacuation of the entire building. He advises the ERT on their arrival of any missing person.		orderly and quick evacuation.	personnel, restricting access to hazards area, confinement, containment, and decontamination are initiated.
Landslides or slope failures	Two (2) sets of procedures are needed for the employees – one for those who discover the emergency; the other for those who hear the alarm system. Incidents need to be classified into minor or major (for which an emergency situation is declared), incipient or active, and catchments at risk (which define areas for evacuation).	Upon discovery of the landslide, the employee reports the situation immediately to the Emergency Coordinator who classifies the incident and commences appropriate actions. On hearing the alarm, the employee evacuates and proceeds to the designated safe zone.	Upon notification by the Emergency Coordinator of the need for evacuation and the impacted facility areas and catchments, he activates the appropriate alarm. He also notifies the concerned leaders. He then notifies the ERT and earthmoving crew.	Upon receipt of the call or alarm, the Team proceeds to a safe place closest to the affected area. They restrict entry to the impact area and assist in the evacuation of personnel. They implement recovery. First aid, and restoration measures.	He responds to the reported landslide or slope instability; directs the actions of the ERT, earth-moving crew and personnel; and coordinates with the local disaster coordinating councils and external organizations as needed. He ensures that the required actions on evacuation, personnel accountability, remediation, and cleanup are completed. He assesses the damage and determines temporary works to minimize further damage.
Mine accidents		The employee advises the Control Room Operator of the nature of the problem and exact location. If trained, he renders first aid. He sends available personnel to meet the ERT.	He obtains from the caller the exact location, nature, and severity of the problem. He calls in the ERT.	The ERT proceeds immediately to the accident scene. The first arriving Team member reports by radio that he is on-scene and his initial assessment. He advises any additional resources required. He renders first aid as appropriate.	
Severe weather	All employees assigned to the open pit, TSF, waste rock dump, and process plant should be vigilant during storms and heavy downpours. GRC may adopt the emergency alert levels of the local government units, *i.e.*, disaster preparedness during storm signal 1 and declaration of an emergency condition during storm signal 3. GRC should designate	During storm signals 1 and 2, outdoor activities of personnel should be minimized. At storm signal 3, employees take refuge in the designated storm shelters.	He monitors storm bulletins and continuously updates the Emergency Coordinator. He makes the necessary announcements to personnel.	Team members will respond as needed. The response is generally an after-the-fact response and primary responsibility is for evacuation and accountability of personnel.	He directs the actions of the ERT and employees. He ensures that the needed actions on evacuation, accounting of personnel, and securing of the facility are initiated. He assesses the damage and determines damage control work that can be safely performed by personnel.

Emergency	General Note	Employees or Contractors	Control Room Operator	Emergency Response Team	Emergency Coordinator
	shelters for employees.				
Fire	Two (2) sets of procedures are needed for the employees – one for those who discover the emergency; the other for those who hear the alarm system.	The urgent actions of the personnel who discover the fire are clear the area of people, confine the fire, activate the fire alarm, use the portable fire extinguisher if it can be done safely, advise the ERT on their arrival if all personnel are accounted for, and assist the ERT if requested. Personnel who hear the fire alarm must implement the evacuation procedures.	Upon hearing the manual fire alarm, he activates the main fire alarm. He then notifies the ERT and the fire department of the municipalities. He sends one person to meet the fire department at the facility gate.	The first arriving team member advises the Control Room Operator of his initial assessment of the situation. He then assists in the evacuation of people. If the fire is still in the incipient stage, he attempts to extinguish it. If there is danger of explosion, he shouts the warning and escapes promptly. In case of explosion, he escapes promptly because of the danger of recurrence. With the help of the other team members and fire department, the fire is put out.	He ensures that the needed actions on evacuation, personnel accounting, fire suppression, cleanup, etc. are initiated. He advises the fire department of present conditions in the facility, especially any chemicals involved and the assistance Project personnel may provide. After the fire is extinguished, he assesses the damage and determines which areas of the facility cannot be re-occupied.
Earthquake	Earthquakes strike without warning. GRC will avoid earthquake-related deaths and injuries by removing hazards in the plant and offices, identifying safe places indoors and outdoors, have disaster supplies on hand, and undertake earthquake drills periodically.	If indoors, drop to ground; take cover under a sturdy table or furniture, and hold on until the shaking stops. Stay inside until the shaking stops and it is safe to go outside. If outdoors, move away from buildings, posts, and utility wires and stay there. If in a moving vehicle, stop as quickly as safety permits away from buildings, trees, overpasses, utility wires and stay in the vehicle. Proceed cautiously once the earthquake stopped. If trapped under debris, do not light a match nor move about or kick up dust. Tap on a pipe or wall for rescue. Shout only as a last resort.	He monitors the situation and updates the Emergency Coordinator and the Response Team if possible. He coordinates with external emergency organizations for assistance.	Team members will respond after the earthquake as needed. Response can be in the form of first-aid, rescue, fire fighting , or inspection of utilities and buildings.	He directs the actions of the Team, employees, and contractors. He ensures that the required actions on evacuation, accounting of personnel, first aid, rescue, fire-fighting, inspection of utilities, and securing of the facility are initiated.

ABANDONMENT POLICIES AND GUIDELINES

The Siana Gold Project will adhere to MGB's "Guidelines in the Preparation of an FMRDP pursuant to DAO No. 1996-40". According to these guidelines, the Final Mine Rehabilitation and Decommissioning Plan (FMRDP) is to be integrated with the Environmental Protection and Enhancement Program (EPEP) which is submitted to the MGB after the grant of an ECC to the Project. The FMRDP has two (2) goals:

1. To prevent or eliminate long-term environmental impacts by returning mining-disturbed land to a physically and chemically stable, visually acceptable, productive, or self-sustaining condition, taking into consideration the beneficial uses of the land and the surrounding areas as agreed with the stakeholders

2. To ensure that alternative skills and sustainable livelihood opportunities are provided and left behind to mine employees and their dependents and to the host and neighboring communities.

The guidelines define "physically stable" to mean that the mine facility does not pose a hazard to public health and safety as a result of failure or physical deterioration, and that it continues to perform the function for which it was designed for its design life.

"Chemically stable" means that the mine facility should not release chemicals or contaminants into the environment. The guidelines further provide that the use of effluent-treatment facilities is not considered rehabilitation but a temporary measure to meet regulatory requirements, or while awaiting the development of technically and economically viable rehabilitation methods or while waiting for the rehabilitation measure to reach its maximum efficiency and until the water outputs can be treated by passive treatment or discharged directly to the environment.

"Visually acceptable" recognizes that the trace of a mining site cannot be completely removed but can be reduced by the removal of all unnecessary buildings and infrastructures and the blending of the slopes and surfaces with the natural background.

"Productive condition" may include agroforestry, agriculture, industrial, or residential facilities which may require passive or active care.

"Self-sustaining use" means that the end use can be sustained by natural processes and will not require actions by man.

On the final land use of the mined-out site, the guidelines prescribe the following as bases:

1. Naturally occurring hazards in the area

2. Level of environmental and social impacts caused by the operation

3. Expected post-closure operational use of the land and

4. Productivity of the land surrounding the site.

The guidelines provide a schedule of annual payments that will build up the full amount of the estimated FMRDP cost a year ahead of the mine closure. For a five (5) – year life, the prescribed annual payments are:

- 43.7 % of total FMRDP cost for the first year of operation
- 31.3 % for the second
- 18.7 % for the third and
- Balance of 6.3 % for the fourth year.

For a ten (10) – year life, the prescribed annual payments are:

- 26.5 % of cost for the third year of operation
- 22.5 % for the fourth
- 17.7 % for the fifth
- 16.3 % for the sixth
- 9.5 % for the seventh
- 5.5 % for the eighth and
- Balance of 2 % for the ninth year.

The Impacts Management Plan lists the envisioned rehabilitation and decommissioning activities for the Project. To fully define said activities, an FMRDP formulation program will be implemented. This program has the following components:

1. Materials characterization through physical, chemical, and biological tests to guide the selection and treatment of materials for rehabilitation
2. Field revegetation trials to involve combinations of soil treatment and floral species and ecosystem function analysis
3. Cover capping options to contain the waste and heavy metals and trial programs for the waste rock dump and TSF
4. Hydrological simulation studies
5. Identification and assessment of potential post-mining land uses given the site, economic, environmental, market and social realities
6. Risk management in closure planning and
7. Closure action planning and budgeting.

ENVIRONMENTAL MONITORING PLAN

Self-monitoring Plan

Table 6-5. Environmental monitoring plan

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
All Project Phases	Land												
	• Visual aesthetics – solid waste	Daily volume of solid waste dumped in the landfill; weekly volume of compost generated	Volume measurement	Daily and weekly	Project area	Environment and Community Manager (ECM)							
	Water quality					Construction Manager, Operations Manager (after Construction)							
	• Turbidity	TSS (mg L^{-1})	Gravimetric method	Quarterly	W/B 1 to 8	ECM	P 12,000	10% inc	20% inc	≤30% inc			
			Turbidity meter	Daily	IW 1 to 6		Probe	30	50	70			
	• Oil and grease	Oil and grease (mg L^{-1})	Gravimetric (petroleum ether extraction)	Quarterly	W/B 1 to 8	ECM	P 18,000			2			
				Daily - visual	IW 1 to 6					5			
	• Sewage	BOD_5 (mg L^{-1})	Azide modification (Dilution technique)	Quarterly	W/B 1 to 8	ECM	P 27,000			7(10)			
				Quarterly	IW1					50			

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		Total coliform (MPN 100mL^{-1})	Multiple-tube fermentation	Quarterly	W/B 1 to 8	ECM	P 32,000			5,000			
				Quarterly	IW1					10,000			
	Freshwater biology	Composition and structure of stream macroinverte-brates	Comparative measures of biological community composition	Quarterly	W/B 1 to 8	ECM	P 160,000						
		Fish assemblage and structure	Participatory fish stock assessment	Quarterly	LM 1 to 6	ECM	P 240,000						
	People					Construction Manager, Operations Manager (after Construction)							
	• Socio- economics – employment taxes, community program	Percentage of population below poverty/ subsistence line; employment, industries, and income – Project and non-Project-related; proportion of 6-12 yrs old not in elementary school;	FGDs and household survey	Annual	Direct and indirect impact barangays	ECM	P 40,000						

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		proportion of 13-16 years old not in secondary school; proportion of households with make-shift houses											
		Complaints on water quality, fish catch, employment, SDMP, dust, noise, foul smell, community water supply, flooding, erosion, ground subsidence	Review of complaints register and interviews	Weekly and as needed	Direct and indirect impact barangays	ECM							
	• Culture – Mamanwa acculturation and discrimination	Proportion of Mamanwas directly employed to total Mamanwas; number of skills and training activities, and trainees actually employed;				ECM							

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		number of cultural awareness											
		programs and participants; changes in material culture											
	• Occupational health and safety – excessive exposure to elements, musculo-skeletal stress, physical injuries, loss of hearing, respiratory diseases, exposure to hazardous reagents	Safety and health program; monthly safety reports; safety meetings, trainings, and inspections; PPEs; accident statistics and reports; medical records	Review of records	Semestral	GRC and contractors	Safety and Health Manager							
	• Public health – vector and water-borne diseases, traffic hazards, respiratory diseases, spread of diseases by migrant workers, heavy metals, AMD	Metals and general health conditions	Blood chemistry, hepatitis test, basic blood chemistry, CBC and blood analysis, urinalysis, fecalysis of selected samples	Annual	Direct and indirect impact barangays	ECM	P 300,000						
Construction													

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
Surface earthworks and civil works	Land					Construction Manager							
	• Terrestrial biology – loss of grassland habitats	Areas cleared or disturbed	Area measurement	Weekly	Project Area	ECM							
	Air – Dust and noise	TSP (mg NCM^{-1})	Gravimetry	Quarterly and as needed	A/N a to 4	ECM	P 100,000			230, 150			
		Noise (dBA)	Direct readout soundmeter	Quarterly and as needed	A/N a to 4	ECM				55, 50, 45			
Pit dewatering	Land					Construction Manager							
	• Terrestrial biology – loss of wetland habitat	Ban on wildlife hunting and eggs gathering enforced; flora and fauna protection programs in SDMP implemented	Site assessment and reports	Monthly	Project area and direct impact barangays	ECM							
	Water					Construction Manager							

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
	• Hydrology - flooding	Water level along Dayano Creek and Magpayang River (m)	Site measurement	Weekly and during heavy rains	Along Dayano Creek and Magpayang River	ECM				Banks over-flowing			
	• Water quality • Freshwater biology	Dissolved solids (mg L^{-1})	TDS meter	Daily	IW4, W/B 5	ECM							
		Streamflow (L s^{-1})	Water level and current measurement	Weekly and during heavy rains	W/B 5								
Pit development and build-up of TSF and waste rock dump	Land					Construction Manager							
	• Geomorphology – Physical instability	Tension cracks, scarps, settling, erosion, seepage, phreatic surface	Visual, topographic survey, and reading of piezometer	Weekly	TSF, waste rock dump, pit walls	ECM							
	• Geochemistry – acid generation	Net acid generation (NAG) pH=4	Blasthole cuttings sampling	During blasthole drilling	Open pit area	Manager Mining	P 3,500,000						
	Water					Construction Manager							
	• Hydrology – flooding, dam overtopping	Water level (m)	Measurement and documentation	During heavy rains	W/B 2, W/B 4 to 5, W/B 7, IW 1 to 6, TSF, open pit, waste rock dump	ECM							

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
	• Water quality • Freshwater biology	As (mg L^{-1})	AAS	Quarterly	W/B 1 to 8, IW 1 to 6	ECM	P 38,000			0.05, 0.2			
		Ba (mg L^{-1})					P 24,000			---			
		Cd (mg L^{-1})					P 18,000			0.01, 0.05			
		Cu (mg L^{-1})					P 18,000			0.05			
		Hg (mg L^{-1})					P 38,000			0.002, 0.005			
		Mn (mg L^{-1})					P 18,000			---			
		Pb (mg L^{-1})					P 18,000			0.05, 0.3			
		Sr (mg L^{-1})					P 98,000			---			
		Zn (mg L^{-1})					P 18,000			---			
		pH	Meter reading	Quarterly	W/B 1 to 8					6.5-8.5			
				Daily	IW 1 to 6					6.5-9			
	Air					Construction Manager							
	• Air	TSP and noise – as indicated											
	• Vibration	Airblast and flyrocks	Airblast measurement	Initially and as needed	Open pit area	Manager Mining							
Gold cyanidation plant	Water					Construction Manager							

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
commissioning and subsequently flotation plant commissioning	• Water quality • Freshwater biology	pH – as indicated earlier											
		NaOH, $CuSO_4$, HCl, Diesel	Visual	Daily	Reagent storage and mixing area, process plant area	Manager Processing				No spills			
		Metals – as indicated											
		NaCN (mg L^{-1})	Distillation – titremetry or CN meter	Daily	IW2 to 3	Manager Processing	P 5,000			0.05, 0.2			
		Water level (m) of events pond	Measurement of water level	Every shift	Process plant area	Manager Processing				Empty at start and end of shift			
Underground development works	Land					Construction Manager							
	• Geomorphology	Ground subsidence – cracks and other signs of surficial failure	Visual	Weekly	Within 500 m from pit edges	ECM							
	Water												
	• Hydrology	Water level (m)	Measurement of water level	During heavy downpours	Underground works	Manager Mining							

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
	• Water quality • Freshwater biology	pH – as indicated											
		Metals – as indicated											
Operations													
Open pit, TSF, and waste rock dump operations	Land					Operations Manager							
	• Geomorphology – physical instability	Tension cracks, scarps, settling, erosion, seepage, phreatic surface	Visual, topographic survey, and reading of piezometer	Weekly	TSF, waste rock dump, pit walls	ECM							
	• Geochemistry – acid generation – as indicated												
	Water					Operation Manager							
	• Hydrology – flooding, erosion, and dam overtop	Water level (m)	Measurement of water level	During heavy rains	W/B 2, W/B 4 to 5, W/B 7 IW 1 to 6, TSF, open pit and underground works	Manager Mining, Manager Processing, ECM							
	• Water quality • Freshwater biology	NaCN	Distillation – titremetry or CN meter	Daily	IW2 to 3	Manager Processing							

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
		Metals – as indicated											
		pH – as indicated											
	Air												
	• Dust and noise	TSP and noise – as indicated											
	• Vibration, air blast	Airblast and flyrocks	Airblast measurement	Initially and as needed	Open pit area	Manager Mining							
Gold cyanidation plant operations (combined with flotation plant subsequently	Water					Operations Manager							
	• Water quality • Freshwater biology	pH, CN, metals, reagents – as indicated				Manager Processing							
Underground operations	Land												
	• Geomorphology - subsidence	Tension cracks, signs of surficial failure – as indicated											
	Water												
	• Hydrology	Water level (m) – as indicated											

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
	• Water quality • Freshwater biology	Metals, pH – as indicated											
Abandonment													
Closure of operations	Land					Operations Manager							
	• Visual aesthetics - wastes	Types and volumes of wastes and unnecessary items left at site	Visual and measurement	Weekly	Project Area	ECM							
	• Geomorphology – physical stability and subsidence	Tension cracks, scarps, settling, erosion, seepage, other signs of surficial failure	Visual	Monthly	TSF, waste rock dump, and 500 m from edge of pit	ECM							
		Drainage channels – blocks and scour	Visual	Monthly	TSF, waste rock dump, other areas	ECM							
	• Terrestrial biology	Species composition, density cover, diversity, regeneration	EFA	Semestral	TSF, waste rock dump, other areas	ECM							
	Water												

Key Environmental Aspects per Project Phase	Potential Impacts Per Environmental Sector	Parameter for Monitoring	Sampling and Measurement Plan			Lead Person	Annual Estimated Cost	EQPL Management Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
	• Hydrology	Streamflow (L s^{-1}) and water level (m) as indicated											
	• Water quality • Freshwater biology	pH, metals, CN as indicated											
	Air	TSP – as indicated											

Multi-Sectoral Monitoring Framework

Table 6-6. Composition and functions of MMT

Stakeholder Group Proposed for MMT Membership	Basis of Priority Selection	Proposed MMT Role	Scope of MMT Responsibilities/ Activities
MGB Regional Office (MGBRO)	The MGBRO is in charge of the administration and disposition of mineral lands and mineral resources in the regional level. It also undertakes geological, mining, metallurgical, geological, and mineral exploration surveys. Based on DAO No. 1996-40, the MGBRO representative heads the MMT for mining projects. It also provides secretarial and support services to the Team	MMT Chairman	Team leadership to ensure that the Team objectives of monitoring compliance by the Project proponent with the EPEP and of recommending necessary amendments to the EPEP to improve Project performance are met; strengthening of monitoring, analytical, and reporting capabilities of Team members; resolution of issues within the Team; management of the Monitoring Trust Fund, and reporting of MMT activities and accomplishments to the Mine Rehabilitation Fund Committee.
EMB Regional Office (EMBRO)	The EMBRO implements the environmental laws and regulations on the EIA system, clean water, clean air, solid waste, hazardous wastes, and	MMT Co-Chairman	Team co-leadership to ensure that the Team monitors compliance by the Project proponent with the ECC conditions and the Environmental

Stakeholder Group Proposed for MMT Membership	Basis of Priority Selection	Proposed MMT Role	Scope of MMT Responsibilities/ Activities
	chemicals at the regional level. It also undertakes environmental education and information.		Management Plan of the EIS; strengthening of monitoring, analytical, and reporting capabilities of Team members; resolution of issues within the Team, and reporting of ECC accomplishments through the MMT Compliance Monitoring and Validation Report.
GRC	GRC is the Project proponent with commitments and accountabilities under the ECC, EIS, and EPEP.	MMT Member	Provision of budget (Monitoring Trust Fund) to the MMT; availability to MMT of all Project information necessary to determine compliance with environmental requirements and commitments; coordination with MMT members on the inspection of project activities and facilities including the testing, calibration, and operation of pollution control devices, and presentations and discussions with the Team.
Barangay Governments of Cawilan, Siana, Dayano, del Rosario, Magpayang, and Pongtud	The Barangay Government represents the direct impact and indirect impact communities. It is thoroughly familiar with the physical, socio-economic, cultural, and health conditions and resources in such areas. It is therefore a very good source of information, issues, and recommendation.	MMT Member	Participation in actual monitoring works for the Project; provision of information to the MMT about the physical and human conditions as well as issues, problems, and suggestions of community members; and preparation and review of MMT reports.
Lake Mainit Development Alliance (LMDA)	LMDA is the organization of the Provincial Governments of Agusan del Norte and Surigao del Norte; Municipal Governments of Kitcharao, Jabonga, Santiago, Tubay, Alegria, Mainit, Tubod, and Sison; national government agencies of DENR, BFAR, NEDA, PIA, DOT, and DA; academe; business sector; farmers/fisherfolks; NGOs, and POs. Its mission is the sustainable development and management of Lake Mainit. LMDA is the implementor, partner and recipient of the Philippines-Australia Community Assistance Program through the Focal Community Assistance Scheme. It is a major stakeholder of the Siana Project.	MMT Member	Participation in actual monitoring works for the Project; provision of information on policies, plans, and programs of the LMDA especially those that may impact or be impacted by the Project; advice to MMT of any complaints, issues, or recommendations concerning the Project, and preparation and review of MMT reports.

Environmental Guarantee and Monitoring Fund Commitment

DAO No. 1996-40, the implementing rules and regulations of Republic Act No. (RA) 7942, also known as the 1995 Philippine Mining Act, requires proponents of mining projects to put up a Mine Rehabilitation Fund (MRF) prior to construction. The MRF consists of a Monitoring Trust Fund (MTF) amounting to no less than P 100,000.00 and a Rehabilitation Cash Fund (RCF), equivalent to whichever is lower of 10 % of the budget required for an Environmental Protection and Enhancement Program (EPEP) or P 5 million. The MRF is deposited as a trust fund in a government bank and is maintained by the proponent up to the end of the post-decommissioning period of ten (10) years. The mining proponent requests for withdrawal and disbursement from said fund based on its EPEP and Annual Environmental Protection and Enhancement Program (AEPEP). The request is submitted to the Mine Rehabilitation Fund Committee (MRFC). The proponent replenishes the MTF and the RCF on a monthly and annual basis, respectively.

The EPEP is a comprehensive environmental management plan for the life of the mining project on which AEPEPs are based and implemented to achieve the environmental management objectives, criteria, and commitments including protection and rehabilitation of the disturbed environment. The EPEP is a post-ECC condition submitted to the MGB for review.

The MTF covers the maintenance and other operating budget for transportation and travel expenses, laboratory analysis, supplies and materials, communication services, consultancy work, and other reasonable expenses incurred by the MMT.

The RCF funds the project's approved rehabilitation activities and schedules for specific mining project phase, including research programs as defined in the EPEP and AEPEP.

The MRFC is created by the MGB Regional Office. It is co-chaired by the MGB Regional Director and DENR Regional Executive Director. Its membership is drawn from the local government unit, local NGOs and community organizations, and the project proponent.

As discussed in Section 6.5, the proponent is also required to submit a Final Mine Rehabilitation and Decommissioning Plan (FMRDP) to the MGB Regional Office. After the Plan is approved, the proponent puts up a Final Mine Rehabilitation and Decommissioning Fund (FMRDF) in a government bank. The fund is built up following a pre-defined schedule to amount to the full cost of the FMRDP prior to the end of the operating life of the mine.

To ensure the compensation of damages caused by the mining project, DAO No. 1996-40 requires proponents to pay a Mine Waste and Tailings Fee (MWTF) based on the amount of mine waste and mill tailings generated every six (6) months.

GRC is committed to submitting the necessary reports and putting up the required funds after the ECC is issued to the Project.

INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

In accordance with DAO No. 1996-40, GRC will establish a Mine Environmental Protection and Enhancement Office (MEPEO) prior to Project construction. This Office will "set the level of priorities and marshal the resources needed to implement environmental management programs."

Figure 3-21 is the GRC Organizational Chart. As shown, the MEPEO is the Environment and Community Office headed by the Environment and Community Manager (ECM) which is within the Administration Division. Assisting the ECM are the Community Relations Officers and an Environmental Engineer.

The Environmental Engineer's responsibilities are:

- Operation and maintenance of the pollution control structures such as tailings pond, waste dump, sewage treatment plant (STP), landfill, and sediment control structures.
- Operation and maintenance of the nursery and plantation activities.
- Permitting and permit maintenance and the keeping of as-built plans, maintenance records, and waste generation data.
- Implementation of all programmed environmental monitoring activities for effluents, emissions, etc. on time and consistent with quality assurance and quality control protocols.
- Design, recommendation, and implementation of measures that will make the Project comply with the Project's environmental policy and the statutory environmental requirements.

The ECM assumes overall responsibility and accountability for environmental management and community development. Among others, he takes direct responsibility for the following:

- Implementation of the chemicals management plan.
- Operation and maintenance of the Project's ERPP.
- Coordination with the contractors and other Departments on environmental management.
- Operation of the Environmental Committee where the contractors' senior representatives sit as members.
- Interaction with the government and publics including the Multi-partite Monitoring Team (MMT) and Mine Rehabilitation Fund Committee (MRFC) on environmental concerns.

The Environmental Engineer and ECM play key roles in the Project's environmental management plans. GRC will ensure that highly-trained and competent persons with demonstrated hands-on experience in mining environmental management are appointed to the positions.

GRC will implement the Project through contractors. It is crucial that responsibilities and sanctions including penalties on environmental management are explicitly defined in the contracts.

To assure a holistic approach and quick response to environmental concerns, GRC will create an Environment Committee. This Committee is headed initially by the Construction Manager and subsequently the Operations Manager. It is composed of senior representatives of the major contractors. The ECM acts as Technical Adviser to the Committee Chairman. The Committee meets weekly to discuss environmental plans, responsibilities, accomplishments, and issues. Action plans are agreed upon to address the issues. These plans are continuously monitored until the issues are fully resolved.

To supplement the works of the Environment Committee is the Multipartite Monitoring Team (MMT). The MMT evaluates on a quarterly basis the Project's compliance with the ECC conditions, EMP of the EIS, EPEP, AEPEP, and agreements during the MMT exit meetings. The MGB and EMB Regional Offices which will co-chair the MMT are responsible for training the MMT members in mine monitoring and evaluation works.

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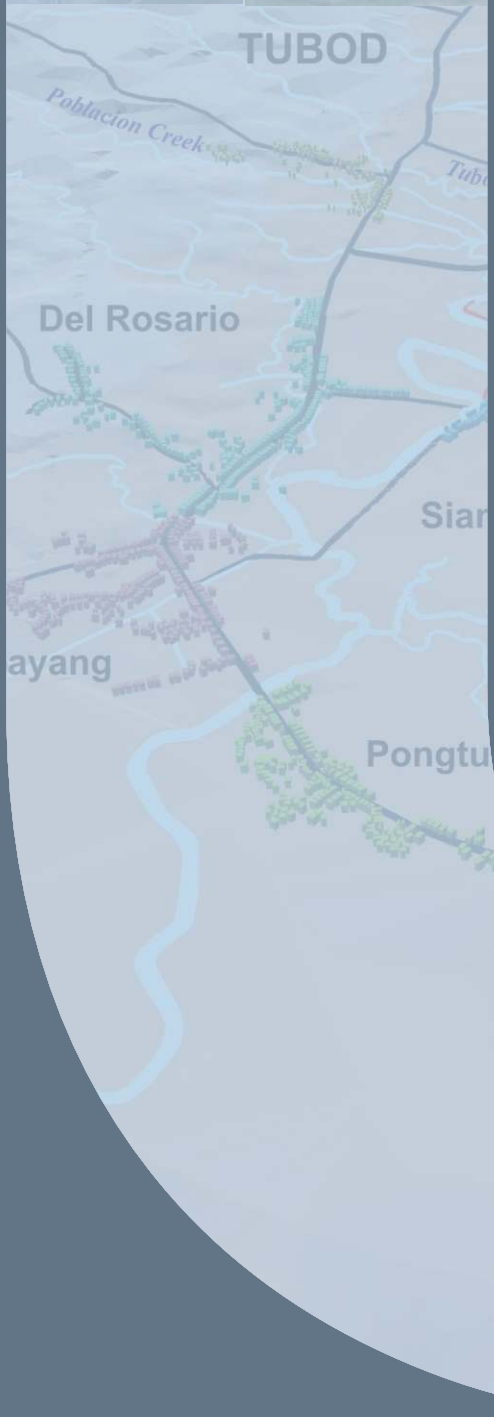

JANUARY 2009

Environmental Impact Statement (EIS) of the Siana Gold Project

Annexes

Prepared by BMP Environment & Community Care, Inc. for:

Greenstone
Resources Corporation

Annex 8-1. Scoping checklist

SCOPING and PROCEDURAL SCREENING CHECKLIST FOR ENVIRONMENTAL IMPACT STATEMENT (EIS)

EIS SCOPING AND PROCEDURAL SCREENING CHECKLIST

Project Name	SIANA GOLD MINING PROJECT	Project Location	Barangay: Cawilan; Municipality/City: Tubod; Province: Surigao del Norte; Region: Caraga
Proponent Name	GREENSTONE RESOURCES CORP.	Proponent Address	Siana & Dayano Mainit, Surigao del Norte, Caraga
Proponent Contact Person	MR. GREG EDWARDS	Proponent Means of Contact	Landline No: ; Fax No. : ; Mobile No : ; Email :
EIA Consultant	BMP Envi.	Consultant Address	12C PET Plans Tower, EDSA, Guadalupe Viejo, Makati City
EIA Consultant Contact Person	DR. RAUL CUNETO	Consultant Means of Contact	Landline No: 890-5902 ; Fax No. : 897-3984 ; Mobile No : ; Email : bmpenvironment@yahoo.com
EMB/DENR Scoping Representatives	MARIA R. SALLAC	Place of Scoping	
		Date of Scoping	

NOTES:

1) **The EIA Report shall have about 250 pages**, for management purposes, inclusive of all summaries, main report and all attachments. The suggested lay-out specifications are as follows: Font 10 Arial, single space; justified margin; no indentations; 1" margin all around, A4 bond size, back to back printing; optional continued numbering of paragraphs per Chapter (i.e. 1.0 - paragraph number 1,2,3, etc; 2.0 – paragraph number 1,2,3,etc...)
2) **The page breakdown per section provided below is only for GUIDANCE purposes.** The Proponent is strongly encouraged to submit only the minimum information necessary to establish the key impacts of the project and to manage such impacts., e.g. only the summary/analysis of secondary information obtained by the Proponent in the course of the EIA study need to be submitted. However, the EMB or the EIA Review Committee shall exercise its discretion to ask for the detailed information when it evaluates the need for such during the EIA Review meetings.
3) Label the EIA Report as a **DRAFT.** The **FINAL** report is to be resubmitted after the EIA review is completed and before the ECC is issued.
4) The Proponent and Review Team may clarify, make changes or adjustments to the Specific Requirements and provide SPECIAL INSTRUCTIONS" for Scoping purposes.
5) The Proponent shall have pre-filled out this Checklist prior to submission of the Letter-Request for Scoping. For projects during the transitory period whose proponents have not filled out the checklist, the Proponent shall be first asked by the EIARC Chair to identify which items in the Technical Scoping part of this checklist it proposes to cover in terms of likely impacts and related baseline information per impact, before the EIARC discusses and confirms the final scope.

A. REQUIREMENTS ON EIA REPORT OUTLINE, FORMAT AND CONTENT

GENERAL CONTENTS/ REQUIREMENTS	SPECIFIC CONTENTS/REQUIREMENTS	FOR SCOPING USE	FOR PROCEDURAL SCREENING USE			
		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	NO	REMARKS
Project Fact Sheet	~2-3 pages: Information highlights from Executive Summary on Project Description; Project Specific EIA Process, Baseline Profile, Key Impacts, Key environmental management measures and monitoring plans; include 0.25 page of project regional site location on Philippine Map inset.	✓	first 6 pages of EIS			
Table of Contents	~9-10 pages: Include all sections of the EIS for procedural screening purposes; list of tables, figures, annexes	✓	after PF sheet			
Executive Summary	Maximum ~15 pages					
1.0 Brief Project Description	~3 pages (tabulated) : project location & area (with 0.25 – 0.50 page project regional location on Philippine map inset), rationale, components, project phases/stages, process/ technology (as applicable), products and production capacity or rate (as applicable), types & estimated generation rate of major waste streams, manpower, project cost, project duration and schedule	✓	p. 1-3			
2.0 Brief Summary of Project's EIA Process	~2 pages: (tabulated): name/expertise of preparer team, study period, study area (and attach 1 page map), EIA method, summary of public participation in scoping and conduct of EIA study	✓	p. 3-6			
3.0 Summary of Baseline Characterization	~4 pages (tabulated): Present integrated key findings/conclusions per ecosystem (Land, Water Air and People) in terms of criticality of environmental quality status. No need to detail findings per module.	✓	p. 6-8			

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GENERAL CONTENTS/ REQUIREMENTS	SPECIFIC CONTENTS/REQUIREMENTS	FOR SCOPING USE	FOR PROCEDURAL SCREENING USE			
		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Pagels in the EIA Report	Validated Acceptable by EMB Case Handler? YES	NO	REMARKS
4.0 Summary of Impact Assessment and Environmental Management Plan	~3 pages: 1) Impacts Mitigation Summary 1st column: Key project activities per phase (i.e. most critical environmental aspects which are the sources of key impacts); 2nd column: environmental component or module affected, nature and magnitude of most significant impacts; 3rd column: proposed options for prevention and mitigation of impacts 2) Present a statement each for SDP Framework, IEC Framework, ERP Policy, Abandonment Policy	✓	p. 9-17 p. 17			
5.0 Summary of the Environmental Monitoring Plan	~2 pages: 1) Summary of EMoP Matrix of Proponent – focused only on 1-3 most important objectives and corresponding parameters to be monitored per phase of the project, limit level to be complied with, station description to be monitored and what frequency 2) Summary of MMT or public participation framework in post-ECC monitoring	✓	p. 17-21			
6.0 EMF and EGF Commitments	~1 page: Present EMF and EGF amount committed	✓	p. 21-22			
DRAFT MAIN EIS	Maximum ~142 pages (Less attachments):					
1. BASIC PROJECT INFORMATION	~3 pages (tabulation of Project name, location,/address (from Sitio to Region); nature of project; threshold limits applied for; Proponent Name, address, contact numbers, brief profile; EIA Preparer Name, address, contact numbers. Attach project site map in NAMRIA topographic (or nautical, if applicable) map in 1:50,000 scale	✓	p. 1-1 to 1-2			

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GENERAL CONTENTS/ REQUIREMENTS	SPECIFIC CONTENTS/REQUIREMENTS	FOR SCOPING USE	FOR PROCEDURAL SCREENING USE			
		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	NO	REMARKS
2. DESCRIPTION OF THE PROJECT'S EIA PROCESS	~25 pages including all attachments as specified below	✓				
2.1 EIA TOR	Tabulate the main issues raised by the EIARC (see below Summary of Most Significant Issues) and the community (refer to List of Issues During Public Scoping) and state where/how each was addressed in the EIA Study; attach the detailed Scoping checklists (Public and Technical) as an annex	✓	p. 2-1 to 2-3			
2.2 EIA Team	Tabulate data on EIA Team: list of team members, field of expertise, module assigned to both proponent and preparer team	✓	p. 2-3			
2.3 EIA Study Schedule	Inclusive periods of study/field surveys , state climate/season	✓	p. 2-4			
2.4 EIA Study Area	Present area from project site up to extent of coverage of study: Show study area in NAMRIA topographic (and nautical , if applicable) map of 1:50,000 scale	✓	p. 2-4 to 2-5			
2.5 EIA Methodology	Tabulate only generic EIA approach and data sources	✓	p. 2-5 to 2-9			
2.6 Public Participation	Tabulate chronologically the following: EIA stage, dates, sectors involved, issues raised, committed actions by the Proponent where relevant; and explain or shed light on succeeding public's response/ reactions/participation or explain prevailing perceptions/ actions by the public. On sectors and issue, differentiate the list into supportive and opposing sectors as well as issues considered valid and invalid.	✓	p. 2-10 to 2-21			
3. PROJECT DESCRIPTION	~ 30 pages					
3.1 Project Location &	• Presented in legible maps (use clearly scanned or original		p. 3-1			

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		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler?		REMARKS
				YES	NO	
Area	NAMRIA topographic (or nautical, if applicable) map of 1:50,000 or appropriate scale) showing both project site up to regional location with Philippine map as inset; Regional and provincial vicinity map (showing major landmarks, existing industries, settlements, etc) • Show title, legend, scale, project location and political boundaries (from sitio/barangay to region); delineation of areas of primary and secondary impact areas, Present geographic coordinates • Present applicable ECA categories and statement on technical description on environmental criticality of the site	✓				
3.2 Project Rationale	• Present need for project based on national & local economic development and in terms of contribution to sustainable development agenda or current development thrusts of the Philippines ; • Briefly justify/describe existence of expected commercial quantities of resources to meet local/national development or sectoral objectives (e.g. describe geologic resource for metallic/non-metallic mining, petroleum /geothermal reservoir, etc); Attach detailed Economic Geology as Annex	✓	p. 3-1 to 3-2			
3.3 Project Alternatives	Present criteria used in determining preliminary options for facility siting; development design; process/technology selection; resource utilization	✓	p. 3-2 to 3-3			
3.4 Project Development Plan, Process/ Technology Options and	Attach tentative/options of Physical Plan/Site Development Map being considered at the FS stage (e.g., present annual program of development for a mine project); discuss processes/technologies being considered; tabulate project components and estimated dimensions/specifications (facilities/infrastructures, other single	✓	p. 3-4 to 3-10			

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		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	NO	REMARKS
Project Components	projects supporting the main project) and locate in map at a level of detail feasible at FS Stage	✓				
3.5 Description of Project Phases, Aspects, Wastes, Other Issues, Built-in Measures	Tabulate project phases, activities/environmental aspects, associated wastes*, other key environmental and social issues; and built-in pollution control measures *Under the column on Waste Generation: subheadings are as follows: types of wastes, estimated waste generation rate, estimated volume for the duration of the project phase)	✓	p. 3-10 to 3-31			
3.6 Manpower Requirements	Present manpower requirements per project phase; specify expertise needed; nature & estimated number of jobs available for men; nature and number of jobs available for women; specify strategy and tentative scheme for sourcing locally from host and neighboring LGUs and those from outside	✓	p. 3-32 to 3-34			
3.7 Project Cost		✓	p. 3-34 to 3-36			
3.8 Project Duration and Schedule	Present estimate per project phase	✓	p. 3-37			
4. BASELINE ENVIRONMENTAL CONDITIONS, IMPACT ASSESSMENT AND MITIGATION	~ 50 pages (less Attachments): For each module, present a) Methodology of EIA Modular Study including tabulation of stations with coordinates and qualitative description, as well as NAMRIA topographic map of the study area in 1:50,000 or more detailed scale; b) Summary of primary and secondary data (present detailed info as annexes; c) highlights of findings and conclusions on the baseline profile as to sensitivity to project impacts. • On Baseline: MINIMUM DATA TO BE HIGHLIGHTED ARE THOSE ASKED IN THE PEMAPS QUESTIONNAIRE IN ANNEX	✓	p. 4-1 to 4-79			

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GENERAL CONTENTS/ REQUIREMENTS	SPECIFIC CONTENTS/REQUIREMENTS	FOR SCOPING USE	FOR PROCEDURAL SCREENING USE			
		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	Validated Acceptable by EMB Case Handler? NO	REMARKS
	2-7d OF THE RPM. Subsequently, focus on 3-5 key findings on the baseline profiling per relevant module. No need to present or attach ALL primary data. Important to present highlights of analysis of baseline data: a) present summary analysis of physico-chem, bio and social data in terms of how the values compare with environmental standards, how the biostatistics compare with typical ecological values, how social data compare with national and local norms or Philippine statistics. b) present estimates* and relative percentages of total area likely to be utilized, total volumes of soils to be excavated, # watersheds and total vegetation to be cut, # of rivers and extent of coastal/marine waters to be affected, total households to be displaced, etc... c) presence and statistical highlights of ecologically and economically most important species and ECAs which may be affected; state nature of impact of project and how this can be prevented or mitigated. d) presence of any physico-chem, biological & social indicators (pseudo-indicators) of project impacts for monitoring purposes • On Impacts: Focus on 1-3 most significant impacts/issues of the most critically affected modules under Land, Water, Air, People across each project phase. Include discussion of residual, unavoidable and cumulative impacts, where relevant and appropriate. • On Mitigation: present major interventions/actions for each	✓				

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		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	NO	REMARKS
	identified significant issue.					
4.1 THE LAND	• Discuss Land Use/classification and associated Terrestrial Biology (flora and fauna); • Discuss only relevant aspects of Geology which will explain the geohazards; (Note: For Metallic and Non-metallic Mining Projects, Geothermal Exploration and other similar projects, other aspects of Geology particularly which describe the geologic resource in relation to the project proposal must be described as part of Project Description to justify geologic resource use) • Discuss Geomorphology'(i.e. land forms/topography/slope/ terrain) which explain the limitations or nature of the land use and distribution of population and nature of and vegetation/wildlife forms; • Discuss Pedology (main soil type and quality) which rationalize/explain and lend support to the land use, population and biota profile	✓	p. 4-1 to 4-2 p. 4-10 to 4-17 p. 4-2 to 4-6 p. 4-7 to 4-10			
4.2 THE WATER	Discuss relevant modules: Hydrology and Hydrogeology, Oceanography, Water Quality, Freshwater and Marine Biology Note #1: Identify which surface and groundwater systems will be affected by the project; present water quality status with highlight on the most relevant parameters, critical uses and the users of these water bodies; present the most important species likely to be affected by the project; present conclusions of modeling (where relevant) of extent of physical and chemical dispersion/trajectory of most relevant parameter and resulting concentrations with increasing distance and	✓	p. 4-20 to 4-40			

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		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	NO	REMARKS
	depth from the source as basis for deriving a mixing or buffer zone and delineating the DIA from the IIA; map out the economically and ecologically critical areas/resources and superimpose on the biophysical data; Note #2: Present key findings and conclusions of analysis of surface and groundwater quality; Identify key potential impacts of the project across project phases and propose corresponding measures					
4.3 THE AIR	• Meteorology (Note: For most projects, the relevant parameters are only the climate types. Seasons, rainfall profile, wind roses and climatological extremes as the latter pose environmental hazards; the rest of the climatological data can be attached as an Annex); • Air Quality (& Noise, if relevant) : Present highlight of air quality status with highlight on the most relevant parameters; present conclusions of modeling (where required) on extent of physical and chemical dispersion/trajectory of most relevant parameter and resulting ground level concentrations with increasing distance from the source as basis for deriving a buffer zone and delineating the DIA from the IIA; superimpose on the economically and ecologically critical areas/resources and population/significant socio-cultural features • Note: Present key findings and conclusions of analysis of air quality; Identify key potential impacts of the project across project phases and propose corresponding measures	✓S D ✓	p. 4-46 to 4-48 p. 4-49 to 4-52			
4.4 THE PEOPLE	Present highlights of primary and secondary data on the DIA and IIA, including highlights of perception survey; Present key findings and	✓	p. 4-52 to 4-95			

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		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	NO	REMARKS
	conclusions of analysis of the Socio-Cultural Environment; Identify key potential impacts of the project considering biophysical findings across project phases and propose corresponding measures					
5 ENVIRONMENTAL RISK ASSESSMENT (WHEN APPLICABLE)	~2 page Present only key findings and conclusions of the ERA. Refer to Section C of this Checklist and Annex 2-7e of the RPM to determine coverage and nature of ERA to be required.	✓	p. 5-1 to 5-22			
6 ENVIRONMENTAL MANAGEMENT PLAN	~30 pages					
6.1 Impacts Management Plan	Use Annex 2-17 of RPM – limit to most significant impacts per project phase and per environmental component arising from key environmental aspects	✓	p. 6-1 to 6-34			
6.2 Social Development Framework	Use Annex 2-18 of RPM	✓	p. 6-34 to 6-35			
6.3 IEC Framework	Use Annex 2-19 of RPM	✓	p. 6-35 to 6-39			
6.4 Emergency Response Policy and Generic Guidelines	The policy and generic guidelines are to be consistent with the relevant agencies' requirements that are to be complied with after the ECC is issued, e.g. MGB has a prescribed ERP content for mining projects.	✓	p. 6-40 to 6-45			
6.5 Abandonment /Decommissioning /Rehabilitation Policy and	Statement on Proponent's policies and generic procedures; Detailed Abandonment/Decommissioning Plan to be submitted post-ECC, within a timeframe specified in the ECC	✓	p. 6-45 to 6-47			

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GENERAL CONTENTS/ REQUIREMENTS	SPECIFIC CONTENTS/REQUIREMENTS	FOR SCOPING USE	FOR PROCEDURAL SCREENING USE			
		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	Validated Acceptable by EMB Case Handler? NO	REMARKS
Generic Guidelines						
6.6 Environmental Monitoring Plan			p. 6-48 to 6-62			
6.6.1 Self-Monitoring Plan	Use Annex 2-20 of RPM (including costing) and applicable parts of Annex 3-1 on ECC Compliance Monitoring of the Proponent; Attach filled out PEMAPS Questionnaire (Annex 2-7d) – present a statement on the existence of a PATHWAY, criticality of the RECEPTOR, status of perception of ENVIRONMENTAL PERFORMANCE from supportive or opposing groups.	✓	p. 6-48 to 6-61 Table 6-1 Annex 8-3			
6.6.2 Multi-sectoral Monitoring Framework	For projects with MMT requirement, tabulate the following: list of stakeholder community sectors or representatives who are proposed to be likely members of the MMT as validated by EIA process, basis of priority selection, proposed MMT role, and scope of MMT responsibilities/activities; strategy or approach in establishing and monitoring Environmental Quality Performance Levels (EQPLs) in coordination with the MMT's program of identifying pseudo/quasi-indicators of environmental damage. Refer to Annexes 3-2 and 3-4 of the RPM.	✓	p. 6-62 to 6-63 Table 6-6			
6.6.3 Environmental Guarantee and Monitoring Fund Considerations	Present a proposed amount of EMF (based on a draft AWFP in Annex 3-4 and consistent with guidelines in Annex 3-5); Present a committed amount of EGF and the basis for the estimate, following the guidelines in Annex 3-6	✓	p. 6-64			
6.7 Institutional Plan for EMP Implementation	Discuss the Table of Organization of the Proponent where the reporting line and manpower complement/positions of the EU, MEPEO or equivalent units to higher management and relationships with	✓	p. 6-64 to 6-65			

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		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	NO	REMARKS
	operating departments are shown					
7 BIBLIOGRAPHY/ REFERENCES	~2 pages	✓	p. 7-1 to 7-5			
8 ANNEXES	~80 pages					
8.1 Scoping Checklist	Use Annex 2-7a of the RPM (signed off document) with attached signed off Public Scoping List of Issues, as applicable (Annex 2-7c)	✓	p. 8-1 to 8-22			
8.2 Original Sworn Accountability Statement of Proponent	Use Annex 2-21 of RPM	✓	p. 8-23			
8.3 Original Sworn Accountability Statement of Key EIS Consultants	Use Annex 2-22 of RPM	✓	p. 8-24 to 8-25			
8.4 Proof of Public Participation	Attendance Sheets of IEC, Public Scoping, Public Consultation/Public Hearing; Proof of public participation in the EIA Study	✓ - minutes	p. 8-26 to 8-65			
8.5 Baseline Study Support Information	• Detailed analysis of primary and secondary information per module; perception survey analysis with sample questionnaire; Lab analytical results for soil, ground and surface freshwater and marine waters, air quality, noise – all tables compared with relevant Philippine standards, Philippine typical baseline values, Philippine statistics or other equivalent reference standards. • The rest of the baseline data obtained by the Preparer shall be presented during the EIA Review Meetings in case the Review Team has items to validate against detailed baseline info. These can also be used by the Proponent in its self-monitoring and MMT	✓	p. 8-66 to 8-104			

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		CLARIFICATIONS/ CHANGES/SPECIAL INSTRUCTIONS BY EIARC/EMB	Page/s in the EIA Report	Validated Acceptable by EMB Case Handler? YES	NO	REMARKS
	validation activities.					
8.6 Impact Assessment and EMP Support Information	ERA, PEMAPS Questionnaire, etc	✓	p. 8-105 to 8-110			

NOTE: The EIA review process will advise DOH if the project will pose a significant public health risk to the environment, e.g. public health may be affected if the wastes/discharges are direct contributors to the leading causes of mortality/morbidity in the DIA, regardless of environmental management measures. To assist EMB on its review, DOH shall coordinate with the DENR-EMB on the declaration of Health Sensitive Projects and Health Sensitive Areas. Until such time, DOH shall review EHIA independently of the EIA Process, consistent with the DENR-DOH MOA on EHIA. Further, workers' HIA component of the EHIA is recommended to be coordinated by DOH with DOLE for the latter's consideration in its requirement of an Occupational Health and Safety Program from the Proponent.

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DURING TECHNICAL SCOPING: OTHER INSTRUCTIONS BY THE EIARC/EMB ON THE FORMAT AND CONTENT OF THE EIA REPORT TO BE SUBMITTED			DURING PROCEDURAL SCREENING: OTHER OBSERVATIONS/COMMENTS/REMARKS BY THE EMB CASEHANDLER ON THE FORMAT AND CONTENT OF THE SUBMITTED EIA REPORT
1)	MOA B/W JCG and GRC Annex 8-8 Annex 8-9	1)	
2)	Minutes of Public Participation	2)	
3)	Rationale for non-updating source	3)	

of the module.

4. Basic design and drawings of the pollution control devices including (tailings dam, among others)
5. Effect of dewatering on the Community in General.

ANNEX 2-7a

B. TECHNICAL SCOPING CHECKLIST [1]

NOTE: Attach list of issues raised by the attending community representatives during the Public Scoping (Annex 2-7c). Integrate the issues in the Technical Scoping Checklist below.

	List of Key Environmental Issues	Relevance based on PD and Project Location[2] LS = Likely Significant; LI = Likely Insignificant; NR= Not Relevant			a) Basis of Assessment of Relevance; b) Proposed Method of Impact Assessment; c) Other Instructions per Project Phase?	Description of Environment	Required?		Proposed Methodology of Securing and Presenting Information; Other Considerations in EIA Study	Page in the EIA Document	Verified acceptable by EMB CH?	
		LS	LI	N R			Y	N			Y	N
1.0	THE LAND					THE LAND						
1.1	Land Use and Classification					Land Use and Classification						
1.1.1.	Change/Inconsistency in land use					Description of existing land use/zoning/ classification	✓			p. 4-1 to 4-2		
1.1.2.	Encroachment in Protected Area under NIPAS					Land Use Map *(include location of any ECAs and special land features)*	✓			Fig. 4-2		
1.1.3.	Encroachment in other ECAs											
1.2	Geology/Geomorphology					Geology/Geomorphology						
1.2.1.	Change in surface landform /topography/terrain/slope					Slope and Elevation Map	✓			Fig. 4-4		

[1] This table has two major columns: Key environmental issues to be addressed, and the Description of Environment (primary or secondary data) based on one or more environmental issues identified. There is no one-to-one correspondence between the potential issue columns to the left and the baseline information to the right. These columns are provided to ensure the EIA Study focuses on the most relevant environmental issues. **LS = likely significant, LI = likely insignificant, NR = nor relevant**. LS requires in depth quantitative analysis depending on the availability of mathematical methods. LI requires qualitative analysis. NR column is provided since there are listed impacts that may not be after all existent due to the nature of the project and location. During the EIA study, some project aspects may be discovered as significant and may be the basis of Additional Information in the review.

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List of Key Environmental Issues		Relevance based on PD and Project Location² LS = Likely Significant; LI = Likely Insignificant; NR= Not Relevant			a) Basis of Assessment of Relevance; b) Proposed Method of Impact Assessment; c) Other Instructions per Project Phase?
		LS	LI	NR	
1.2.2.	Change in sub-surface/ underground geomorphology (e.g. underground mining)				
1.2.3.	Inducement of subsidence				
1.2.4.	Inducement of landslides or other natural hazards				
1.2.5.					
1.2.6.					
1.2.7.					
1.2.8.					
1.2.9.					
1.2.10.					
1.2.11.					
1.3	**Pedology**				
1.3.1.	Soil Erosion				
1.3.2.	Change in soil quality (e.g. in irrigation areas)				
1.4	**Terrestrial Biology**				
1.4.1.	Vegetation removal and loss of habitat				
1.4.2.	Threat to existence of important				

Description of Environment	Required?		Proposed Methodology of Securing and Presenting Information; Other Considerations in EIA Study	Page in the EIA Document	Verified acceptable by EMB CH?	
	Y	N			Y	N
Regional/General Geological Map	✓			Fig. 4-6		
Geological Cross-Sections	✓			Fig. 3-2		
Sequence Stratigraphic Column of Rock Units	✓			Fig. 4-7		
Geomorphological Map	✓			Fig. 4-5		
g factor Contour Map for Rocks	✓			Fig. 4-10		
Seismicity Map	✓			Fig. 4-9		
Differential Settling Hazard Map	✓			Fig. 4-8		
Bathymetric and Morphostructural Map	✓	[redacted]	FOR THE LAKE	Fig. 4-14		
Results of Petrographic and Mineragraphic Analyses	✓			p. 3-5		
Results of Geochemical Analyses of Rock Samples	✓			Table 4-1		
Pedology	→		FOR PROJECT MODELLING			
Summary of Soil Investigation Report on soil type and quality	✓			p. 4-7 to 4-9		
Laboratory Results of Soil Sample Analysis	✓			Table 8-3		
Erodibility Potential	✓			p. 4-9 to 4-11		
Terrestrial Biology						
Flora and Fauna Species Inventory or Survey	✓		FOR ONLY BIRDS - 2008	Table 8-6 Table 8-7		
Summary of Endemicity	✓			Table 8-8		

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	List of Key Environmental Issues	Relevance based on PD and Project Location² LS = Likely Significant; LI = Likely Insignificant; NR= Not Relevant			a) Basis of Assessment of Relevance; b) Proposed Method of Impact Assessment; c) Other Instructions per Project Phase?
		LS	LI	NR	
	local species				
1.4.3.	Threat to abundance, frequency and distribution				
1.4.4.	Hindrance to wildlife access				
2.0	THE WATER				
2.1	Hydrology/Hydrogeology				
2.1.1.	Change in drainage morphology				
2.1.2.	Change in stream, lake water depth				
2.1.3.	Reduction in stream volumetric flow				
2.1.4.	Inducement of flooding				
2.1.5.	Water resource competition				
2.1.6.	Reduction/Depletion of groundwater flow				
2.2	Oceanography				
2.2.1.	Change in circulation pattern				
2.2.2.	Change in bathymetry				
2.2.3.					
2.3	Water Quality				
2.3.1.	Groundwater pollution				

Description of Environment	Required?		Proposed Methodology of Securing and Presenting Information; Other Considerations in EIA Study	Page in the EIA Document	Verified acceptable by EMB CH?	
	Y	N			Y	N
/Conservation Status						
Summary of Abundance, Frequency and Distribution	✓			Table 8-6		
Site Observation/ Transect Walk Map	✓			Fig. 4-13		
THE WATER						
Hydrology/Hydrogeology						
Topographic Map showing Drainage System	✓			Fig. 4-14		
Regional Hydrogeologic Map	✓			Fig. 4-6		
Streamflow Measurements/ Mean Monthly Flow Data	✓		GRAPHICAL [illegible] 2005 - 2008	p. 4-22 Fig. 4-15		
Flood Peaks, Volumes, frequency rating curves and Stormwater flow estimates	✓			p. 4-21 to 4-25		
Spring and Well Inventory and location map	✓		UPDATE MEASUREMENTS	Fig. 4-16		
Flow measurement location map	✓			Fig. 4-15		
Oceanography						
Predicted Tides		✓				
24-Hour Tidal Cycles		✓				
Surface Current System		✓				
Water Quality						
Physico-Chemical Characteristics of Wells and Springs	✓			Table 8-10		

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List of Key Environmental Issues		Relevance based on PD and Project Location² LS = Likely Significant; LI = Likely Insignificant; NR= Not Relevant			a) Basis of Assessment of Relevance; b) Proposed Method of Impact Assessment; c) Other Instructions per Project Phase?
		LS	LI	N R	
2.3.2.	Stream water pollution				
2.3.3.	Lake water pollution				
2.3.4.	Marine water pollution				
2.4	**Freshwater Ecology**				
2.4.1.	Threat to abundance, frequency and distribution of species				
2.4.2.	Loss of important species				
2.4.3.	Loss of habitat				
2.5	**Marine Ecology**				
2.5.1.	Threat to abundance, frequency and distribution				
2.5.2.	Loss of important species				
2.5.3.	Loss of habitat				
2.5.4.					

Description of Environment	Required?		Proposed Methodology of Securing and Presenting Information; Other Considerations in EIA Study	Page in the EIA Document	Verified acceptable by EMB CH?	
	Y	N			Y	N
Physico-Chemical Characteristics of Inland Surface Waters	✓		UP TO LAKE [illegible]	Table 8-10		
Physico-Chemical Characteristics of Coastal Waters		✓				
Bacteriological Characteristics of Wells and Springs	✓			Table 8-10		
Bacteriological Characteristics of Inland Surface Waters	✓			Table 8-10 Table 8-14		
Bacteriological Characteristics of Coastal Waters		✓				
Sampling Site Map	✓			Fig. 4-18		
Freshwater Ecology						
Abundance of ecologically and economically important species	✓		2005 DATA	Table 8-16 Table 8-14		
Presence of Pollution indicator Species	✓			p. 4-10 to 4-12		
Sampling Site Map	✓			Fig. 4-18		
Marine Ecology						
Abundance of ecologically and economically important species		✓				
Presence of Pollution indicator Species		✓				
Marine Resource Map		✓				
Abundance/Densities/Distribution of mangroves, coral reefs, fishes, sea grasses, algae, seaweeds,		✓				

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ANNEX 2-7a

	List of Key Environmental Issues	Relevance based on PD and Project Location[2] LS = Likely Significant; LI = Likely Insignificant; NR= Not Relevant			a) Basis of Assessment of Relevance; b) Proposed Method of Impact Assessment; c) Other Instructions per Project Phase?
		LS	LI	NR	
2.5.5.					
3.0	THE AIR				
3.1	Meteorology/Climatology				
3.1.1.	Change in the local climate, e.g. local temperature				
3.1.2.	Contribution to global greenhouse gas				
3.2	Air Quality (& Noise)				
3.2.1.	Air pollution				
3.2.2.	Increase in noise				
4.0	THE PEOPLE				
4.1.1.	Displacement of settler				
4.1.2.	Change in land ownership				
4.1.3.	Displacement of property				
4.1.4.	Right-of-way conflict				

Description of Environment	Required?		Proposed Methodology of Securing and Presenting Information; Other Considerations in EIA Study	Page in the EIA Document	Verified acceptable by EMB CH?	
	Y	N			Y	N
plankton, etc		✓				
Sampling Site Map		✓				
THE AIR						
Meteorology/Climatology						
Monthly Average Rainfall of the Area	✓		SD	Fig. 4-24		
Climatological Normals/Extremes	✓		SD	Table 8-23, Table 8-24		
Wind Rose Diagrams	✓		SD	Fig. 4-27		
Frequency of Tropical Cyclones	✓		SD	Fig. 4-22		
Air Quality (& Noise)						
Ambient concentrations of TSP, SO_x, NO_x, PM10, etc., 1-hour, 24-Hour Sampling	✓			Table 8-25		
Noise Levels	✓			Table 8-26		
Sampling Station Map (air and noise)	✓			Fig. 4-28		
THE PEOPLE						
Demography	✓		UPDATE	Annex 8-7		
Settlement Map and Population Distribution Map	✓		"	Fig. 4-37 to Fig.4-42		
Population Growth Rate	✓		"	p. 4-54 to 4-56		
Number of Households and Household Size by Barangay	✓		"	Table 2 of Annex 8-7		
Summary of Demographic data per Barangay to be directly affected	✓		"	Table 4 of Annex 8-7		
				Table 1 of Annex 8-7		
				Table 3 of Annex 8-7		

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ANNEX 2-7a

List of Key Environmental Issues	Relevance based on PD and Project Location² LS = Likely Significant; LI = Likely insignificant; NR= Not Relevant			a) Basis of Assessment of Relevance; b) Proposed Method of Impact Assessment; c) Other Instructions per Project Phase?	Description of Environment	Required?		Proposed Methodology of Securing and Presenting Information; Other Considerations in EIA Study	Page in the EIA Document	Verified acceptable by EMB CH?	
	LS	LI	NR			Y	N			Y	N
					Land Area, Population, Population Density, Main Sources of Income, Gender and Age Composition, Literacy, Highest Educational Attainment, Employment Status	✓		UPDATE	Table 4-7 Table 4-11 Table 4-14 Table 4-17, Fig. 4-43 to 4-45		
4.1.5. In-migration					Household Profile based on results of the Socio-Economic/Perception Survey	✓		"	Table 4-16		
4.1.6. Presence of Indigenous People					Indigenous Peoples		✓	· STATEMENT			
4.1.7. Cultural Change					Health	✓		UPDATE	p. 4-79 to 4-86		
4.1.8. Threat to public health					Morbidity and Mortality Rates (Infants and Adults) from Direct Impact Areas	✓		"	p. 4-81		
4.1.9. Local benefits from the project				2005 to 2008	5-Year Trend in Morbidity and Mortality	✓		"	Table 4-21 to 4-28		
					Notifiable Diseases in the Area including Endemic Diseases	✓		"	p. 4-86 to 4-87		
					Local Health Resources (Government and Private)	✓		"	p. 4-80 Table 4-22		
					Environmental Health and Sanitation Profile: water supply, human excreta mgt, waste mgt and disposal systems and food hygiene	✓		"	Fig. 4-49 p. 4-72 to 4-74		
4.1.10. Threat to delivery of basic services					Water Supply and Demand	✓		DOM. CONSTR.	p. 3-12; 4-23; Fig. 4-41		
					Power Supply and Demand	✓		GENSET	Annex 8-7		
4.1.11. Traffic congestion					Transportation/Traffic situation	✓			Annex 8-7		
SUMMARY/HIGHLIGHTS OF TECHNICAL SCOPING									For Procedural		

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ANNEX 2-7a

List of Key Environmental Issues	Relevance based on PD and Project Location[2] LS = Likely Significant; LI = Likely Insignificant; NR= Not Relevant			a) Basis of Assessment of Relevance; b) Proposed Method of Impact Assessment; c) Other Instructions per Project Phase?	Description of Environment	Required?		Proposed Methodology of Securing and Presenting Information; Other Considerations in EIA Study	Page in the EIA Document	Verified acceptable by EMB CH?	
	LS	LI	N R			Y	N			Y	N

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	Considering all project activities and phases, select the most critical Environmental Aspects (major sources of most significant impacts)	List of Associated Most Significant Environmental Issues/Stressors	Agreed EIA Approach in Impact Assessment and Mitigation on key environmental aspects and impacts/issues	Remarks	Screening: Page in EIA Document	Screening: Verified Acceptable by EMB CH? Y	Screening: Verified Acceptable by EMB CH? N
1	Land	Soil erosion Sedimentation			p. 4-9 to 4-10		
2	Water	Chemical Spill			p. 4-24		
3	People	Flooding			p. 4-28		

C. ENVIRONMENTAL RISK ASSESSMENT

If the project has the following:	Required Study/Report	Y	N
1. Facilities for the production or processing of organic or inorganic chemicals using: alkylation, amination by ammonolysis, carbonylation, condensation, dehydrogenation, esterification, halogenation and manufacture of halogens, hydrogenation,hydrolysis, oxidation, polymerization, sulphonation, desulphurization, manufacture and transformation of sulphur-containing compounds, nitration and manufacture of nitrogen-containing compounds, manufacture of phosphorus-containing compounds, formulation of pesticides and of pharmaceutical products, distillation, extraction, solvation	Risk Screening Study		✓
2. Installations for distillation, refining or other processing of petroleum products.	Risk Screening Study		✓
3. Installations for the total or partial disposal of solid or liquid substances by incineration or chemical decomposition	Risk Screening Study – CYANIDE DETOX PLANT	✓	
4. Installations for the production or processing of energy gases, for example, LPG, LNG, SNG	Risk Screening Study		✓
5. Installations for the dry distillation of coal or lignite	Risk Screening Study		✓
6. Installations for the production of metals or non-metals by a wet process or by means of electrical energy	Risk Screening Study – GOLD & ZINC	✓	
7. ~~Installations for the production of metals or non-metals by a wet process or by means of electrical energy~~	~~Risk Screening Study~~		
8. Specific facilities or the use of certain processes listed in the **Risk Thresholds Table** below.	Risk Screening Study	✓	
9. Facilities that would use, manufacture, process or store hazardous materials in excess of Level 1 threshold inventory in **Risk Thresholds Table** below.	Hazard Analysis Study, and Emergency/ Contingency Plan based on the study and worst-case scenario.	✓	

• SAFETY DEVICES FOR ALL STORAGE FACILITIES

ANNEX 2-7a

If the project has the following:	Required Study/Report	Y	N
1(Facilities that would use, manufacture, process or store hazardous materials in excess of **Level 2** threshold inventory in **Risk Thresholds Table** below.	Quantitative Risk Assessment (QRA) and Emergency/Contingency Plan based on the QRA	✓	

Risk Thresholds Table

CATEGORY	LEVEL 1 (tons)	LEVEL 2 (tons)	CATEGORY	LEVEL 1 (tons)	LEVEL 2 (tons)
Explosives	10	50	Toxic substances (medium)	10	50
Flammable substances	5,000	50,000	Toxic substances (high)	5	20
Highly flammable substances	50	200	Toxic substances (very high)	0.2	1
Extremely flammable substances	10	50	Toxic substances (extreme)	0.001	0.1 – CYANIDE
Oxidizing substances	50	200	Unclassified (Type A)	100	500
Toxic substances (low)	50	200	Unclassified (Type B)	50	200

NEED FOR PUBLIC HEARING/CONSULTATION /SITE VISIT OR SITE/VALIDATION DURING EIA REVIEW	BASIS FOR RECOMMENDATION/DECISION
1) Proponent's Request	
2) EIARC Evaluation	SITE VISIT (WEN YET EIARC & MGB/PENRO/CENRO MEMBERS)
3) EMB Evaluation	

SCOPED BY: EIARC MEMBERS

NAME	EXPERTISE	SIGNATURE	NAME	EXPERTISE	SIGNATURE
[illegible] MANUEL	Geology & Mining	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	SIA	[illegible]			

EIA PERSONNEL REPRESENTATIVE DURING TECHNICAL SCOPING:		REPRESENTATIVE/S OF THE PROJECT PROPONENT:	
MARK R. [illegible]		[illegible]	
Signature over Printed name	Signature over Printed name	Signature over Printed name	Signature over Printed name
NOTED BY: EIAM Division Chief		REPRESENTATIVE/S OF THE EIA PREPARER	
CESAR S. SIADOR, JR.		[illegible]	MARITA B. CUAÑO
Signature over Printed name		Signature over Printed name	Signature over Printed name

DAVID L. AMELILLAGAN, JR.
MGB REPRESENTATIVE

CARLO C. CULTOPO
PAWB REPRESENTATIVE

ANNEX 2-7a

PROCEDURAL SCREENING RECOMMENDATION BY EMB CASEHANDLER:			
1st Procedural Screening:	Return	☐	Accept Document for Filing of Application for
REMARKS:			
Printed Name of EMB Case handler:		Signature: _____	Date:
2nd Procedural Screening:	Return	☐	Accept Document for Filing of Application for
REMARKS:			
Printed Name of EMB Case handler:		Signature: _____	Date:

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ANNEX 2-7a

Annex 8-2.

SWORN STATEMENT OF ACCOUNTABILITY OF THE PROPONENT

This is to certify that all the information and commitments in this ENVIRONMANTAL IMPACT STATEMENT REPORT for the SIANA GOLD PROJECT are accurate and complete to the best of our knowledge, and that an objective and thorough assessment of the Project was undertaken in accordance with the dictates of professional and reasonable judgment. Should I learn of any information, which would make this ENVIRONMANTAL IMPACT STATEMENT REPORT inaccurate, I shall immediately bring the said information to the attention of the DENR-EMB.

I hereby certify that no DENR-EMB personnel was directly involved in the preparation of this SIANA GOLD PROJECT REPORT other than to provide procedural and technical advice consistent with the guidelines in the DAO 03-30 Revised Procedural Manual.

I hereby bind MYSELF to answer any penalty that may be imposed arising from any misrepresentation or failure to state material information in this ENVIRONMENTAL IMPACT STATEMENT REPORT.

In witness whereof, I hereby set my hand this _____ day of _____ 2008 at _____.

_____

GREGORY C. EDWARDS

Managing Director

Greenstone Resources Corporation

SUBSCRIBED AND SWORN TO before me this _____ day of _____ 2008, affiant exhibiting his Community Tax Certificate No. _____ issued at _____ on _____.

Doc. No. _____

Page No. _____

Book No. _____

Series of _____

Annex 8-3.

SWORN STATEMENT OF ACCOUNTABILITY OF PREPARERS

This is to certify that all information in this ENVIRONMENTAL IMPACT STATEMENT REPORT for the **SIANA GOLD PROJECT** is accurate and complete to the best of our knowledge, and that an objective and thorough assessment of the Project was undertaken in accordance with the dictates of professional and reasonable judgment. Should we learn of any information which would make this ENVIRONMENTAL IMPACT STATEMENT REPORT inaccurate, we shall immediately bring the said information to the attention of the DENR-EMB.

We hereby certify that no DENR-EMB personnel was directly involved in the preparation of this **SIANA GOLD PROJECT** REPORT other than to provide procedural and technical advice consistent with the guidelines in the DAO 03-30 Revised Procedural Manual.

We hereby bind ourselves jointly and solidarily to answer any penalty that may be imposed arising from any misrepresentation or failure to state material information in this ENVIRONMENTAL IMPACT STATEMENT REPORT.

In witness whereof, we hereby set our hands this _____ day of _____ 2008 at _____.

	Name	Field of Expertise	Signature
1	Rolando V. Cuaño, Ph.D.	Geology and geohazards Erosion and sediment control Environmental risk assessment Environmental management system	
2	Jose N. Tanchuling	Water quality Project description	
3	Felixberto M. Centeno	Meteorology Air quality and noise Hydrology	
4	Perfecto P. Evangelista, Ph.D.	Soils and erosion Agriculture and land use	
5	Bibiano P. Ranes, Ph.D.	Terrestrial flora and fauna	
6	Carmela P. Española	Terrestrial fauna	
7	Roberto C. Pagulayan, Ph.D.	Freshwater biology	
8	Cesar L. Villanoy, Ph.D.	Hydrodynamics	
9	Marita G. Cuaño	Socio-economics Public health Stakeholder engagement	
10	Nestor T. Castro, Ph.D.	Indigenous people and culture	

SUBSCRIBED AND SWORN TO before me this _____ day of _____ 2008, affiants exhibiting their Community Tax Certificate information, as follows:

	Name	Community Tax Certificate Information		
		CTC No.	Place of Issue	Date of Issue
1	Rolando V. Cuaño, Ph.D.	PASSPORT NO. QQ0914699	MANILA	08/22/05
2	Jose N. Tanchuling	06119180	Manila	6/12/08
3	Felixberto M. Centeno	19652699	Calamba City	1/16/08
4	Perfecto P. Evangelista, Ph.D.			
5	Bibiano P. Ranes, Ph.D.			
6	Carmela P. Española	24149929	Q.C.	04/21/08
7	Roberto C. Pagulayan, Ph.D.	11090698	A.C.	02/19/08
8	Cesar L. Villanoy, Ph.D.	24149469	Q.C.	04/01/08
9	Marita G. Cuaño	PASSPORT NO. QQ0914698	MANILA	08/22/05
10	Nestor T. Castro, Ph.D.	10212042	PASIG	01/22/08

Doc. No. _____
Page No. _____
Book No. _____
Series of _____

Annex 8-4. Proof of public participation

Republic of the Philippines
Department of Environment and Natural Resources
ENVIRONMENTAL MANAGEMENT BUREAU
DENR Compound, Visayas Avenue, Diliman, Quezon City 1116
Telephone Nos.: 925-47-93 to 97
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1st LEVEL SCOPING MEETING for the
PROPOSED SIANA GOLD MINING PROJECT of
GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
09:30 a.m., December 22, 2004
EIA Conference Room, EMB Bldg., DENR Cpd., Visayas Avenue, Diliman, Q.C.

ATTENDANCE SHEET

Name	Office/Contact No.	Signature
[illegible]	EMB/NRE - 926 20 F3	
GREG EDWARDS	GREENSTONE 09196991423	
REY B. ROMONIT	[illegible] 912 2533 [illegible]	
EDWIN D RAMIREZ	MINES & GEOSCIENCES BUREAU 926 [illegible]	
FLORENDA SANTIAGO	DLSU 0917 356 4942	
DAISY SERRANO	EMB - EIARC	
JOSE TANCHULING	BMP	
ROLANDO V. CUARE	BMP	
CARLO P. QUISTORIO	PHILIPS	
V. Flaviano S. Legaspi	EIARC	
ERNESTO B. VILLALUZ	EMB	

Protect the environment...Protect life...

GREENSTONE RESOURCES CORPORATION
Barangay Cawilan, Tubod, Surigao del Norte

FOCUS GROUP DISCUSSION
January 13, 2005
Magpayang, Maimt, Surigao del Norte

NAME	OFFICE/DESIGNATION	ADDRESS	SIGNATURE
1. RICARDO O. MONTAÑO JR.	PUROK 3 PRESIDENT	Magpayang Maimt Surigao	
2. VICTOR A. JACINTO	BRGY. KAGAWAD	MAGPAYANG MAIMT	
3. Mario M. Mendaro	Brgy. Sec.	Magpayang, Maimt	
4. SONIA E. ALCE	BHW.	Magpayang	
5. Arnel Ale	Capo	Magpayang	
6. Fe Q. Pangaya	BIC - Chairman	Magpayang	
7. Magdalena L. dela Peña	Sangguniang Brgy.	Magpayang	
8. Elsie A. Sangkuenga	Brgy. Kagawad	Magpayang	
9. Eufemia Perodeo	Purok Purok	Magpayang	
10. MICHAEL B. AMPARO	Brgy. Kag.	MAGPAYANG	
11. [illegible]	Brgy. Treasurer	Magpayang	
12. Miguel Mahomoc	BFARMC	Magpayang	
13. Alden N. Cacide	BHW/BNS	Magpayang	
14. Conchita Esmeralda		Magpayang	
15. Consuelo Balogo			
16. Ricky Feril	Purok chairman	Magpayang	
17. Gracito D. Montaño	Brgy. Kag.	Magpayang	
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GREENSTONE RESOURCES CORPORATION
Barangay Cawilan, Tubod, Surigao del Norte

FOCUS GROUP DISCUSSION
January 13, 2005
Pongtud Alegria, Surigao del Norte

NAME	OFFICE/DESIGNATION	ADDRESS	SIGNATURE
1 Benedicto E. Ocon	BRGY. KAGAWAD	PONGTUD	
2 Joel I. Omac	Purok Pres. 5	Pongtud	
3 Paul M. [illegible]	" " "	"	
4 [illegible] Jr.	Brgy. Kagawad	Pongtud	
5 FLORENTINO GACINDO JR.	BRGY KAGAWAD	PONGTUD	
6 [illegible]	Senior citizen	Pongtud	
7 Carmelita G. Sedo	P.2 - Pres	Pongtud	
8 Nestor Ortiz	P.3 - Pres	Pongtud	
9 [illegible]	[illegible]	Pongtud	
10 Doel M. [illegible]	Kagawad	Pongtud	
11 Elma I. Comandante	PHC	Pongtud	
12 [illegible]	BDAHMC	Pongtud	
13 Teresita I. [illegible]	AT-III - Pongtud Elem. School	Pongtud	
14 Alexie Boquilon	MGB R13	Surigao city	
15 Marcita P. Tamalak	MGB 13	Surigao City	
16 [illegible] Jr.	Brgy. Secretary	Pongtud	
17 [illegible]	[illegible]	[illegible]	
18 [illegible]	Brgy. Kapitan	Pongtud Alegria SDN	
19 [illegible]	MISFI sec/Treasurer	Pongtud Alegria SDN	
20 [illegible]	Secretary a Women Ass.	Pongtud	
21 Vilma I. Cantaga	IFAD Volunteer	Pongtud	
22 [illegible]	Womens Member	Pongtud	
23 BALTAZAR [illegible]	PUROK 4 PRES. SDN.		
24 [illegible]	Mun. Agriculturist	LGU - ALEGRIA	
25 [illegible]	Brgy. Treasurer	Brgy. Pongtud	

bmp

GREENSTONE RESOURCES CORPORATION

Barangay SIANA MAINIT Surigao del Norte

FOCUS GROUP DISCUSSION

January 14, 2005

Siana, Mainit, Surigao del Norte

NAME	OFFICE/DESIGNATION	ADDRESS	SIGNATURE
1. RAUL M. ALO	BRGY. CAPTAIN	Siana	[illegible]
2. Felicitas L. Bulanon	Brgy. Kagawad	Siana, Mainit SDN	[illegible]
3. RICARDO SALUNGAY	" "	—	[illegible]
4. Domenciano Camboy		—	[illegible]
5. Conrado Canulab	Alerto President	—	[illegible]
6. Jesus Manligues	Chapel President	—	J.M.
7. Ma. Theresa O. Absin	Brgy. Secretary	—	[illegible]
8. Rosario I. Mijares	Purple Pres.		[illegible]
9. Sofronio M. Antonillo	Irrigators Ass.	"	[illegible]
10. ALFREDO DETILO	CFF PRESIDENT		[illegible]
11. Albina S. Catigan	Brgy. Kag.	"	[illegible]
12. ROGELIO NARADIA	BRGY KAG.	"	[illegible]
13. DIOSDADO PATAGAN	BRGY. TANOD	"	[illegible]
14. SALVADOR ODTOJAN	CAL - SIANA	"	[illegible]
15. CARMELITO MANLIGUEZ	Kag. - SIANA	"	[illegible]
16. Perla Sandoval	PDO - I - MSO Surigao City	-do-	[illegible]
17. Chuchi M. Amarille	BHW	Siana	[illegible]
18. Lydia M. Ebuña	Head Teacher - 3	Siana	[illegible]
19. VERONICA D. MANTILLAY	CHAPEL PRES.	SIANA	[illegible]
20. Ricardo Antonio	Farmer	Siana	R.A.
21. Juanito Garcia	Driver	Siana	J.G.
22. Ginger Galve		Siana	G. Galve
23. Esperlita Dolaunt		Siana	[illegible]
24. Jimie Naraja		Siana	[illegible]
25. Virginia M. Taduja		Siana	VMTaduja
26.			
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GREENSTONE RESOURCES CORPORATION
Barangay Cawilan, Tubod, Surigao del Norte

FOCUS GROUP DISCUSSION
January 19, 2005
Dayano, Mainit, Surigao del Norte

NAME	OFFICE/DESIGNATION	ADDRESS	SIGNATURE
1. Pedro P. Dapar	Brgy. President	Dayano	
2. REBECCA L. CDIOJAH	DED.ED	Dayano	
3. Edipolo M. Bautista	Kagawad	DAYANO	
4. Eddie P. Amandam	Kagawad	DAYANO	
5. Evelyn V. Amonoy	B.H.W.	DAYANO	
6. Lucinda V. Fabiosa	Kagawad	Dayano	
7. Gregolo Hagueros	Kagawad	Dayano	
8. Catalina Asoc	E	Dayano	
9. Rodrigo Ochoto	Kagawad	Dayano	
10. Elemita D. Galvia	P.T.A. Pres. Dayano	Dayano	
11. Venancio Naroga Jr.	Dayano Former Brgy	Siana	
12. RONALDO ASOC	KAGAWAD	DAYANO	
13. LETECIA L. SERRANO	Brgy. Treas.	Dayano	
14. Ronnie C. Arnaiz	Brgy. Capt.	Dayano	
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Republic of the Philippines
Department of Environment and Natural Resources
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2nd LEVEL SCOPING MEETING for the
PROPOSED SIANA GOLD MINING PROJECT of
GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
January 15, 2005

ATTENDANCE SHEET

	Name	Residence/Office/Contact No.	Signature
1	[illegible]	FIARC	
2	DAISY SERRANO	FIARC	
3	Edwin D. Ramirez	FIARC	
4	FLORENDA SANTIAGO	DENR	
5	Ernesto Villaluz	EMB - CO	
6	CARLO A. CASTRO	PAWB	
7	[illegible]		
8	[illegible]	S. B. TUBOD, SDN	
9	[illegible]	Barangay Captain Tubod SDN	
10	LAUREL M. GALES	DONONG BARANGAY	
11	ALEJANDRO DAMORE	S.B. MEMBER	
12	William Lamboy	Brgy Capt	
13	JOHNNY K. VILLAPANE	SB MAINIT SDN	
14	ARCHIMEDES NEUTAN	SB - TUBOD, SDN	
15	JOSE G. NADOR JR.	LGU - MAINIT, SDN	
16	LOHITO C. [illegible]	SB - SDN	
17	[illegible]	Brgy	
18	[illegible]	Brgy Kagawad	
19	[illegible]	Brgy Kagawad	
20	Edgardo M. [illegible]	ARV Regional	
21	[illegible]	PROV. KAGAWAD	
22	WILLIE G. ABELLA	LGU	
23	VICENTE MARQUEZ	VICE MAYOR	
24	[illegible]	LGU	
25	[illegible]	—	
26	Angelito [illegible]	LGU - Mainit	
27	[illegible]	—	
28	[illegible]	—	
29	ADRIANO L. JACOBA	BRGY. KAG	
30	Juanito L. Ellar	SB Member	
31	Remegio Lopez	Brgy. Kag.	

Republic of the Philippines
Department of Environment and Natural Resources
ENVIRONMENTAL MANAGEMENT BUREAU
DENR Compound, Visayas Avenue, Diliman, Quezon City 1116
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2nd LEVEL SCOPING MEETING for the PROPOSED SIANA GOLD MINING PROJECT of GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
January 15, 2005

ATTENDANCE SHEET

	Name	Office/Contact No.	Signature
1	ABADAN ALMONDINO	SAN PABLO, TUBOD SDN.	
2	REYNALDO S. DIGAMO	EMB, REGION 13 (3913626)	
3	JESSA LOU S. DE CLARO	EMB - REGION 13	
4	EDWIN A. HOLLMAN	EMB - CARAGA REGION	
5	MIGUEL T. VILLER	EMB - CARAGA	
6	[illegible]	Brgy. Capt. Pongtud Alegria	
7	Daisy O. Malid	Sangguniang Kabataan Pongtud	
8	[illegible]	Brgy Treasurer - Brgy Pongtud	
9	[illegible]	" Kagawad " "	
10	[illegible]	Brgy. Kag. - Brgy. Pongtud	
11	[illegible]	Brgy. Kagawad - Pongtud	
12	[illegible]	" " Pongtud	
13	[illegible]	Brgy. Secretary - Pongtud	
14	[illegible]	Brgy. " Pongtud	
15	[illegible]	Kagawad Pongtud	
16	[illegible]	" "	
17	[illegible]	SK- Chairman	
18	[illegible]	Brgy. Kagawad	
19	TEOFILO A. ALVE	Brgy. Chieftain	
20	ALVIN S. DEGAMUDING	Brgy. Kag.	
21	ERNESTO P. MONTAÑEZ	Brgy. Kag.	
22	[illegible]	Brgy. Tubaon Mayor Jayag	
23	VICENTE G. ARMEO	Brgy. Kag.	
24	CARMELITO C. MANTOCHA	Supervising Sanitation Inspector	
25	[illegible]	Brgy.	
26	[illegible]	Brgy. Secretary	
27	[illegible]	Brgy.	
28	[illegible]	Brgy. Kag.	
29	[illegible]	Barangay	
30	[illegible]	Brgy Dayano Kagawad	
31	[illegible]	Brgy Tubaon SDN	

Protect the environment...Protect life...

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2nd LEVEL SCOPING MEETING for the PROPOSED SIANA GOLD MINING PROJECT of GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
January 15, 2005

ATTENDANCE SHEET

	Name	Residence/Office/Contact No.	Signature
1	FRANCO ODINAR	LGU - ALEGRIA 09185647784	
2	Jesus C. Dale	LGU Alegria	
3	EDILBERTO MARTINEZ	" "	
4	MARIANE CORQUILLA	- do -	
5	ROLANDO S. UGAY	LGU-ALEGRIA	
6	Roldan D. Esma	LGU - Alegria	
7	Rogelio M. Bible	LGU Alegria	
8	RODOLFO NAMANYA	BRGY. KAGAY	
9	RAUL M. AJOC	LGU - SIANA	
10	[illegible], LEONIDES	LGU - TUBOD	
11	NELSON T. DE PEDRO	LGU TUBOD	
12	[illegible]	DENR	
13	Ruben C. [illegible]	DENR, MGB	
14	[illegible]	LGU - mayor	

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2nd LEVEL SCOPING MEETING for the
PROPOSED SIANA GOLD MINING PROJECT of
GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
January 15, 2005

ATTENDANCE SHEET

	Name	Residence/Office/Contact No.	Signature
1.	[illegible]	[illegible]	
2.	[illegible]	[illegible]	
3.	[illegible]	[illegible]	
4.	[illegible]	[illegible]	
5.	[illegible]	[illegible]	

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PROPOSED SIANA GOLD MINING PROJECT of
GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
January 15, 2005

ATTENDANCE SHEET

Name	Residence/Office/Contact No.	Signature
1 Juanita [illegible]	Siana	[signature]
2 Rosario V. [illegible]	Siana	[signature]
3 [illegible]	Siana	[signature]
4 Pelagia [illegible]	Siana	[signature]
5 [illegible]	Siana	[signature]
6 [illegible]	Siana	[signature]
7 [illegible]	Siana	[signature]
8 [illegible]	"	[signature]
9 [illegible] Amarille	Siana	[signature]
10 Maria [illegible]	Siana	[signature]
11 Danilo [illegible]	"	[signature]
12 Alfredo Petilo	PRES. CFF	[signature]
13 Ricardo Salinegay	BRGY KAG	[signature]
14 [illegible]	PRES. [illegible]	[signature]
15 Rosalita G. Amarille	Siana fish cage president	[signature]
16 Nida [illegible]	Siana	[signature]
17 [illegible] Taripe	Siana	[signature]
18 [illegible]		
19 Warlito C. [illegible]	Siana	[signature]
20 [illegible]	Siana	[signature]
21 [illegible]	Siana	[signature]
22 [illegible]	Siana	[signature]
23 [illegible]	Siana	[signature]
Raymond Abrigo	Siana	[signature]

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January 15, 2005

ATTENDANCE SHEET

Name	Residence/Office/Contact No.	Signature
1. Aida J. Garcia	Magpayang	[signature]
2. Fe J. Payang	"	[signature]
3. Concepta Esmeralda		[signature]
4. SONIA E. ALCG	Magpayang	[signature]
5. Antonio Esmeralda		
6. Eugenia Paredes	Magpayang	[signature]
7. Belinda A. Alcg	Magpayang	[signature]
8. [illegible]	[illegible]	[signature]
9. Miguel [illegible]	Magpayang	[signature]
10. Rev. Larry L. Vitor	Timamana, Tubod,	[signature]
11. Ruth P. Vitor	" "	[signature]
12. Jorge P. [illegible]	Mainit Surigao norte	[signature]
13. [illegible]	Mainit Sur [illegible]	[signature]
14. Pedro P. [illegible]	[illegible] Mainit SPN	[signature]
15. [illegible]	Magpayang	[signature]
16. DIONISIO V. [illegible]	" "	[signature]
17. [illegible], Dagon	[illegible]	[signature]
18. [illegible] M. [illegible]	(CAFIA, Ppas)	[signature]
19. Nora S. Pintay	Day Care Worker	[signature]
20. EDGAR P. [illegible]	Tubod, [illegible]	[signature]

bmp

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2nd LEVEL SCOPING MEETING for the
PROPOSED SIANA GOLD MINING PROJECT of
GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
January 15, 2005

ATTENDANCE SHEET

	Name	Residence/Office/Contact No.	Signature
1	Esmeraldo Elfa	Cawilan Brgy President	[illegible]
2	Reynaldo Manite	"	[illegible]
3	Julita Pelimoreo	Land owner Cawilan	[illegible]
4	Marida P Maza	Land owner "	[illegible]
5	Donald Pretan	-do-	[illegible]
6	Felixberto Sumagang	Landowner	[illegible]
7	Ernesto Elumba	Purok Pres	[illegible]
8	[illegible]		[illegible]
9	Andres Moralde	Cawilan Tubod S.D.N.	[illegible]
10	Florita Elsiorra	Cawilan Tubod Surigao del Norte	[illegible]
11	Rolindo Barro	Cawilan Tubod	[illegible]
12	Rachel Sapalgo	Cawilan Tubod	[illegible]
13	Marcial Cardenas	Cawilan, Tubod	[illegible]
14	Rolando Morit	Cawilan Tubod	[illegible]
15	Allan Gozano	" "	[illegible]
16	Orlando Garcia	Siana	[illegible]
17	Alfonso Gonzaga	Cawilan Tubod	[illegible]
18	Ben Sipulan	Cawilan	[illegible]
19	Jose Barro	Cawilan	[illegible]
20	Jose Medina	Cawilan	[illegible]
21	[illegible]	Cawilan Tubod	[illegible]
22	[illegible]	" "	[illegible]
23	Lucia Dagan	" "	L. Dagan
24	[illegible]	"	[illegible]
25	[illegible]		[illegible]
26	[illegible] Dalangan		[illegible]
27	Bonifacio Minicol		[illegible]
28	Rico Banao	Cawilan, Tubod	[illegible]
29	Randel Banate	Cawilan, Tubod	[illegible]
30	Ventura Arderon	" "	[illegible]
31	Morales, Juvan	" "	[illegible]

ENVIRONMENTAL MANAGEMENT BUREAU

2ND LEVEL SCOPING MEETING
PROPOSED SIANA GOLD MINING PROJECT
GREENSTONE RESOURCES CORPORATION
January 16, 2009

ATTENDANCE SHEET

Name	Residence/Office/Contact No.	Signature
JESUS [illegible]	CAWAYAN	
JOEL ELSURA	CAWAYAN	
ROGELIO [illegible]	CAWAYAN	
[illegible]	"	
RICHARD ELSURA	CAWAYAN	
JOEL MORE	CAWAYAN	
[illegible]	CAWAYAN	
EDGARDO [illegible]	CAWAYAN	
[illegible]	CAWAYAN	
[illegible]	CAWAYAN	
[illegible]	CAWAYAN	
[illegible]	CAWAYAN	
[illegible]	CAWAYAN	

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TUBOD

TUBOD

2nd LEVEL SCOPING MEETING for the
PROPOSED SIANA GOLD MINING PROJECT of
GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
January 15, 2005

ATTENDANCE SHEET

Name	Residence/Office/Contact No.	Signature
[illegible] Pacatang	Tubod Surigao del Norte	

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2nd LEVEL SCOPING MEETING for the
PROPOSED SIANA GOLD MINING PROJECT of
GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
January 15, 2005

ATTENDANCE SHEET

Name	Residence/Office/Contact No.	Signature
RICARDO C. [illegible]	[illegible] MAINIT SURIGAO [illegible]	

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January 15, 2005

ATTENDANCE SHEET

	Name	Residence/Office/Contact No.	Signature
1.	GREG EDWARDS	SURIGAO 0919 699 6423	
2.	LANCE GOUEY	SURIGAO/PERTH	
3.	REY B. GOMONIT	TUBOD, SURIGAO del NORTE	
4.	BERNIE GONZALES	SURIGAO CITY	
5.	Alan Willis	12/28 Col. 056 Pa. 7th Wa	
6.	[illegible]	QUEZON CITY	
7.	ANNA MARIE PEDAMON	DAYANG, MAINIT, SDN	
8.	BRGY. CAPACAN	SIANA, MAINIT, SDN	
9.	BERRY A. SUMAID	Surigao	
10.	[illegible]	[illegible]	
11.	[illegible]	Magpayang Mainit SDN	
12.	NICK MORECINDEZ	SIANA, Mainit SDN	
13.	[illegible]	[illegible]	
14.	LUIS TAGUPE	SIANA MAINIT SDN.	
15.	[illegible]	SIANA MAINIT SDN	
16.	[illegible]		
17.	G. TUDIO	SIANA MAINIT SDN	
18.	RICKY P. [illegible]	GRC	
19.	JOEL C. MORIL	CAMILAN TUBOD SDN	
20.	RICARDO MACHACE	CAMILAN TUBOD	

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2nd LEVEL SCOPING MEETING for the
PROPOSED SIANA GOLD MINING PROJECT of
GREENSTONE RESOURCES CORPORATION in Mainit, Surigao del Norte
January 15, 2005

ATTENDANCE SHEET

	Name	Residence/Office/Contact No.	Signature
1.	JOSE N. Tanchuling	BMP	
2.	[illegible]	EMB - GC	
3.	[illegible]		
4.	MARIETTA EFREN		
5.	Ma. Fe Sotomil	BMP	
6.	R.V. Cuenta	BMP	
	M.G. Cuenta	BMP	

GREENSTONE RESOURCES CORPORATION
Barangay Cawilan, Tubod, Surigao del Norte

FOCUS GROUP DISCUSSION
January 14, 2005
Cawilan, Tubod, Surigao del Norte

NAME	OFFICE/DESIGNATION	ADDRESS	SIGNATURE
1. Virgilio H. Elaique	Brgy Kagawad	Cawilan, Tubod	
2. Marcelo Morgado	LML	//	
3. Bonifacio Papas		//	
4. Mario Caballer	Purok Pres	//	
5. Ernesto Elumbaog	Purok Pres	//	
6. Reynaldo Juanite	Brgy. KAG	//	
7. Mario S. Monta	KAG.	//	
8. Rosalina S. Papas	Purok Pres.	//	
9. Mercedita C. Albino	T-H (TIC)	Cawilan, Tubod	
10. John C. [illegible]	Brgy. Treasurer	Cawilan, Tubod, SDN	
11. [illegible] P. [illegible]	BKK President	//	
12. Fernando [illegible]	[illegible]	[illegible]	
13. Pacatang, J.M.	(CAFIA Pres)	Cawilan	
14. Remegio P. Lopez	Brgy Kagawad	Cawilan, Tubod	
15. Vilma D. [illegible]	Gen. PTA President	Cawilan, Tubod	
16. Benito Fabian			Fabian

Greenstone Resources Corp.

05806 Nanang Street, Villa Corito Sub Div.,
Surigao City, Republic of the Philippines

Telephone: +63 86 826 2510
Facsimile: +63 86 826 1286

Meeting : INFORMATION EDUCATION CAMPAIGN
Purpose : INFORMATION DRIVE
Date : April 16, 2005
Venue : Magpayang Public Market
Time : 8:00 AM

No.	Names	Signature
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Greenstone Resources Corp.

05896 Nonong Street, Villa Corita Sub Div.,
Surigao City, Republic of the Philippines

Telephone: +63 86 826 2510
Facsimile: +63 86 826 1286

Meeting : INFORMATION EDUCATION CAMPAIGN
Purpose : INFORMATION DRIVE
Date : April 16, 2005
Venue : Siana Multipurpose Hall
Time : 2:00 PM

No.	Names	Signature
1	DANILO A. MAQUILAN	
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Greenstone Resources Corp.

05886 Nonong Street, Villa Corris Sub Div.,
Surigao City, Republic of the Philippines

Telephone: +63 86 826 2510
Facsimile: +63 86 826 1286

Meeting : INFORMATION EDUCATION CAMPAIGN
Purpose : INFORMATION DRIVE
Date : April 17, 2005
Venue : Dayano Multipurpose Hall
Time : 1:00 PM

No.	Names	Signature
1		
2	Angling Estate	
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Greenstone Resources Corp.

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Facsimile: +63 86 826 1286

Meeting : INFORMATION EDUCATION CAMPAIGN

Purpose : INFORMATION DRIVE

Date : April 27, 2005

Venue : Del Rosario Multipurpose Hall

Time : 1:00 PM

No.	Names	Signature
1	Marilyn	
2	FEE [illegible]	
3	[illegible]	
4	[illegible]	
5	[illegible]	
6	Lynda [illegible]	
7	JOFRONIO ORTA	
8	[illegible]	
9	[illegible]	
10	[illegible]	
11	Amor [illegible]	
12	[illegible]	
13	[illegible]	
14	[illegible]	
15	Geruine Quiban	
16	[illegible]	
17	Rosalina C. Ajo	
18	Charlita A. [illegible]	
19	[illegible]	
20	JOSEPHINE I. [illegible]	
21.	[illegible]	
22.	RONALD G. ESMERALDA	
23.	FRANCHITA N. NAGAS	
24.	[illegible]	
25.	[illegible]	
26.	Ma. Fe G. [illegible]	
27.	[illegible]	
28.	EDILBERTO CAPILI JR.	
29.	Emer L. Dano	
30.	SUGUI, DANIW P.	

GREENSTONE RESOURCES CORPORATION

Focus Group Discussion on the Siana Gold Project

Venue: KAPIHAN SA MAINIT, Mainit, SDN

REVIEW COMMITTEE

	Name	Organization	Designation	Signature
1	BIEN SANTIAGO	EIA Rev Com	Upland Farmers	
2	DAVID MANUEL	EIA Rev Com	Emp- DENR RLC	
3	Antonio Cacanding	EMB	REV COM	
4	MARK R. SALLAN	EMB	EMB Law Unit	
5	GREG EDWARDS	GRC	MD	
6	LANCE GOVEY	GRC	DIRECTOR - Technical	
7	EDWIN A. MOLLANEDA	EMB-CARAGA	FOCAL PERSON FOR FORESTS	
8	DARY SERRANO	EIA REVCOM	REVCOM	
9				
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GREENSTONE RESOURCES CORPORATION

Focus Group Discussion on the Siana Gold Project

April 24, 2008

Time: [illegible]

Venue: KAPIHAN SA MAINIT, Mainit, SDN

Name	Organization	Designation	Signature
1 EUNICE P. CINCO	GREENSTONE RESOURCES CORP.	Company Nurse	[signature]
2 BEBIE JEAN CORIMATE	GREENSTONE RESOURCES CORP.	DATA ENCODER	[signature]
3 [illegible] B. GONGALIT	"	BRGY. WORKER	[signature]
4 RICKY P. COLARIT	"	COM. LIAISON OFFICER	[signature]
5 MARNIC P. ORZUZ[illegible]		Dayano Brgy. Captain	[signature]
6 WINNIDA V. FABIOLA		DAYANO Brgy. Kagawad	[signature]
7 Editha M. Ocfrafe		Dayano Brgy. Kagawad	[signature]
8 Eddie P. [illegible]		Dayano BRGY. Kagawad	[signature]
9 [illegible] A. Peñaflor		Dayano Brgy. Kagawad	[signature]
10 Marvin B. Lambot		Dayano SK Chairman	[signature]
11 [illegible] L. SERRANO	"	- do -	[signature]
12 ARIEL D. OBREJAN	"	Siana SK Chairman	[signature]
13 Ma. Teresa D. Abuk	"	Brgy. - Secretary	[signature]
14 GAUDENCIO A. MANLIGUEZ	"	BRGY. CAPTAIN	[signature]
15 [illegible] Pagapong	"	" Kagawad	[signature]
16 [illegible] M. Cabajan	"	BRGY. TREAS.	[signature]
17 [illegible] B. [illegible]	"	BRGY. KAGAWAD	[signature]
18 RANDY L. ODYINA	"	BRGY. - KAGAWAD	[signature]
19 DIOSDAN U. PATACAN	"	BRGY. KAGAWAD	[signature]
20 Virgilio H. Escleria	LGU - Cawilan	" "	[signature]
21 Bernadith S. Sanchez	LGU - CAWILAN	" "	[signature]
22 [illegible] C. Sumagang	LGU - Cawilan	" Treasurer	[signature]
23 REYNALDO C. [illegible]	"	Brgy. CAPT.	[signature]
24 Romegio P. Lopez	N G O	CARBA TREAS.	[signature]
25 Nancy B. Seda	LGU - CAWILAN	Brgy. Kagawad	[signature]

GREENSTONE RESOURCES CORPORATION

Focus Group Discussion on the Siana Gold Project

[illegible]

[illegible]

Venue: KAPIHAN SA MAINIT, Mainit, SDN

Name	Organization	Designation	Signature
1 Delfin T. [illegible]	Greenstone Resources Corp.	Security officer	[signature]
2 [illegible] P. [illegible]	LGU Cawilan	Brgy Kagawad	[signature]
3 [illegible] M. [illegible]	" [illegible]	Brgy Kagawad	[signature]
4 [illegible] M. [illegible]	" [illegible]	Brgy Kagawad	[signature]
5 Reynaldo P. [illegible]	GRC	Brgy Kagawad	[signature]
6 Dante M. Tabo	LGU Tubod	P.B.	[signature]
7 [illegible] E. [illegible]	[illegible]	[illegible]	[signature]
8 Fe S. [illegible]	LGU Cawilan	Brgy. Secretary	[signature]
9 Albino [illegible]	LGU "	Tanod	[signature]
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GREENSTONE RESOURCES CORPORATION

Focus Group Discussion on the Siana Gold Project

[illegible]

[illegible]

Venue: KAPIHAN SA MAINIT, Mainit, SDN

Name	Organization	Designation	Signature
1 Cresencio O. Bupa	Irrigator - DAYANO		[illegible]
2 RENIE FABIOSA	DAYANO FARMERS ASSN	AUDITOR	[illegible]
3 Junita S. Lambot	DFA (Womens) - DAYANO	member	Lambot
4 Mary Ann G. Perezplan	DFA / WOMENS - DAYANO	Treas. + Sec.	[illegible]
5 Marilou P. Diola	BHW - DAYANO		MPDiola
6 Thelma P. Aviola	Womens - DAYANO	Member	T.P. Aviola
7 Monica C. Esparola	DFA / Womens - DAYANO		[illegible]
8 Ninconia B. Cantrillas	Irrigator - DAYANO	Secretary	[illegible]
9 Alfredo C. Mosqueto	Farmer - DAYANO	Vice	[illegible]
10 Jobinsiana N. Miranda	Womens - DAYANO	BNS	[illegible]
11 Virginia H. Navarrette	Womens - DAYANO	Kalihim	[illegible]
12 Rodrigo E. Odalte	Pres. Catholic Parish	President	[illegible]
13 [illegible] P. Montegudo	KMKK Pres. - SIANA	Pres.	[illegible]
14 Carlos P. Cajora	KMKK Coord. - SIANA		
15 Pamela P. Tarayo	KMKK Aud. - SIANA		[illegible]
16 Rosita D. Acclay	KMKK - SIANA		[illegible]
17 Nicolas L. Baldera	BNS - Siana (Mining) Womens	President S.C.	[illegible]
18 Cayeda Ibarra	Irrigator - Siana	Member	Pedong
19 Isabel R. Garcia	C. [illegible] - SIANA		[illegible]
20 Chichi M. Amarille	BHW - WOMENS - SIANA	BHW	[illegible]
21 Dominga Lambo	Farmers - SIANA		[illegible]
22 Emelita E. Lozada	BHW - SIANA	BHW	[illegible]
23 Violeta B. Jamile	BHW - SIANA	BHW	[illegible]
24 Adelinda L. Cuyapu	KMKK - SIANA		[illegible]
25 Helen B. [illegible]	KMKK - SIANA		[illegible]

GREENSTONE RESOURCES CORPORATION

Focus Group Discussion on the Siana Gold Project

April 24, 2008

Time: 2:00 pm

Venue: KAPIHAN SA MAINIT, Mainit, SDN

Name	Organization	Designation	Signature
1 SERGIO AJOC	Senior Citizen - SIANA		[illegible]
2 EDUINA FRANKLIN	FARMER - SIANA		[illegible]
3 TEOFILO DENATER	Farmer - DATANO		[illegible]
4 Rustica Obao	Sr. Citizen - SIANA		R. Obao
5 Emily V. Caballero	BHW - CAWILAN		[illegible]
6 Natividad d. Caballero	Sec. Treas. Sr. Citizen - CAWILAN		[illegible]
7 Elisenia Flor	CVO - CAWILAN		[illegible]
8 Roger C. Kashiram	CVO - CAWILAN		[illegible]
9 RANDY L. ODYINA	V-PRES. IRRIGATION - SIANA		[illegible]
10 Paz J. Odjuit	Sr. Senior Citizen - SIANA		[illegible]
11 [illegible]	Senior Citizen - SIANA		[illegible]
12 Evelyn Y. Omenicio	BHW - DATANO		Omenicio
13 Merlita O. Gofinda	PLD. Women - DATANO		[illegible]
14 Annete P. Paguera	Muse Women - DATANO		[illegible]
15 Marilyn J. Pared	Sec - Youth - DATANO		[illegible]
16 MARIA B. AJOC	Women - SIANA		[illegible]
17 Resie Joy B. Ajoc	V-Pres. Youth - DATANO		[illegible]
18 Karen Jane B. Ibac	Treas. Youth - DATANO		B. Ibac
19 Lilibeth P. Dopar	Auditor Youth - DATANO		Dapar
20 SALVADOR A. COTOJAN	Treas. - SIANA IRRIGATION - SIANA		[illegible]
21 Vanessa Parangon	Pres. Youth - DATANO		Parangon
22 William Mardam	Sgt. @ arms Youth - DATANO		W. Mardam
23 Prenda Joy B. Ajiz	Sec - Women - DATANO		[illegible]
24 Elenita D. Gatavia	Vice Pres. Women Assn. Farmers - DATANO		[illegible]
25 Evelyn P. Contrider	BHW - DATANO		[illegible]

GREENSTONE RESOURCES CORPORATION

Focus Group Discussion on the Siana Gold Project

April 24, 2007

Time: 2:00 pm

Venue: KAPIHAN SA MAINIT, Mainit, SDN

	Name	Organization	Designation	Signature
51	1 Joel M. Pacatang	CAFIA - CAWILAN	President	
52	2 Prudencia L. Tegomen	CAFIA - CAWILAN	Treasurer	
53	3 WILMA O. LEANO	BHW - CAWILAN	BHW	
54	4 Simon A. Barrios Jr.	LGU (C.V.O.) - CAWILAN	Brgy Tanod	
55	5 Felix V. Nieves	LGU - CAWILAN	Sp. Chairman	
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Annex 8-5. Baseline study support information

Table 8-1. Laboratory results of sediment sampling

Station	Cu ppm	Cd ppm	Ni ppm	Ag ppm	Zn ppm	Hg ppm	Cr ppm	Pb ppm	As ppm	Sb ppm
MAGPAYANG RIVER										
Upslope										
• Timamana	31	<0.02			44	0.25		9.5	0.93	
• Stn 3	26	<1	30	<1	27	<0.12	24	<10	<0.1	<1
• STA 2	63	<1			74	0.11		<10	7	
Spanish Ditch										
• STA 3	145	<1			107	0.27		19	27	
• Stn 4	49	<1	<5	<1	44	<0.12	2	4.7	0.038	49.4
Facility										
• TD1	197	1			754	19.49		425	264	
• TD2	224	3			1371	12.89		1525	233	
• TD3	184	3			912	5.83		725	244	
• WD1	152	<1			208	0.65		142	20	
• WD2	117	<1			108	0.34		46	55	
• WD3	62	<1			251	0.71		43	51	
Immediately downslope										
• STA 4	96	<1			80	0.13		<10	15	
• Stn 8	36	<1	<5	<1	36	<0.12	18	<10	<0.1	<1
• Stn 9	22	<1	43	<1	31	<0.12	20	<10	<0.1	<1
DAYANO RIVER										
Upslope										
• Stn 12	115	<1	<5	<1	62	<0.12	10	<10	<0.1	<1
Facility										
• OP1	156	<1			196	0.41		76	83	
• Pit										

Station	Cu ppm	Cd ppm	Ni ppm	Ag ppm	Zn ppm	Hg ppm	Cr ppm	Pb ppm	As ppm	Sb ppm
Downslope										
• Stn 2	87	<1	<5	<1	113	<0.12	2	<10	<0.1	<1
• STA 1	118	<1			131	0.71		82	49	
MAGPAYANG RIVER										
Downslope of Dayano River confluence										
• Stn 10	31.5	<1	20.8	<1	297	<0.12	9.7	45.6	0.03	<1
• Magpayang	29	0.50			122	0.15		40	0.57	
LAKE MAINIT										
• Lake										
• Sta 3	24	<0.02			36	0.12		6.4	0.14	
• Sta 4	17	<0.02			37	0.11		<0.06	0.38	
• Sta 2	65	<0.02			133	0.15		<0.06	0.37	

NOTES:

1. The results are lifted from various sampling episodes listed in Table 4-3.
2. The locations of the sampling stations are shown in Figure 4-18.
3. For the stations which were sampled more than once, the mean value is reported.

Table 8-2. Auger boring observations

Auger Boring Observation No. 1	
Location: Barangay Dayano, Mainit Coordinates: N 09° 32' 08.9" E 125° 31' 15.6"	
Slope:	28%
Land Use:	Coconut with Santol trees
Depth(cms)	**Description**
0-10	Dark brown (7.5 yr. 4/4) moist, clay, slightly sticky, slightly plastic, friable.
10-50	Yellowish red (5 yr 5/8) moist clay, slightly sticky, slightly plastic, friable.
50-100	Yellowish red (5 yr 5/8) moist, clay, slightly sticky, slightly plastic, friable, many soft weathered red (10R 4/6) rock fragments.
100-120	Strong brown (7.5 YR 5/6) moist, clay, slightly sticky, slightly plastic, friable with soft weathered yellowish brown (10 YR 5/4) rock fragments.
Auger Boring Observation No. 2	
Location: Barangay Cawilan Tubod Coordinates: N 09° 33' 08.9" E 125° 31' 15.6"	
Slope:	36%
Vegetation/Land Use:	Limestone forest (Molave type forest with wild banana and bamboo)
Depth(cms)	**Description**
0-15	Yellowish brown (10 YR. 5/4) moist, loam, non-sticky, non-plastic friable.
15-60	Reddish yellow (7.5 YR 6/8) moist, clay, sticky, plastic, slightly firm with common soft and hard limestone fragment.
60-120	Variegated brownish yellow (10 YR 6/8) and brown (10 YR 4/3 moist, clay, sticky, plastic, slightly firm, few hard small limestone.
Note: Many limestone outcrops on the slope surface.	
Auger Boring Observation No. 3	
Location: Barangay Cawilan Tubod Coordinates: N 09° 33' 11.1" E 125° 34.2' 25.5"	
Slope:	1%
Land Use:	Coconut with Rainfed Rice
Depth(cms)	**Description**
0-18	Brown (10 YR. 4/3) and Olive gray (5Y 4/2) moist, silty clay loam; slightly firm; many fine distinct clear yellowish red (5YR 4/6) mottles
18-70	Brown (10 YR 4/3) moist, clay, sticky, plastic and firm.
70-120	Brown (10 YR 4/3) moist, clay, sticky, plastic, firm, few soft and hard spherical Fe-Mn concretion.
Auger Boring Observation No. 4	
Location: Barangay San Pablo, Tubod Coordinates: N 09° 33' 06.4" E 125° 30.4' 46.5"	
Slope:	10%
Land Use:	Coconut

Depth(cms)	Description
0-15	Brown (10 YR. 4/3) moist, clay, slightly sticky, slightly plastic, slightly firm.
15-100	Reddish yellow (7.5 YR 6/6) moist, clay, slightly sticky, slightly plastic firm.
100-120	Reddish yellow (7.5 TR 6/6) moist, clay, slightly sticky, slightly plastic, firm; with common soft and hard yellowish red 5 YR 4/6) weathered rock fragments.
Auger Boring Observation No. 5	
Location: Barangay Magpayang, Mainit Coordinates: N 09° 31' 57.9" E 125° 33' 43.0"	
Slope:	<1%
Land Use:	Irrigated Paddy Rice
Depth(cms)	**Description**
0-20	Dark gray (10 YR. 4/1) wet, clay loam; non-sticky, non-plastic, friable; many fine and medium distinct clear strong brown (7.5 YR 5/6) slightly mottles.
20-65	Very dark gray (7.5 YR N3) moist, clay loam, slightly sticky, slightly plastic, firm.
65-120	Variegated grayish brown (10 YR 5/2) and light olive brown (2.5 Y 5/4) moist, clay, sticky, plastic, firm.
Note: Many Golden Kuhol (snails) on the surface.	
Auger Boring Observation No. 6	
Location: Barangay Siana, Mainit Coordinates: N 09° 32' 18.4" E 125° 33' 59.6"	
Slope:	<1%
Land Use:	Irrigated Paddy Rice
Depth(cms)	**Description**
0-15	Gray (10 YR. 5/1) wet, clay loam; non-sticky, non-plastic, slightly firm; many fine distinct clear strong brown (7.5 YR 4/6) mottles.
15-75	Yellowish brown (10 YR 5/4 moist, clay; sticky, plastic, firm.
75-120	Variegated brown (10 YR 5/3) and strong brown, (7.5 Y 4/6) moist, clay, sticky, plastic, firm.
Auger Boring Observation No. 7	
Location: Barangay San Pablo, Tubod Coordinates: N 09° 33' 06.6" E 125° 33' 59.2"	
Slope:	<1%
Land Use:	Irrigated Paddy Rice
Depth(cms)	**Description**
0-18	Gray (10 YR. 5/1) wet; clay loam; non-sticky, non-plastic, friable; common fine diffuse clear light olive brown (2.5 Y 5/4) mottles.
18-80	Gray (10 YR 5/1) moist, clay, slightly sticky, slightly plastic, firm.
80-90	Greenish gray (5 BG 5/1) moist, sandy clay, sticky, plastic, firm.
90-120	Variegated gray (10 YR 5/1) and strong brown (7.5 YR 4/6) moist, clay, sticky, plastic very firm; many soft and hard spherical limestone fragments.

Table 8-3. Results of soil laboratory analyses

Soil Properties	Soils of the Upland			Soils of the Lowland			
	Observation 1 Brgy. Dayano	Observation 2 Brgy. Cawilan	Observation 4 Brgy. San Pablo	Observation 3 Brgy. Cawilan	Observation 5 Brgy. Magpayang	Observation 6 Brgy. Siana	Observation 7 Brgy. San Pablo
Physical Properties Drainage	Well drained	Well drained	Well drained	Moderately well drained	Poorly drained	Poorly drained	Poorly drained
Slope (%)	28	36	10	1	<1	<1	<1
Texture	Clay	Loam over clay	Clay	Silty clay loam over clay	Clay loam	Clay loam over clay	Clay loam over clay
Soil depth (cm)	>100	>100	>100	>100	>100	>100	>100
Chemical Properties pH	4.8	5.5	4.7	5.7	5.4	5.7	5.3
Organic Matter (%)	2.63	2.15	2.85	2.88	3.63	2.78	3.12
Phosphorus (mg/kg)	0.51	7.36	0.98	52.5	35.7	57.1	15.1
Exch. Potassium (cmol/l)	0.26	0.29	0.44	0.49	0.39	0.43	0.48
Cation Exch. Capacity (cmol/l)	39.22	28.79	44.82	41.04	39.55	41.5	39.12
Base Saturation %	25.92	59.74	36.4	69.85	72.78	68.04	64.19
Zinc (mg/kg)	0.32	0.79	0.45	2.08	12.3	2.32	2.18
Copper (mg/kg)	0.25	1.13	0.11	3.52	5.55	3.75	4.13
Iron (mg/kg)	9	51	28	134	196	147	160
Manganese (mg/kg)	67	63	15	49	71	34	68

Note: The locations of the soil stations are shown in Figure 4-12.

Table 8-4. Environmental requirements of selected plants

Plant	Slope (%)	Soil Depth (cm)	Drainage	Soil pH	Soil Texture	Soil Fertility
Agoho	0 - >50	> 75	Moderately well to well drained	5.0–7.5	Loamy to clay	Low to medium
Mahogany	0 - >50	> 75	Moderately well to well drained	5.0–7.5	Loamy to clayey	Low to medium
Vetiver	0 - >50	> 50	Moderately well to well drained	4.0–8.0	Sandy loam to clay loam	Low to medium
Coconut	0–30	> 75	Moderately well to well drained	6.0–7.5	Sandy loam to clay loam	Medium
Lanzones/ Rambutan	0 -30	100	Moderately well to well drained	4.5 -6.5	Loamy to clayey	Medium
Citrus, Mandarin	0–30	> 75	Moderately well to well drained	3.5- 8.0	Loamy to clayey	Medium
Malungay	0–30	> 50	Moderately well to well drained	5.0–7.0	Loamy to clayey	Low to high
Banana	0–18	> 75	Moderately well to well drained	5.0–7.0	Sandy loam to clay loam	Medium
Pineapple	0-30	50	Moderately well	4.5-5.5	Sandy loam to clay loam	Low to medium
Peanut	0– 8	50	Well drained	5.8–6.2	Sandy loam to clay loam	Low to medium
Corn	0– 8	> 75	Moderately well to well drained	5.0–7.0	Sandy loam to clay loam	Medium to high
Coffee	0–30	> 75	Well drained	4.5–6.5	Loamy to Clayey	Medium
Cacao	0–30	> 75	Well drained	5.5–7.0	Loamy to Clayey	Medium
Gabi, (upland)	0-18	50	Well drained	5.5-7.0	Clay loam to structured clay	Low to medium
Monggo	0-8	30	Well drained to somewhat poorly drained	5.8-6.2	Sandy loam to clay loam	Medium
Ginger	0-18	50	Moderately well drained	5.5-6.5	Sandy loam to clay loam	Medium
Arrowroot	0-18	50	Moderately well drained	5.5-6.5	Sandy loam to clay loam	Medium
Paddy rice	0-3	50	Somewhat poorly drained to poorly drained	5.5-7.0	Sandy clay loam to clay	Medium

Table 8-5. Qualitative suitability classification

Plant	Soils of the Upland			Soils of the Lowland			
	Obsv. 1 Brgy. Dayano	Obsrv 2 Brgy. Cawilan	Obsrv 4 Brgy. San Pablo	Obsrv Brgy. Cawilan	Obsrv 5 Brgy. Magpayang	Obsrv 6 Brgy. Siana	Obsrv 7 Brgy. San Pablo
Agoho	S	NS	S	S	NS	NS	NS
Mahogany	S	NS	S	S	NS	NS	NS
Vetiver	S	NS	S	S	NS	NS	NS
Coconut	S*	NS	S*	S	NS	NS	NS

Plant	Soils of the Upland			Soils of the Lowland			
	Obsv. 1 Brgy. Dayano	Obsrv 2 Brgy. Cawilan	Obsrv 4 Brgy. San Pablo	Obsrv Brgy. Cawilan	Obsrv 5 Brgy. Magpayang	Obsrv 6 Brgy. Siana	Obsrv 7 Brgy. San Pablo
Lanzones/Rambutan	S*	NS	S*	S	NS	NS	NS
Citrus, Mandarin	S*	NS	S*	S	NS	NS	NS
Malungay	S*	NS	S*	S	NS	NS	NS
Banana	S*	NS	S*	S	NS	NS	NS
Pineapple	S*	NS	S*	S	NS	NS	NS
Peanut	NS	NS	NS	S	NS	NS	NS
Corn	NS	NS	NS	S	S**	S**	S**
Coffee	S*	NS	S*	S	NS	NS	NS
Cacao	S*	NS	S*	S	Ns	Ns	NS
Gabi (Upland)	NS	NS	S*	S	NS	NS	NS
Monggo	NS	NS	NS	S	S**	S**	S**
Ginger	NS	NS	S*	S*	NS	NS	NS
Arrowroot	NS	NS	S*	S	NS	NS	NS
Paddy rice	NS	NS	NS	S	S	S	S

Notes: S – suitable
* - suitable but with very low P and Zn as limitations
** - suitable but with drainage as limitation; crops can be used as catch crop or green manure
NS – not suitable

Table 8-6. Floral species observed in 2005

Family/Common Name	Scientific Name	Uses
Forest tree species		
A. ULMACEAE		
1. Anabiong	*Trema Orientales*	Fuel wood
B. MORACEAE		
1. Antipolo	*Artocarpus blancoi*	Source of food and lumber
2. Himbabao	*Broussonetia luzonica*	Food and tool handle
3. Upli	*Ficus ampelas*	Fruits and food for birds
4. Hagimit	*F. minahassae*	Fruits and food for birds
5. Tibig	*F. nota*	Fruits and food for birds
6. Hauili	*F. Septica*	Fruits and food for birds
7. Niog-niogan	*F. pseudopalma*	Fruits and food for birds
8. Dungo	*F. Fubinervis*	Fruits and food for birds
9. Basikong kalawang	*F. Botryocarpa*	Fruits and food for birds
10. Kalulot	*Artocarpus Rubrevenia*	Lumber
11. Rimas	*A. Altilis*	Source of food and lumber
C. TILIACEAE		
1. Balobo	*Diplodiscus paniculatus*	Source of food and lumber
2. Anilau	*Colona Serratifolia*	Fuel wood
D. MIMOSACEAE		
1. Giant Ipil-ipil	*Leucaena leucocephala*	Fuel wood
2. Akle	*Serialbizia acle*	Lumber

Family/Common Name	Scientific Name	Uses
E. FABACEAE		
1. Dapdap	*Erythrina orientalis*	
2. Narra (smooth)	*Pterocarpus indicus*	
F. LYTHRACEAE		
1. Banaba	*Lagerstroemia speciosa*	Medicinal purposes and lumber
G. MYRTACEAE		
1. Guava	*Psidium guajava*	Food and tool handle
2. Duhat	*Syzygium cumini*	Food and lumber
H. EUPHORBIACEAE		
1. Binayuyu	*Antidesma ghaesembilla*	Fruit for birds and fuel wood
		Chop stick
2. Hamindang	*Macaranga bicolor*	Fruit for birds and chop stick
3. Binunga	*M. tanarius*	
I. SAPINDACEAE		
1. Malugai	*Pometia pinnata*	Lumber
J. MELIACEAE		
1. Mahogany	*Swietenia macrophylla*	Lumber
K. ANACARDIACEAE		
1. Balinghasai	*Buchanania Arborescens*	Lumber
L. APOLYNACEAE		
1. Batino	*Alstonia macrophylla*	Lumber
2. Dita	*A. scholaris*	Lumber
M. VERBENACEAE		
1. Gmelina	*Gmelina arborea*	Lumber
2. Alagau	*Premna odorata*	Fruit for birds and fuel wood
3. Molave	*Vitex parviflora*	Lumber
N. EHRETIACEAE		
1. Anonang	*Cordia dichotoma*	Fuel wood
O. URTICACEAE		
1. Dalunot	*Pipturus Arborescen*	Sapling for house construction
P. ANNONACEAE		
1. Ilang-ilang	*Cananga odorata*	Perfume and lumber
Q. LAURACEAE		
1. Puso -puso	*Neolistsea vidalii*	Lumber (post)
R. CAESALPINIACEAE		
1. Sachoan	*Cassia Javanica*	Fuel wood
S. BURSERACEAE		
1. Pagsahingin	*Canarium Asperum*	Lumber
T. LEEACEAE		
1. Kaliantan	*Lega philippinensis*	Fruits for bird
2. Amamali	*L. aculeata*	Fruits
U. RUBIACEAE		
1. Malakape	*Canthium diococcum*	fuel wood
2. Kahoy dalaga	*Mussaenda philippica*	Ornamental
3. Bangkal	*Nauclea orientales*	Furniture

Family/Common Name	Scientific Name	Uses
4. Wisak	*Neonauclea media*	Fuel wood
5. Nino	*morinda bracteata*	Fuel wood
V. BIGNONIACEAE		
1. Pingkapinkahan	*Oroxylum indicum*	
2. Banai-banai	*Rodermachera dinnata*	
3. African tulip	*Spathodea campanulata*	
W. STERCULIA		
1. Dungoa	*Hertiera littoralis*	Lumber
2. Tan-ag	*Kleinhovia hospita*	Lumber
3. Bayog	*Pterospernum Diversifolium*	Fuel wood
X. DILLENIACEAE		
1. Malakatmon	*Dillenia indica*	Lumber
2. Katmon kalabaw	*D. suffruticosa*	
Y. COMBRETACEAE		
1. Makalumpit	*Terminalia calamansanai*	Lumber
2. Talisai	*T. catappa*	
Z. ARALIACEAE		
1. Malapapaya	*Polyscias nodosa*	Lumber and veneer
Introduced fruit trees		
A. MORACEAE		
1. Nangka	*Artocarpus blancoi*	Food
B. MYTACEAE		
1. Guava	*Psidium guajava*	Food
2. Duhat	*Syzygium cumini*	
C. ANACARDIACEAE		
1. Mango	*Mangifera indica*	Food
D. RUBIACEAE		
1. Kape	*Coffea sp.*	Beverage
E. RUTHACEAE		
1. Pomelo (Lukban)	*Citrus grandis*	Food
2. Kalamansi	*C. sp.*	Food
F. AVERRHOACEAE		
1. Kamias	*Averrhoa bilimbi*	Food
2. Balimbing	*A. Carambola*	Food
G. SAPOTACEAE		
1. Caimito	*Chrysophyllum cainito*	Food
2. Tiesa	*Lacuma nervosa*	Food
3. Chico	*Manilkara sapota*	Food
Climbers		
A. DIOSCOREACEAE		
1. Ubi	*Dioscorea alata*	Food
B. FLAGELLARIACEAE		
1. Baling-uai	*Flagellaria indica*	Handicraft
C. COMMELINACEAE		
1. Alikbangon	*Commelina benghalensis*	Food

Family/Common Name	Scientific Name	Uses
D. VITACEAE		
1. Ayo	*Tetrastigma harmandii*	Food
Palm Spp.		
1. Coconut	*Cocos nucifera*	Food oil
2. Buri	*Corypha utan*	Leaves for roofing
3. Kaong	*Archantophoenix pinnata*	Fruits
4.Takipan	*Caryota cumingii*	Petiol good for broom
5. Pugahan	*C. rumphiana*	Fruits
6. Acas-as	*Pandancis luzonensis*	Ornamental and food
Herbs, weeds, and grasses		
A. GRAMINAE		
1. Amorseko	*Chrysopogoa aciculatus*	
2. Bermuda grass		
3. Carabao grass		
4. Kayawan tinik	*Bambusa spinosa*	Construction
5. Bayog	*Dendrocalamus mirrilianus*	Construction
6. Buho	*Schizostachyum lumampad*	Construction
7. Cogon	*Imperata cylindrica*	Roofing and plant indicator
8. Talahib	*Saccharum spontaneum*	Handicraft and plant indicator
B. OXALIDACEAE		
1. Makahiya	*Biophytum sensitvitum*	
C. MARANTACEAE		
1. Banban	*Donoa cannaeformis*	Handicraft
D. ZINGIBERACEAE		
1. Tagbak	*Alpinia elegants*	Medicinal
2. Wild ginger	*Zingiber Zerumbet*	Medicinal
E. CANNACEAE		
1. Tikas pula	*Canna coccinea*	
F. TYPHACEAE		
1. Cat tail	*Typha angustifolia*	
G. MUSACEAE		
1. Banana	*Musa sp.*	Food
H. ARACEAE		
1. Gabi	*Colocasia esculentum*	Food
2. Ponggapon	*Amorphophallus campanulantus*	Food
3. Pakpak paniki	*Philodendum lacerum*	
I. COLVULVOLACEAE		
1. Lambayog	*Ipondea rotundas*	
J. CYPERACEAE		
1. Mutha	*Cyperus rotundus*	
2. Sarrat	*Sclera scrobiculata*	
K. COMPOSITAE		
1. Hagonoy	*Chromolaena odorata*	
2. Uoko	*Mikania cordota*	

Table 8-7. Faunal species observed in 2005

Taxon	Frequency	Uses
Avifauna		
Cattle Egret[1] *Bubulcus ibis coromandus* ARDEIDAE	Common	Occasionally as food
Wandering Whistling-Duck[1] *Dendrocygna arcuata* ANATIDAE	Less common	Food
Philippine Duck[1,3] *Anas luzonica* ANATIDAE	Less common	Food
Brahminy Kite[1,2] *Haliastus indus intermedius* ACCIPITRIDAE	Less common	Considered as pest
Serpent Eagle[2] *Spilornis holospilus* ACCIPITRIDAE	Less common	Considered as pest
Red Jungle Fowl[1] *Gallus gallus* PHASIANIDAE	Less common	Food
Barred Button-Quail *Turnix suscitator* TURNICIDAE	Less common	Food
Slaty-Breasted Rail *Rallus striatus* RALLIDAE	Less common	Food
White-Browed Rail *Poliolimnas cinereus* RALLIDAE	Less common	Food
Watercock[1] *Gallicrex cinerea* RALLIDAE	Less common	Food
Painted Snipe *Rostratula benhalensis* ROSTRATULIDAE	Common	Food
Pink-Necked Green Pigeon[1] *Treron vernans* COLUMBIDAE	Less common	Food
Batu-bato Streptopelia bitorquata COLUMBIDAE	Less common	Food
Eemerald Dove *Chalcopaps indica* COLUMBIDAE	Less common	Food
Phil. Hanging Parakeet[2] *Loriculus philippensis*	Less common	Hunted and Sold as Pets

Taxon	Frequency	Uses
PSITTACIDAE		
Philippine Coucal[1] *Centropus viridis* CUCULIDAE	Less common	Considered as Pests
Phil. Grass Owl *Tyto capensis* TYTONIDAE	Less common	Item for Hunting
Nightjar *Caprimulgus macrurus* CAPRIMULGIDAE	Less common	Item for Hunting
Swiftlet *Collocalia troglodytes* APODIDAE	Very common	None
White Collared Kingfisher[1] *Halcyon chloris* ALCEDINIDAE	Common	Item for Hunting
Bee-eater *Merops viridis* MEROPIDAE	Less common	Item for Hunting
Barn Swallow *Hirundo rustica* HIRUNDINIDAE	Common	None
Oriole *Oriolus chinensis* ORIOLIDAE	Less common	Sold as pets
Crow *Corvus macrorhynchus* CORVIDAE	Less common	Considered as pests
Philippine Bulbul[1] *Pycnonotus goiavier* PYCNONOTIDAE	Very common	Item for hunting
Canegrass Warbler *Megalurus palustris* SYLVIIDAE	Common	Item for hunting
Malaysian Fantail *Rhipidura javanica* MUSCICAPIDAE	Less common	Item for hunting
White-Breasted Wood-Swallow[1] *Artamus leucorhynchus* ARTAMIDAE	Less common	Item for hunting
Brown Shrike[1] *Lanius cristatus* LANIIDAE	Less common	Item for hunting
Glossy Starling *Aplonis panayensis* STURNIDAE	Less common	Sold as pets

Taxon	Frequency	Uses
Sunbird[1] *Nectarinia jugularis* NECTARINIIDAE	Common	Item for hunting
Tree Sparrow *Passer montanus* PLOCEIDAE	Common	Considered as pets
Mammals		
South. Phils. Musk Shrew *Suncus occultidens* SORICIDAE	Less common	Considered as pests
Paniki *Pteropus sp.* PTEROPODIAE	Less common	Hunted for food
Long-tailed Macaque[2] *Macaca fascicularis* CERCOPITHECIDAE	Less common	Hunted for food and sold as pets
Daga *Rattus tanezumi* MURIDAE	Less common	Food
Dagang Palay *Rattus argentiventer* MURIDAE	Common	Food
Alimos[1] *Paradoxurus sp.* VIVERRIDAE	Less common	Food
Philippine Warty Pig[1] *Sus philippensis* SUIDAE	Less common	Food
Reptiles		
Monitor Lizard[1,2] *Varanus salvator* VARANIDAE	Common	Food
Reticulated Python[1,2] *Python reticulatus* PYTHONIDAE	Less common	Food
Philippine Cobra[2] *Naja naja* ELAPIDAE	Less common	Considered as pests
Tuko *Gekko gecko* GEKKONIDAE	Less common	None
Water Lizard *Hydrosaurus pustulosus* AGAMIDAE	Less common	Food
Flying Lizard *Draco volans*	Less common	None

Taxon	Frequency	Uses
AGAMIDAE		
Skink *Mabuya sp.* SCINCIDAE	Less common	None

Notes:

1. The species was also observed during the 2008 sampling.
2. Listed under CITES Appendix II.
3. Considered “vulnerable” and included in IUCN RED List.

Table 8-8. Birds species observed in 2008

English Name	Scientific Name	Status	S1	S2	S3	S4	S5	S6	S7	S8	Overall
Purple Heron	*Ardea purpurea*	R				1					1
Javan Pond-Heron	*Ardeola speciosa*	R		1					8		9
Little Heron	*Butorides striata*	R	1								1
Cattle Egret	*Bubulcus ibis*	R	6	6				4	4		20
Cinnamon Bittern	*Ixobrychus cinnamomeus*	R	1	2		1					4
Wandering Whistling-Duck	*Dendrocygna arcuata*	I-R									0
Philippine Duck **	*Anas luzonica*	E					12				12
Tufted Duck	*Aythya fuligula*	I-M									0
Brahminy Kite *	*Haliastur indus*	R	2								2
Red Junglefowl	*Gallus gallus*	R	6								6
Blue-breasted Quail	*Coturnix chinensis*	R						1		1	2
Barred Rail	*Gallirallus torquatus*	R	4					3			7
White-browed Crake	*Porzana cinerea*	R					1				1
Plain Bush-hen	*Amaurornis olivacea*	E	4								4
White-breasted Waterhen	*Amaurornis phoenicurus*	R	1							1	2
Watercock	*Gallicrex cinerea*	I-R									0
Common Moorhen	*Gallinula chloropus*	R	2	2							4
Purple Swamphen	*Porphyrio porphyrio*	I-R									0
Greater Painted-snipe	*Rostratula benghalensis*	I-R									0
Little Ringed-Plover	*Charadrius dubius*	M					1				1
Snipe sp.	*Gallinago sp.*	I-M									0
Common Sandpiper	*Actitis hypoleucos*	M	1								1

English Name	Scientific Name	Status	S1	S2	S3	S4	S5	S6	S7	S8	
Pink-necked Green-Pigeon	*Treron vernans*	R					2		15	1	18
White-eared Brown-Dove	*Phapitreron leucotis*	E	8		2						10
Yellow-breasted Fruit-Dove	*Ptilinopus occipitalis*	E	1								1
Green Imperial-Pigeon	*Ducula aenea*	I-R									0
Philippine Cuckoo-Dove	*Macropygia tenuirostris*	NE	1				2				3
Spotted Dove	*Streptopelia chinensis*	R	12	10					10	6	38
Zebra Dove	*Geopelia striata*	R	10	8					6	4	28
Common Emerald Dove	*Chalcophaps indica*	R	3						1	1	5
Guaiabero *	*Bolbopsittacus lunulatus*	E					1				1
Colasisi *	*Loriculus philippensis*	E									0
Brush Cuckoo	*Cacomantis variolosus*	R	15			1					16
Plaintive Cuckoo	*Cacomantis merulinus*	R	5			1					6
Common Koel	*Eudynamys scolopaceus*	R	1								1
Philippine Coucal	*Centropus viridis*	E	5		3		2		3	2	15
Grass Owl	*Tyto capensis*	I-R									0
Philippine Eagle-Owl **	*Bubo philippensis*	I-E									0
Philippine Nightjar	*Caprimulgus manillensis*	E					2				2
Island Swiftlet	*Aerodramus vanikorensis*	R	20						15	10	45
Glossy Swiftlet	*Collocalia esculenta*	R			8	8	8	10	20	10	64
Pygmy Swiftlet	*Collocalia troglodytes*	E					4	4	10	6	24
Variable Dwarf-Kingfisher	*Ceyx lepidus*	I-R									0
White-throated Kingfisher	*Halcyon smyrnensis*	R	8		4		1	4			17
White-collared Kingfisher	*Todirhamphus chloris*	R	5							2	7
Kingfisher sp.	*Actenoides sp.*	I-E									0

English Name	Scientific Name	Status	S1	S2	S3	S4	S5	S6	S7	S8	Overall
Mindanao Tarictic *	*Penelopides affinis*	E	6					2			8
Writhed Hornbilll *	*Aceros leucocephalus*	I-E									0
Rufous Hornbill *	*Buceros hydrocorax*	I-E									0
Coppersmith Barbet	*Megalaima haemacephala*	R	2	1					1		4
Large Woodpecker sp.		I-R									0
Hooded Pitta	*Pitta sordida*	R					3		1	1	5
Pacific Swallow	*Hirundo tahitica*	R	2						6	3	11
Pied Triller	*Lalage nigra*	R	3				2		2		7
Yellow-vented Bulbul	*Pycnonotus goiavier*	R	25		15	15	20		20	12	107
Philippine Bulbul	*Ixos philippinus*	E	10		5					4	19
Black-naped Oriole	*Oriolus chinensis*	R	3	2						2	7
Large-billed Crow	*Corvus macrorhynchos*	R	2					3	2	2	9
Brown Tit-Babbler	*Macronous striaticeps*	E					3				3
Oriental Magpie-Robin	*Copsychus saularis*	R	3							4	7
Pied Bushchat	*Saxicola caprata*	R					2			3	5
Clamorous Reed-Warbler	*Acrocephalus stentoreus*	M			2	2	3			4	11
Striated Grassbird	*Megalurus palustris*	R		5		6			4	4	19
Black-headed Tailorbird	*Orthotomus nigriceps*	E	2		1						3
Bright-capped Cisticola	*Cisticola exilis*	R				4	4		3	4	15
Zitting Cisticola	*Cisticola juncidis*	R	5	8					4		17
Pied Fantail	*Rhipidura javanica*	R	8			2			2	3	15
Grey Wagtail	*Motacilla cinerea*	M	1						1		2
Richard's Pipit	*Anthus richardi*	R	3	2					2		7
White-breasted Wood-swallow	*Artamus leucorynchus*	R	4	2							6
Brown Shrike	*Lanius cristatus*	M	1								1

English Name	Scientific Name	Status	S1	S2	S3	S4	S5	S6	S7	S8	Overall
Asian Glossy Starling	*Aplonis panayensis*	R		6							6
Coleto	*Sarcops calvus*	I-E			30						30
Olive-backed Sunbird	*Cinnyris jugularis*	R				8			6	6	20
Purple-throated Sunbird	*Leptocoma sperata*	R						20			20
Sunbird sp.			20	6			10				36
Striped Flowerpecker	*Dicaeum aeruginosum*	E								1	1
Visayan Flowerpecker **	*Dicaeum haematostictum*	E	8								8
Buzzing Flowerpecker	*Dicaeum hypoleucum*	E							2		2
Orange-bellied Flowerpecker	*Dicaeum trigonostigma*	R	2								2
Eurasian Tree Sparrow	*Passer montanus*	R		30							30
White-bellied Munia	*Lonchura leucogastra*	R					8				8
Chestnut Munia	*Lonchura malacca*	R	15	6		6			10	8	45
Number of Individuals			**158**	**68**	**65**	**51**	**70**	**43**	**111**	**89**	**655**
Number of Species			**45**	**18**	**9**	**12**	**22**	**9**	**25**	**26**	**83**
Number of Endemic Species			**8**	**0**	**5**	**0**	**7**	**2**	**3**	**4**	**20**

Notes:

1. Species names in bold are endemic and those underlined are near-endemic to the Philippines.
2. I is interview data; R means resident; M is migrant; NE is near-endemic; E is endemic
3. * connotes that the species is part of CITES Appendix II; ** means that the species is “vulnerable” and included in the IUCN Red List species.
4. The locations of sampling transects are shown in Figure 4-13.

Table 8-9. Mammals and herpetological species observed in 2008

English Name	Scientific Name	Status
Common Palm Civet	*Paradoxurus hermaphroditus*	I
Philippine Brown Deer**	*Cervus mariannus*	I
Philippine Warty Pig**	*Sus philippensis*	I
Malay Civet	*Viverra tagalunga*	I
Long-tailed Macaque*	*Macaca fascicularis*	X
Philippine Tarsier*	*Tarsius syrichta*	I
Philippine Pygmy Squirrel	*Exilisciurus concinnus*	X
Flying Fox sp.	*Pteropodidae sp.*	I
Insectivorous bat sp.	*Microchiroptera sp.*	X
Reticulated Python*	*Python reticulatus*	I
Philippine Pit Viper	*Trimeresurus flavomaculatus*	I
Common Rat Snake	*Elaphe erythrura*	I
Samar Cobra*	*Naja samarensis*	X
King Cobra*	*Ophiophagus hannah*	I
Variable Malay Monitor Lizard*	*Varanus salvator*	I
Sailfin Water Lizard	*Hydrosaurus pustulatus*	X
Common House Gecko	*Hemidactylus frenatus*	X
Marine Toad	*Bufo marinus*	X
Mindanao Fanged Frog**	*Limnonectes magnus*	X
Serpentes sp. 1		X
Serpentes sp. 2		X

Notes:

1. Species names in bold are endemic to the Philippines
2. I is interview data; X means seen or heard.
3. * means that the species is included in CITES Appendix II; ** connotes that the species is “vulnerable” and part of the IUCN RED List.

Table 8-10. Laboratory results of water quality sampling

Station	pH	Cond. µS/cm	Temp. °C	DO Mg/L	BOD_5 mg/L	Coliform N/100mL	TSS mg/L	TDS mg/L	O&G mg/L	Phenol µg/L	NO_3-N mg/L	PO_4 – P mg/L	SO_4^{-2} mg/L	Ca mg/L	CN mg/L	Hg mg/L	As mg/L	Cu mg/L	Pb mg/L
MAGPAYANG RIVER																			
Upslope																			
• Timamana	7.4		25.6	10.19			5	183								<0.0001	<0.005	0.02	<0.06
• Stn 3	7.4	292	27.5	83.5%	2.4	7485	8	188	1.6	<1	0.06	0.2	9.4	482	0.012	<0.001	0.87	<0.02	<0.03 0.07
• STA 2	7.7	222	26.7	8.33			<5									<0.001	0.005	<0.02	<0.03
Spanish Ditch																			
• STA 3	7.6	216	26.7	6.56			10		<0.5							<0.001	<0.005	0.02	<0.03
• Stn 4	7.5	283	28.9	71.2%	2.02	4831	10.2	168	1.7	<1	0.65	0.13	38.4		0.01	<0.001	0.43	<0.02	<0.03
Facility																			
• TP1	7.7	657	31.9	6.34			34	649	<0.5							<0.001	0.005	<0.02	<0.03
• TP2	7.4	482	29.8	6.31			8	459	<0.5							<0.001	<0.005	<0.02	<0.03
• TP3	7.7	204	28.0	7.51			<5	345								<0.001	<0.005	<0.02	<0.03
• TSY	8.0	422			1.7	198	17	278	0.92	<1	0.75	0.44	115.2		0.02	<0.001	1.3	<0.02	<0.03
• SMRC5	6.5	1299			5.2	<2	71	517		<1					0.58	<0.001	2.8	<0.02	<0.03
• SP1	8.3	394	30.6	6.70			7	378	<0.5							<0.001	<0.005	<0.02	<0.03
Immediately downslope																			
• STA 4	7.6	216	28.0	8.29			<5		<0.5							<0.001	0.005	0.02	<0.03
• Stn 8	7.2	285	27.2	81.1%	2.4	7699	5	187	1.6	21.4	0.44	0.23	8.8		0.01	<0.001	1.3	<0.02	<0.03
• Stn 9	7.6	296	28.3	97.2%	2.2		8	176	1.2	48	0.2	0.2	11.1	45	0.008	<0.001	<0.005	<0.02	<0.03
DAYANO CREEK																			
Upslope																			

Station	pH	Cond. µS/cm	Temp. °C	DO Mg/L	BOD_5 mg/L	Coliform N/100mL	TSS mg/L	TDS mg/L	O&G mg/L	Phenol µg/L	NO_3-N mg/L	PO_4 – P mg/L	SO_4^{-2} mg/L	Ca mg/L	CN mg/L	Hg mg/L	As mg/L	Cu mg/L	Pb mg/L
• Stn 12	7.1	307	25.4	92%	1.2	592	2	184	1.9	18	0.5	ND	2.6			<0.001	<0.005	<0.02	<0.03
Facility																			
• SMRC7	6.4	720			13.3		74	474	1.4						0.02	<0.001	<0.005	<0.02	<0.03
• SMRC8	9.1	1198			2.9		10	174	2.3						0.005	<0.001	<0.005	<0.02	<0.03
• OP1	8.3	433	28.6	7.60			<5	526	<0.5							<0.001	<0.005	<0.02	<0.03
• Pit	7.8	490	30.2	100%	1.4	13	1.8	269	1.7		0.4	0.01	70	53	<0.002 0.010	<0.001	0.66	<0.02	<0.03
• 1-05	8.2	388	29.4	102%				345					51			<0.0001	<0.005	<0.02	<0.01
• 1-20	7.8	425	28.7	92%				278					50			<0.0001	<0.005	<0.02	<0.01
• 1-40	7.7	453	27.3	47%	2.2	8	3	346	0.63	<1	0.86	<0.01	61			<0.0001	<0.005	<0.02	<0.01
• 1-80	7.7	456	27.3	40%				338					73			<0.0001	<0.005	<0.02	<0.01
• 1-88.5	7.7	596	27.3	36%				338					67			<0.0001	<0.005	<0.02	<0.01
• 2-05								220					46			<0.0001	<0.005	<0.02	<0.01
• 2-20								250					48			<0.0001	<0.005	<0.02	<0.01
• 2-70								304					49			<0.0001	<0.005	<0.02	<0.01
• 3-05								280					46			<0.0001	<0.005	<0.02	<0.01
• 3-20								250					55			<0.0001	<0.005	<0.02	<0.01
• 3-40								280					49			<0.0001	<0.005	<0.02	<0.01
Downslope																			
• Stn 2	7.3	325	26.3	88.8%	2.5 <1-6.1	794	4.5	178	1.6	48.6	0.5	0.01	6.6	73	0.010	1.1	ND 0.001	ND	ND
• STA 1	7.2	243	25.0	7.33			52		<0.5							<0.001	0.005	<0.02	<0.03
MAGPAYANG RIVER																			
Downslope of Dayano River																			

Station	pH	Cond. µS/cm	Temp. °C	DO Mg/L	BOD_5 mg/L	Coliform N/100mL	TSS mg/L	TDS mg/L	O&G mg/L	Phenol µg/L	NO_3-N mg/L	PO_4 – P mg/L	SO_4^{-2} mg/L	Ca mg/L	CN mg/L	Hg mg/L	As mg/L	Cu mg/L	Pb mg/L
confluence																			
• Stn 10	7.5	302	27.6	93.4%	2.3	2001	15.5	171	1.1	<1	0.27	0.38	4.8	53	ND 0.010	0.001	ND	ND	ND
LAKE MAINIT																			
• Lake	8	269	29.1	93.0%	2.2	123	10	172	1.4	60	0.28	0.2	10.8						
• Sta 3																<0.0001	<0.005	<0.02	<0.01
• Sta 4																<0.0001	<0.005	<0.02	<0.01
• Sta 2																<0.0001	<0.005	0.04	<0.01

Notes:

1. The results are lifted from various sampling episodes listed in Table 4-3.
2. The locations of the sampling stations are shown in Figure 4-18.
3. For GRC's stations, i.e., those prefixed by "Stn", which were sampled more than once, the mean value and, where significant, the range are reported.
4. The levels of metals and CN are generally not detected (ND). The occasional readings are also reflected in the table.
5. The samples were also analyzed for surfactants, Cd, and Zn. No levels were detected.

Table 8-11. Macroinvertebrates collected from inland streams

Taxa	Class	Magpayang River					Dayano Creek	
		Motorpool	Tailings Pond	Cawilan	Alegria US	Alegria DS	Dayano US	Dayano DS
		Station 7	Station 3	Station 4	Station 5	Station 6	Station 1	Station 2
Sensitive								
Baetidae	Insects	32	2	3			11	
Heptageniidae	Insects	10	25					
Tricorythidae	Insects	4		4				
Caenidae	Insects	3		6				
Paraleptophlebiidae	Insects	3						
Hydropsychidae	Insects	5						
Hydrobiosidae	Insects	1						
Uenoidae	Insects	1						
Neritina pulligera	Molluscs	1						
Thiara scabra	Molluscs		1	1			1	1
Melanoides sp.1 (juncea)	Molluscs	7					1	5
Melanoides sp.2	Molluscs				1			
Moderately tolerant								
Coenagrionidae	Insects	15	13	13	1		7	6
Gomphidae	Insects				1			
Nepidae	Insects							1
Naucoridae	Insects	1						
Dytiscidae	Insects	1						
Hydraenidae	Insects							1
Hydrophilidae	Insects						1	1
Shrimp (*M. mammilodactylus*)	Crustaceans	7	4	2			1	2
Crab	Crustaceans	6		3				
Tolerant								
Ceratopogonidae	Insects							1
Ablabsemyia	Insects	4	1					
Culicidae	Insects		1					
Simuliidae	Insects	4						
Planorbidae sp.	Insects	1						
Gyraulus chinensis	Molluscs	1					2	3
Radix quadrasi	Molluscs		1					
Oncomelania hupensis quadrasi	Molluscs							1
Pomacea canaliculata	Molluscs	1						3

Taxa	Class	Magpayang River					Dayano Creek	
		Motorpool	Tailings Pond	Cawilan	Alegria US	Alegria DS	Dayano US	Dayano DS
		Station 7	Station 3	Station 4	Station 5	Station 6	Station 1	Station 2
Earthworm	Annelids						1	

NOTES: "US" means upslope; "DS" is downslope.

Table 8-12. Plankton collected from inland streams

Plankton/Genera	Magpayang River					Dayano River	
	Motorpool	Cawilan	Tailings Pond	Alegria US	Alegria DS	Dayano US	Dayano DS
	Station 7	Station 4	Station 3	Station 5	Station 6	Station 1	Station 2
Cyanophyta							
Lyngbya sp.	X	X			X		X
Anabaena sp		X	X	X	X		
Chlorophyta							
Coelastrum sp	X			X			
Oocystis sp	X						X
Ankistrodesmus							
Chrysophyta							
Synedra	X		X	X		X	X

Table 8-13. Inferred sediment contributions of lake tributaries

River	Discharge ($m^3 d^{-1}$)	TSS ($mg L^{-1}$)	Sediment Load ($t d^{-1}$)	Sediment Contribution (%)
New Camalig	4,268	5	0.02	0.02
Alimpatayan	7,677	10	0.08	0.09
Tugbongan	7,925	27	0.21	0.24
Tigbawan	7,983	2	0.02	0.02
Mainit	13,608	7	0.10	0.11
Mamkas	17,280	1	0.02	0.02
Agong-ongan	17,574	25	0.44	0.49
San Isidro	18,386	3	0.06	0.06
Jaliobong	38,561	4	0.15	0.17
Magtiaco	58,294	4	0.23	0.26
Magpayang	138,931	7	0.97	1.09
Baleguian	175,694	38	6.68	7.52
Puyo	221,184	9	1.99	2.24
Mayag	1,052,352	74	77.87	87.66
Total	1,779,717		88.84	100.00
Kalinawan River	1,969,229	2	3.94	4.43

Source: Tumanda et al., 2005.

Table 8-14. Total bacterial density, total coliforms, fecal coliforms (*Escherichia coli*) and water classification of some areas of Lake Mainit, Surigao del Norte.

Sampling site	Bacterial density (cfu.mL^{-1})	Total Coliforms (MPN.mL^{-100})	Fecal Coliforms (MPN.mL^{-100})	Tentative Classification of water based on Fecal Coliforms
Mainit	41,333	=1600	=1600	Class B
Jaliobong	14,329	130	79	Class A
San Pablo	5,833	24	24	Class A
San Roque	503	1600	1600	Class B
Bangayan	498	79	79	Class A
Magpayang	388	27	17	Class AA
Bunga	106	350	350	Class B
San Pablo (near poultry)	52	49	49	Class A
Jabonga (fishing Village)	50	49	22	Class A
Jabonga beach	32	33	33	Class A
Middle portion of lake (surface)	<30	2	<2	Class AA
(middle)	<30	<2	<2	Class AA

Legend:

	Class AA	Class A	Class B	Class C	Class D
Total Coliforms(MPN. mL^{-100})	50[M]	1,000[M]	1,000[M]	5,000[M]	-
Fecal Coliforms(MPN.mL^{-100})	20[M]	100[M]	200[M]	-	-

Coliform bacteria - are rod-shaped bacteria found in soil and the intestinal tract of warm blooded animals including humans

Fecal Coliforms(Escherichia coli) – are bacteria entirely of fecal origin and are used as indicator organisms of fecal pollution.

MPN – Most Probable Number (a statistical estimate of the concentration of the total and fecal coliforms that are present in the water sample.

M - refers to the geometric mean of the MPN of coliform organisms during a 3-month period and that the limit indicated shall not be exceeded in 20 percent of the samples taken during the same period.

- means the standards of these are not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources

Classification	Beneficial Use
Class AA	Public Water Supply Class I. This class is intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the National Standards for Drinking Water (NSDW) of the Philippines.
Class A	Public Water Supply Class II. For sources of water supply that will require complete treatment (coagulation, sedimentation, filtration and disinfection) in order to meet the NSDW.
Class B	Recreational Water Class I. For primary contact recreation such as bathing, swimming, skin diving, etc. (particularly those designated for tourism purposes).
Class C	1) Fishery Water for the propagation and growth of fish and other aquatic resources; 2) Recreational Water Class II (Boatings, etc). 3) Industrial Water Supply Class I (For manufacturing processes after Treatment).
Class D	1) For agriculture, irrigation, livestock watering, etc. 2) Industrial Water Supply Class II (e.g. cooling, etc.); 3) Other inland waters, by their quality, belong to this classification.

Source: Tumanda et al., 2005

Table 8-15. Phytoplankton counts for Lake Mainit in 1971.

	2 August cells per cc	2 August μ^3 per cc	2 August μ^3 %	8 November cells per cc	8 November μ^3 per cc	8 November μ^3 %
Cyanophyta						
Chroococcus turgidus	530	37,100		662	46,340	
Aphanothece sp.	89,730	89,730		24,495	24,495	
Anabaena (*Anabaenopsis?*) sp.	40,964	860,244		8,512	178,752	
A. spiroides	1,242	40,986		324	10,692	
Lyngbya limnetica	167,300	334,600		2,650	5,300	
Romeria gracilis	2,962	2,962		*	*	
Dactylococcopsis fascicularis	4,514	9,028		3,466	6,932	
– sp.	295	4,425		103	1,545	
Total	307,537	1,379,075	68.2	40,212	274,056	27.9
Chlorophyta						
Gloeocystis planctonica	220	13,860		528	33,264	
Coccomyxa sp.	3,742	11,226		*	*	
Dimorphococcus sp.	416	14,560		780	27,300	
Dictyosphaerium pulchellum	96	4,800		0	0	
Coelastrum cambricum	329	23,359		462	32,802	
Chlorella spp.	623	6,230		*	*	
Lagerheimia subsalsa	12	1,500		0	0	
Oocystis submarina	398	19,900		522	26,100	
– sp.	44	11,000		0	0	
Ankistrodesmus setigerus	8	280		44	1,540	
Tetrahaedron minimum	199	4,975		717	17,925	
T. regulare	55	1,375		301	7,525	
Selenastrum sp.	530	530		*	*	
Kirchneriella lunaris	69	1,725		0	0	
Kirchneriella sp.	39	975		110	2,750	
Scenedesmus arcuatus	11	825		0	0	
Scenedesmus spp.	44	1,100		22	550	
Total	6,835	118,220	5.8	3,486	149,756	15.2
Bacillariophyceae						
Synedra radians	2	380		7	1,330	
S. rumpens	94	10,340		1,181	129,910	
Melosira granulata	25	7,500		88	26,400	
M. granulata v. *angustissima*	30	3,000		52	5,200	
Total	151	21,220	1.0	1,328	162,840	16.6
Dinophyceae						
Gymnodinium sp.	146	175,200		52	62,400	
Peridinium sp.	113	124,300		52	57,200	
Total	259	299,500	14.8	104	119,600	12.2
Cryptophyceae						
Cryptomonas marssonii	149	178,800		177	212,400	
Rhodomonas minuta	157	10,990		740	51,800	
Total	306	189,790	9.4	917	264,200	26.9
Unclassified fragments	552	13,800	0.7	464	11,600	1.2
Grand total	315,640	2,021,605	99.9	46,511	982,052	100.0

* Census on 8 November did not include these minute species.

Table 8-16. Phytoplankton densities and relative abundance for Lake Mainit in 2003 and 2004.

Phytoplankton		Cells/ sample	Cells.L^{-1}	Relative Abundance
Bacillarophyta				
	Asterionella	4	21.00	
	Coscinodiscus	1	0.03	
	Denticula elegans	166	8.29	
	Diatoma	11	0.54	
	Meridion	37	1.83	
	Navicula	2	0.10	
	Nitzschia	143	7.14	
	Surirella spp	16	0.79	
				0.82
Chlorophyta				
	Apiocystis	1	0.03	
	Bactraspermum	1	0.06	
	Chlamydomonas	1	0.06	
	Chlorococcus lemniticus	26	1.30	
	Chlorosarcina consociata	1	0.03	
	Golenkenia radiata	971	48.50	
	Kirchneriella lunaris	133	6.63	
	Oocystis borgei	3	0.14	
	Oedogonium	41374	2069	
	Sphaerocystis	1172	58.60	
	Spirogyra	6	0.32	
	Volvox auseaus	11	0.539	
				94.05
Chryptophyceae				
	Rhodomonas	3	0.14	
				0.65
Cyanophyceae				
	Anabaena spp	315	15.78	
	Anabaenopsis	402	20.10	
	Anacystis	1	0.03	
	Aphanothece stagnina	4	0.19	
	Aphanocapsa gravilleli	491	24.50	
	Coelospherium kuitzingianu	1	0.06	
	Gomphosphaera	61	3.01	
	Lyngbia	3	0.16	
	Marssaniella elegans	17	0.86	
	Oocystis	112	5.29	
	Phormidium	5	0.26	
	Planktosphaera	574	28.50	
	Spirulina	4	0.22	
				4.28
Dinophyceae				
	Ceratium sp	84	4.18	
	Gonyaulax	300	15.00	
	Glenodinium	5	0.27	
	Gymnodinium	1	0.056	
				0.84

Source: Tumanda et al., 2005

Table 8-17. Phytoplankton genera collected from Lake Mainit in 2005

Parameter/ Phytoplankton	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
Location	Kitcharao	Alegria	Magpayang River mouth	Between Stations 3 and 4	Shore of Mainit town	Western side, Jabonga
Cyanophyta						
Chroococcus sp		210	294	210	84	630
Aphanothece sp.	1134	840	630	1344	882	1,176
Anabaena sp.	3108	5,334	1,092	3612	4,074	6,426
Lyngbya sp.	4116	4,036	1,806	3276	1,428	4,116
Dactylococcopsis sp.	42			42		84
Chlorophyta						
Coelastrum sp.	42	84		42		42
Chlorella sp.	126	168				
Lagerheimia sp.	42	84		42		
Oocystis sp.	126	168	42	210	252	42
Tetrahedron sp.	42					
Selenastrum sp.	169	126		42		
Baccilariophyceae						
Synedra sp.	462	1428	924	1848	714	2730
Melosira sp.	1806	1092	504	1764	966	1260

Note: The station locations are shown in Figure 4-18.

Table 8-18. Zooplankton counts for Lake Mainit in 1971.

	2 August Thousands of indiv./m²	mm³/m²	mm³/m² %	7 November Thousands of indiv./m²	mm³/m²	mm³/m² %
Zooplankton > 100 µ						
Copepods						
Nauplius 1	175	44		833	208	
2	30	9		211	63	
3	< 1	< 1		87	30	
4	5	2		63	28	
5	6	6		232	182	
Total	215	60		1,428	512	
Copepodid I	5	5		423	423	
II	5	8		206	309	
III	43	113		182	486	
IV	133	557		173	727	
V	183	1,186		318	2,067	
Total	368	1,869		1,304	4,011	
Male	176	1,127		651	4,173	
Female	127	1,651		616	7,977	
Total Copepods	886	4,706	38.5	4,000	16,674	80.3
Eggs	512	179	1.5	1,449	509	2.4
Rotifers						
Brachionus falcatus	325	65		146	29	
Keratella tropica	40	1		251	5	
Conochiloides dossuarius	165	41		254	63	
Proalides sp.	360	360		88	88	
Anuracopsis fissa	255	8		95	3	
Polyarthra vulgaris	130	14		81	9	
Total rotifers	1,275	489	4.0	915	197	1.0
Eggs	193	26	0.2	182	24	0.1
Cladocera						
Chydorus barroisi	10	21		5	10	
Diaphanosoma sarsi	1	4		51	256	
Total Cladocera	11	25	0.2	56	266	1.3
Eggs (*Chydorus*)	10	5	0.0	< 1	< 1	0.0
Eggs (*Diaphanosoma*)	< 1	< 1	0.0	< 1	< 1	0.0
Total zooplankton > 100 µ	2,172	5,220	42.7	4,971	17,137	82.5
Total eggs	715	210	1.7	1,632	532	2.5
Total zooplankton + eggs	2,887	5,430	44.4	6,603	17,669	85.0
Zooplankton < 100 µ						
Protozoa						
Ciliates	585,000	1,170	9.6	225,000	450	2.2
Flagellates > 10 µ	3,195,000	4,793	39.3	1,545,000	2,317	11.2
Flagellates < 10 µ	16,365,000	818	6.7	6,808,000	340	1.6
Total Protozoa	20,145,000	6,781	55.6	8,578,000	3,107	15.0
Grand total – all zooplankton	20,147,887	12,211	100.0	8,584,603	20,776	100.0

Table 8-19. Zooplankton densities and relative abundance for Lake Mainit in 2003 and 2004.

Organism		Population density (ind/v.m^{-3})	Total	Relative abundance (%)
Copepod				
	Adult	26738		
	Eggs	1672		
	Nauplii	33760		
			62170	41.95
Rotifers				
	Brachionus eggs	22740		
	Brachionus spp	2961		
	B. forficula	27922		
	B. dimidiatus	7		
	B. vaviabilis	634		
	Chydorus barroisi	123		
	Conochiloides dossaurius	666		
	Filinia brachiata	14		
	Keratella cochloris	26624		
	K. serrulata	465		
	Monostyla bulla	3128		
	Trichocera	382		
			85284	57.55
Cladocera				
	Alona sp	184		
	Camptocercus oklahoman	20		
	Daphnia sp	7		
	Kurzia sp	109		
	Moinodaphnia	27		
	Monophilis sp	68		
	Simocephalus	14		
			429	0.29
Ostracod				
	Cyclocypris sp	14	14	0.00
Insect				
	Mosquito larvae	170	170	0.11
Tintinnids				
	Tintinnopsis spp	126	126	0.09

Source: Tumanda et al., 2005

Table 8-20. Zooplankton genera collected from Lake Mainit in 2005

Parameter/ Phytoplankton	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
Location	Kitcharao	Alegria	Magpayang River mouth	Between Stations 3 and 4	Shore of Mainit town	Western side, Jabonga
Copepods						
Cyclopoids	2	6	2	4	6	2
Nauplius larvae	8	10	2	4	2	2
Cladocerans						
Diaphanosoma sp.	2	2				
Rotifera						
Brachionus sp.	8	4	2	2	2	6
Keratella sp.	4	6		2	2	6

Note: The station locations are shown in Figure 4-18.

Table 8-21. Fish species caught in Lake Mainit in 2005

Family	Species	Common Name and Status
Eleotridae	*Ophieleotris aporos*	Mud gudgeon, biya, Palawan; Native
Gobiidae	*Glossogobius giuris*	Whit goby, biyang puti, pidianga; Native
Cichlidae	*Oreochromis niloticus*	Nile tilapia, tilapia; Introduced
	Clarias batrachus	Catfish, hito, pantat; Introduced
	Clarias macrocephalus	Catfish, hito, pantat; Native
Channidae	*Channa striata*	Mudfish, dalag; Native
Anguillidae	*Anguilla marmorata*	Eel, igat, kasili; Native
Cyprinidae	*Puntius binotatus*	Pait; Native
Phallostethidae	*Neostethus thessa*	Bolinao, native; Endemic
Hemiramphidae	*Dermogenys* sp.	Halfbeak; Probably native

Table 8-22. Climatological normals of PAGASA's Surigao City Station

STATION :653 - SURIGAO, SURIGAO DE NORTE
LATITUDE :09° 48' N LONGITUDE :125° 30' E ELEVATION : 39.0 m
PERIOD :1971 - 2000

	RAIN-	NO	-----TEMPERATURE DEG. C------								--WIND--					
	FALL	OF				DRY	WET	DEW	VP	RH	MSLP		SPD	CLD	DAYS	WITH
MONTH	MM	RD	MAX.	MIN.	MEAN	BULB	BULB	PT.	MBS.	%	MBS.	DIR	MPS	OKT	TSTM	LTNG
JAN.	600.8	24	29.3	22.7	26.0	25.8	24.2	23.6	29.1	88	1010.7	NE	3	6	2	1
FEB.	443.2	21	29.6	22.7	26.2	25.9	24.2	23.6	29.0	87	1011.0	E	3	6	1	0
MAR.	334.6	21	30.4	23.1	26.8	26.5	24.6	23.9	29.6	86	1011.0	E	3	5	1	1
APR.	236.3	17	31.6	23.7	27.7	27.5	25.3	24.5	30.7	84	1010.0	E	2	5	4	3
MAY	127.2	13	32.7	24.2	28.4	28.3	25.8	25.0	31.5	82	1009.1	E	2	5	7	11
JUNE	140.3	14	32.5	24.1	28.3	28.1	25.7	24.9	31.4	82	1009.1	SW	2	6	7	12
JULY	165.9	13	32.2	24.1	28.1	28.0	25.4	24.5	30.6	81	1008.8	SW	2	6	7	15
AUG.	131.4	12	32.6	24.2	28.4	28.2	25.5	24.6	30.8	80	1009.0	WSW	2	6	6	15
SEPT	149.0	14	32.6	24.1	28.4	28.2	25.5	24.6	30.8	80	1009.4	WSW	2	6	8	15
OCT.	255.6	20	31.9	23.8	27.8	27.6	25.4	24.6	30.9	84	1009.2	W	2	6	9	14
NOV.	447.2	22	30.6	23.5	27.1	26.9	25.0	24.3	30.4	86	1009.4	E	2	6	7	8
DEC.	524.9	25	29.8	23.3	26.6	26.3	24.7	24.1	30.0	88	1010.2	NE	2	6	3	3
ANNUAL	3556.4	216	31.3	23.6	27.5	27.3	25.1	24.3	30.4	84	1009.7	E	2	6	62	98

PREPARED BY: PAGASA/CAB/CDS

Table 8-23. Climatological extremes of PAGASA's Surigao City Station

YEAR - AS OF 2003

	TEMPERATURE, DEG C				GREATEST DLY RAINFALL, MM		HIGHEST WIND, MPS			SEA LEVEL PRESSURE, MBS			
MONTH	HIGH	DATE	LOW	DATE	AMOUNT	DATE	SPD	DIR	DATE	HIGH	DATE	LOW	DATE
JAN.	33.7	15-16	18.6	02-78	351.8	24-63	25/	N	24-75	1019.5	29-98	984.9	24-75
FEB.	33.3	02-06	18.2	24-05	472.9	12-74	20/	NE	21-97	1019.1	02-98	1002.5	29-96
MAR.	35.0	31-39	18.8	01-49	237.5	19-59	29/	NW	03-67	1019.3	12-64	999.8	04-89
APR.	35.2	19-87	18.9	05-63	339.0	05-86	35/	WSW	04-94	1018.3	14-93	990.5	05-94
MAY	36.3	22-87	20.8	18-72	198.1	16-62	36/	SSE	07-54	1015.9	09-57	986.1	06-54
JUNE	37.5	15-87	20.7	13-65	235.3	29-70	22/	SSW	30-70	1015.5	08-97	1000.7	30-70
JULY	36.2	31-16	20.0	06-61	201.9	01-52	31/	WNW	02-52	1015.6	04-89	995.2	02-52
AUG.	37.0	19-16	20.0	22-93	137.4	15-40	25/	WSW	17-86	1016.4	11-97	1000.2	15-74
SEP.	37.2	16-87	20.6	01-66	179.4	01-84	60/	ENE	01-84	1016.5	10-93	1000.8	11-00
OCT.	35.6	11-05	20.5	16-06	320.6	13-19	30/	W	23-88	1016.5	03-97	981.8	27-91
NOV.	36.2	02-75	19.7	12-11	564.7	18-68	46/	WSW	18-68	1018.3	23-92	977.3	12-90
DEC.	34.6	18-05	19.1	21-25	566.4	18-03	56/	E	21-86	1017.4	12- 2	977.5	21-86
ANNUAL	37.5	6-15	18.2	2-24	566.4	12-18	60/	ENE	9-01	1019.5	1-29	977.3	11-12
		1987		1905		2003			1984		1998		1990
PERIOD OF RECORD	1903 - 2003				1902 - 2003		1950 - 2003				1949 - 2003		

NOTE : 1. EQUAL SIGN(=) MEANS YEAR 1800
2. NO RECORD FOR THE PERIOD 1941-1945

Table 8-24. Rainfall Intensity-Duration-Frequency Data for Surigao Del Norte

Based on **36 years** of record

COMPUTED EXTREME VALUES (in mm) of PRECIPITATION

Return Period (yrs)	5 mins	10 mins	15 mins	20 mins	30 mins	45 mins	60 mins	80 mins	100 mins	120 mins	150 mins	3 hrs	6 hrs	12 hrs	24 hrs
2	16.3	24.7	31.8	37.8	47.5	57.4	64.2	74.5	83.8	90.8	100.1	108.6	143.5	177.9	204.8
5	24.5	37.2	48.2	56.9	71.1	85.4	95.2	111.0	125.5	136.8	151.5	164.6	216.8	269.1	308.9
10	29.9	45.5	59.0	69.6	86.8	104.0	115.8	135.2	153.1	167.3	185.6	201.7	265.4	329.4	377.8
15	32.9	50.2	65.1	76.7	95.6	114.5	127.3	148.8	168.6	184.5	204.8	222.6	292.8	363.5	416.7
20	35.0	53.5	69.4	81.7	101.8	121.8	135.5	158.3	179.5	196.5	218.2	237.2	311.9	387.3	443.9
25	36.7	56.0	72.7	85.6	106.5	127.5	141.7	165.7	187.9	205.8	228.6	248.5	326.7	405.7	464.9
50	41.8	63.8	82.8	97.4	121.2	144.9	161.0	188.4	213.8	234.3	260.5	283.2	372.2	462.3	529.5
100	46.8	71.6	92.9	109.2	135.8	162.1	180.1	210.8	239.5	262.6	292.2	317.7	417.4	518.4	593.6

EQUIVALENT AVERAGE INTENSITY (in mm/hr) OF COMPUTED EXTREME VALUES

Return Period (yrs)	5 mins	10 mins	15 mins	20 mins	30 mins	45 mins	60 mins	80 mins	100 mins	120 mins	150 mins	3 hrs	6 hrs	12 hrs	24 hrs
2	195.6	148.2	127.2	113.4	95.0	76.5	64.2	55.9	50.3	45.4	40.0	36.2	23.9	14.8	8.5
5	294.0	223.2	192.8	170.7	142.2	113.9	95.2	83.3	75.3	68.4	60.6	54.9	36.1	22.4	12.9
10	358.8	273.0	236.0	208.8	173.6	138.7	115.8	101.4	91.9	83.7	74.2	67.2	44.2	27.4	15.7
15	394.8	301.2	260.4	230.1	191.2	152.7	127.3	111.6	101.2	92.3	81.9	74.2	48.8	30.3	17.4

Return Period (yrs)	5 mins	10 mins	15 mins	20 mins	30 mins	45 mins	60 mins	80 mins	100 mins	120 mins	150 mins	3 hrs	6 hrs	12 hrs	24 hrs
20	420.0	321.0	277.6	245.1	203.6	162.4	135.5	118.7	107.7	98.3	87.3	79.1	52.0	32.3	18.5
25	440.4	336.0	290.8	256.8	213.0	170.0	141.7	124.3	112.7	102.9	91.4	82.8	54.5	33.8	19.4
50	501.6	382.8	331.2	292.2	242.4	193.2	161.0	141.3	128.3	117.2	104.2	94.4	62.0	38.5	22.1
100	561.6	429.6	371.6	327.6	271.6	216.1	180.1	158.1	143.7	131.3	116.9	105.9	69.6	43.2	24.7

prepared by:

the HYDROMETEOROLOGICAL INVESTIGATIONS and SPECIAL STUDIES SECTION

Flood Forecasting branch, PAGASA

Table 8-25. Results of ambient air quality monitoring

Station No.	Location	Date and Time of Sampling	PM_{10}	TSP	SO_2	NO_2
A1	Marciano A. Dapar Elementary School, Brgy. Cawilan	6 January 2005 0953 - 1216	10 µg Ncm^{-1}	1	5.9	8.3
A2	Brgy. Dayano near Dayano Elementary School	6 January 2005 1328 - 1612	5.1	3	5.9	ND
A3	Brgy. Siana near Siana Elementary School	7 January 2005 0924 - 1127	4.1	3	ND	4.4
A4	Brgy. Del Rosario	7 January 2005 1348 - 1554	5.1	3.1	ND	ND
DENR Standard for 1-hr sampling			200	300	340	260

Note: ND means not detected.

Table 8-26. Noise level one-hour measurements

Station	Noise Level Leq dB(A)	DENR Standard dB(A)	Remarks
Marciano A. Dapar Elementary School, Brgy. Cawilan	65.23	50	Failed
Brgy. Dayano near Dayano Elementary School	59.27	50	Failed
Brgy. Siana near Siana Elementary School	64.32	50	Failed
Brgy. Del Rosario	62.81	50	Failed

Note: The DENR standard is the maximum allowable noise level for Class "AA" and "A" during daytime (area 100 m away from the school site and area for residential purposes).

Table 8-27. Applicable ambient air quality guideline values and standards

Parameter	Ambient Air Quality Threshold	Threshold Type	Averaging Period
Total Suspended Particulates (TSP)	300 µg Ncm^{-1}	NAAQS	One (1) hour
	230 µg Ncm^{-1}	NAAQGV	Twenty-four (24) hours
SO_2	340 µg Ncm^{-1}	NAAQS	One (1) hour
	180 µg Ncm^{-1}	NAAQGV	Twenty-four (24) hours
NO_2	260 µg Ncm^{-1}	NAAQS	One (1) hour
	150 µg Ncm^{-1}	NAAQGV	Twenty-four (24) hours

Source: DAO No. 2000-81

Table 8-28. Input parameters for the pollution sources

Mining Area			
1. x (East-West coordinate of Southwest Corner)	4700		
2. y (North-South coordinate of Southwest Corner)	4700		
3. z (elevation), m	50		
4.a) Soil Fraction	Sand	Silt	Clay
	0.40	0.35	0.25

Mining Area			
4.b) Average Particle Diameter (mm)	0.20	0.020	0.002
4.c) Particle Density (g cm^{-3})	2.50	2.50	2.65
5. Point Emission Rate (g s^{-1} m^{-2})	0.001		
6. Release Height (m)	Zero (0) or on the ground		
7. Length of x-side (E-W side) of the open pit (m)	600		
8. Length of y-side (N-S side) of the open pit (m)	680		
9. Pit volume (m^3)	8,260,000		
Standby Diesel Generator			
1. x (East-West coordinate of the center point)	4500		
2. y (North-South coordinate of the center point)	5750		
3. Capacity (kVA)	750		
4. Building Height (m)	8		
5. Maximum Building Width (m)	50		
6. Point Emission Rate (g s^{-1})	TSP	NO_2	SO_2
	0.07	2.43	0.82
7. Release height above ground (m)	10		
8.Stack gas exit temperature (ºK)	800.15		
9. Stack gas exit velocity (m s^{-1})	10		
10. Stack inside diameter (m)	1.0		

Table 8-29. Environmental quality standards for noise in general areas

Category	Type	Daytime	Morning/ Evening	Nighttime
AA	Within 100m from school sites, nursery schools, hospitals, and special home for the aged	50 dBA	45	40
A	Residential areas	55	50	45
B	Commercial areas	65	60	55
C	Light industrial areas	70	65	60
D	Heavy industrial areas	75	70	65
Time		9 a.m.– 6 p.m.	5 a.m.– 9 a.m. 6 p.m.–1 0 p.m.	10 p.m.– 5 a.m.

Source: DENR

Table 8-30. Permissible noise exposure in the workplace

Duration per day	Sound Levels, Slow Response
8 hours	90 dBA
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25	115

Source: OHSS

Table 8-31. Predicted noise levels at the Open Pit

Equipment	5 m		10 m		15 m		20 m		50 m		100 m	
	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}
1. Excavator	100.7	96.7	94.7	90.7	91.2	87.2	88.7	84.7	80.7	76.7	74.7	70.7
2. Dump truck	96.5	92.5	90.4	86.5	86.9	82.9	84.4	80.4	76.5	72.5	70.4	66.5
3. Dozer	101.7	97.7	95.6	91.7	92.1	88.1	89.6	85.6	81.7	77.7	75.6	71.7
4. Grader	105.0	101.0	99.0	95.0	95.5	91.5	93.0	89.0	85.0	81.0	79.0	75.0
5. Loader	99.1	95.1	93.1	89.1	89.6	85.6	87.1	83.1	79.1	75.1	73.1	69.1
6. Water cart	112.1	105.1	106.1	99.1	102.6	95.6	100.1	93.1	92.1	85.1	86.1	79.1
7. Loader	99.1	95.1	93.1	89.1	89.6	85.6	87.1	83.1	79.1	75.1	73.1	69.1
8. Crane	100.6	92.6	94.5	86.6	91.0	83.0	88.5	80.6	80.6	72.6	74.5	66.6
9. Rock breaker	108.9	101.9	102.9	95.9	99.3	92.4	96.8	89.9	88.9	81.9	82.9	75.9
10. Pit bores	103.0	100.0	97.0	94.0	93.5	90.4	91.0	87.9	83.0	80.0	77.0	74.0
11. Pumps	100.9	97.9	94.9	91.9	91.4	88.4	88.9	85.9	80.9	77.9	74.9	71.9
12. Pickup truck	95.0	91.0	89.0	85.0	85.5	81.5	83.0	79.0	75.0	71.0	69.0	65.0
13. Pickup truck	95.0	91.0	89.0	85.0	85.5	81.5	83.0	79.0	75.0	71.0	69.0	65.0
TOTAL	**112.1**	**110.1**	**106.1**	**104.1**	**102.6**	**100.6**	**100.1**	**98.1**	**92.1**	**90.1**	**86.1**	**84.1**

Note: All predictions are in dBA.

Table 8-32. Predicted noise levels at the waste rock dump and TSF

Waste Dump	10 m		50 m		100 m		500 m		800 m		900 m	
	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}
1. Dozer	95.6	91.7	81.7	77.7	75.6	71.7	61.7	57.7	57.6	53.6	56.6	52.6
2. Dump truck	90.4	86.5	76.5	72.5	70.4	66.5	56.5	52.5	52.4	48.4	51.3	47.4
3. Dump Truck	90.4	86.5	76.5	72.5	70.4	66.5	56.5	52.5	52.4	48.4	51.3	47.4
TOTAL	**95.6**	**93.7**	**81.7**	**79.7**	**70.6**	**73.7**	**61.7**	**59.7**	**57.6**	**55.7**	**56.6**	**54.6**
TSF	**10 m**		**50 m**		**500 m**		**1000 m**		**1050 m**			
	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}		
1. Compactor	97.2	90.2	83.2	76.2	63.2	56.2	57.2	50.2	56.8	49.8		
2. Dozer	95.6	91.7	81.7	77.7	61.7	57.7	55.6	51.7	55.2	51.2		
3. Dump truck	90.4	86.5	76.5	72.5	56.5	52.5	50.4	46.5	50.0	46.0		
4. Dump truck	90.4	86.5	76.5	72.5	56.5	52.5	50.4	46.5	50.0	46.0		
TOTAL	**97.2**	**95.3**	**83.2**	**81.3**	**63.2**	**61.3**	**57.2**	**55.3**	**56.8**	**54.9**		

Note: All predictions are in dBA.

Annex 8-6. Impact assessment and EMP support information

Project Environmental Monitoring and Audit Prioritization Schemes

Project Name	Siana Gold Project
Project Location	Brgys. Siana and Dayano, Municipality of Mainit and Brgy. Cawilan, Municipality of Tubod Surigao del Norte
ECC Reference No.	
Proponent	Greenstone Resources Corporation
Pollution Control Officer	Aurelio Espeja
Tel No./Fax No.	+63918 202 6287
Project Type	Mining and processing of gold ore
Project Status	Development

Project Consideration

1.1 Size and Type

1.1.1 Size based on the number of employees — Approximately 500 men construction

1.1.2 Type

ECP (in either ECA or Non-ECA)	✓
Non-ECP but in ECA	
Non-ECP and Non-ECA	

1.2 Waste Generation and Management

1.2.1 Enumerate waste type and specify quantity of wastes generated in the facility

Category	Waste	Type		Quantity
		Hazardous	Non-Hazardous	
Air	Dust		✓	
Liquid	Tailings water	✓		1,556 m^3/yr
	Sewage	✓		75,000 m^3/yr
	Used oil	✓		45.5 to 13 m^3/yr
Solid	Tailings (solid)	✓		750,000 tons/yr
	Waste rock		✓	4,800,000 tons/yr (ave)
	Industrial			
	Grinding (steel) balls		✓	175 tons/yr

1.3 Pollution Control System (PCS)

1.3.1 Enumerate PCS or waste management method used in the facility

Category	PCS/Waste Management Method Used	Remarks
Air	Water sprinkling of road as dust suppressor	Continuous during dry periods.
Liquid	Tailings dam and recycling of process water Cyanide detoxification plant	The tailings dam (TD) is a permanent structure, progressively built-up Detoxification is applied prior to release of tailings water to the TD.
	Sewage treatment plant	Permanent structure
	(Used oil) kept in drums	Sold to recyclers
Solid	Tailings dam	Permanent structure, progressive build-up
	Waste rock dump	Permanent structure, progressive build-up
	(Used grinding balls) kept in drums	Sold as scrap

II. Pathways

2.1 Prevailing wind towards barrio or city? Yes __✓__ No _____

Based from the PAGASA Wind Rose diagram 1987-1996

- From the east, 16% of the year, months of February to May.
- West, 13% of the year, months of June to October
- Northeast, 12% of the year, November to March
- Southwest, 10% of the year, from June to July
- South, 9% of the year, months of April and May.
- North, 8% of the year, months of October to February

The average annual mean wind speed is 2 mps. The dry months are May to September.

Construction stage:

Barangay Siana, located immediately to the south of the TD and west of the open pit, may be affected by dust from the earthmoving activities on these structures brought by the southward and westward winds, respectively. Barangay Siana is less than 100 m from the TD and approximately 300 meters from the open pit.

Barangay Cawilan, which is located immediately north of the waste dump and northeast of the process plant site, may be affected by dust carried by winds from the east in the months of February to May, from the south prevailing in the months of April and May and from the southwest during the months of June to July. This community is less than 100 m from the waste dump and process plant site.

Operation stage:

Mining and waste dump operations, and tailings dam build-up will be continuous for the rest of the open pit operation. The tailings dam will be continuously built-up during the underground operation.

2.2 Rainfall (impacts surface and groundwater pathways)

2.2.1 Average annual net rainfall __3,556.4__ mm

2.2.2 Maximum 24-hour rainfall ___566.4__ mm

2.3 Terrain Flat __✓__ Steep_____

2.4 Is the facility located in a flood-prone area? Yes_____ No __✓____

2.5 Groundwater

Depth of groundwater table __10.7___ m (Please see 3.3)

Receiving Media/Receptors

3.1 Air (Distance to the nearest community) __<1.0__km

3.2 Receiving Surface Water Body

3.2.1 Distance to receiving surface water

Surface bodies of water within the Project:

1. Magpayang River __<0.1__km
2. Dayano River __<0.1__km
3. Spanish ditch __<1.0__km

These bodies of surface water fall within the same sub-catchment area with that of the project sites. The sub-catchment is approximately 21 km^2 inside the Magpayang catchment, which has an estimated area of 57 km^2.

3.2.2 Size of population using receiving surface water (The values quoted are the total barangay population as of August 2007 which grossly overstates the actual users of surface water.)

1. Barangay Siana __872__
2. Barangay Cawilan __1,290__
3. Barangay Magpayang __1,498__
4. Barangay Pungtod __1,216__

3.2.3 Fresh water

3.2.3.1 Classification of fresh water

Under Department (DENR) Administrative Order 34, the minimum water quality parameters to be considered for classifying a surface water are dissolved oxygen (DO), pH, biochemical oxygen demand (BOD), and total coliform organisms. In 2005, BMP made a tentative classification of the surface waters impacted by the Project, using total coliforms, oil & grease, phenols, and PO_4 as P as the limiting factors. The following table shows the results of the classification:

Parameter	Magpayang River	Spanish Ditch	Dayano River
BOD_5	A	A	A
Total Coliform	C or D	C	A
Oil & grease	C	C	C
Phenols	D	-	-
PO_4 - P	C or D	B	A

3.2.3.2 Size of fresh water

1. Magpayang River 143 km^2
2. Dayano River 0.03 km^2
3. Spanish ditch 0.002 km^2

3.2.3.2 Economic value of water use

The residents of Barangays Siana, Dayano, and Cawilan, use the rivers as source of their communal irrigation systems (CIS), washing of clothes, bathing, and care for their animals. Magpayang River is also a source of fish.

3.2.4 Salt water - **Not Applicable**

3.3 Ground Water

3.3.1 Distance to nearest recharge area

The open pit is in a volcaniclastic, carbonate (Timamana limestone), and basalt area. The volcaniclastics and basalts with open fractures at depth as well as the karstic limestone provide groundwater flows. Groundwater in the aquifer flows toward Siana pit from the north and west. The near surface alluvial aquifer, about 6 – 12 m thick, flows from the east towards Magpayang River.

3.3.2 Distance to nearest well used 0.7 km

The pit and the water treatment plant are both inside the Project site.

3.3.3 Ground water use within the nearest well – **Not Applicable**

No longer in use because of GRC's potable water system.

3.4 Land

3.4.1 Indicate current/actual land uses within 0.5 km radius

Residential	✓
Commercial/institutional	
Industrial	
Agricultural/recreational	✓
Protected area	None

3.4.2 Potential/proposed land uses within 0.5 km radius

Residential	✓
Commercial/institutional	
Industrial	✓
Agricultural/recreational	✓
Protected area	None

3.4.3 Number of affected Environmentally Critical Areas within 1 km 1

Lake Mainit is located southwest of the Project site and is the recipient of Magpayang River discharge.

3.4.4 Distance to nearest ECA 3.5 km

IV Environmental Performance (for existing projects for expansion)

Not Applicable

……

(To be filled up by EMB Personnel)

RECOMMENDATIONS

_____

_____

_____

_____

_____

Assessed By: _____

Noted By: _____

.....

ACCOUNTABILITY STATEMENT OF PROJECT PROPONENT

This is to certify that all information in the submitted **Project Environmental Monitoring and Audit Prioritization Scheme (PEMAPS) Questionnaire** of _____ located at _____ is true, accurate and complete. Should I learn of any information, which makes this inaccurate, I shall bring said information to the appropriate Environmental Management Bureau Regional Office.

In witness whereof, I hereby set out my hands this _____ day of _____, 200____ at _____.

_____

PROJECT PROPONENT

SUBSCRIBED AND SWORN to before me this _____day of _____ 200____, at _____. Affiant exhibiting to me his/her Community Tax Certificate No. _____ issued on _____ at _____.

Doc. No. _____

Page No. _____

Book No. _____

Series of 200____

Annex 8-7. Profile of the Impact Municipalities

Impact Municipalities

The project's footprint straddles three barangays, namely, Siana and Dayano in the municipality of Mainit and Cawilan in the municipality of Tubod. They are the host municipalities and the direct impact area. Three other barangays, Del Rosario in Tubod, Magpayang in Mainit, and Pongtud in Alegria will be indirectly impacted by the project.

Tubod

Tubod is located in the central part of the mainland province of Surigao del Norte. It is bisected almost equally from north to south by the Philippine National Highway. It is 36 km south of Surigao City, the provincial capital and 88 km from Butuan City, the capital of Agusan del Norte. It is a landlocked municipality bounded by the municipality of Placer on the north, the municipality of Bacuag on the east, and on the west and south by the municipality of Mainit.

Tubod is a fifth class municipality. For 2008, its total Internal Revenue Allotment is P 20,511,970. Of this, P 4,102,394 is allocated for Development Projects.

Topography and Land Features

The physical land features of Tubod vary from flat and gently sloping to hilly and highly steep with an average elevation of 80 m above sea level. Except in the southern part where the lowlands are located, the municipality is surrounded by mountains and forestland. The barangays with a slope of 0 to 8 % include Poblacion, San Pablo, Marga, and Del Rosario. The mountain ranges of Mt. Diwata, rising up to 300 meters, border the boundary of Tubod and Bacuag. These ranges have a slope of more than 50 %. Mt. Maniayao with an elevation of 644 m, divides Tubod and Mainit on the western and southern sides. The boundary has a slope of 30 to 50 %.

The municipality has a total land area of 5,464 ha. The alienable and disposable land covers three-fourths and the balance is classified as forestland.

History

The name Tubod was derived from the Visayan term Tuburan, meaning spring. This spring, now called Songkoy, is the municipality's major source of domestic and irrigation water.

The Mamanwas were the original settlers of Tubod. They moved to the hinterlands when Christian migrants occupied the area. Agustin Mendez, a Boholano, was the first Christian settler and considered the founder of Tubod. He planted large tracts of land with abaca, rice, root crops, and coconuts. Other migrants from Bohol, Leyte, and Camiguin later settled in the area and engaged in farming.

Tubod was originally a sitio of Timamana, one of the barangays of Placer. In 1909, it became a barangay under the leadership of Agustin Mendez. In 1931, it was declared a barangay of the municipality of Mainit. On September 18, 1957, it was finally classified as an independent municipality by virtue of Executive Order 269 issued by President Carlos P. Garcia. Agustin Mendez was likewise instrumental in its proclamation as a municipality. To support its approval, he donated the lot for the municipal site. The first municipal officials assumed office on 4 October 1958.

Political Subdivisions

Tubod's area comprises 2 % of the land area of Surigao del Norte. It consists of nine (9) barangays shown in Figure 1. Six (6) barangays are located along the National Highway, namely: Poblacion, San Pablo, Del Rosario, Marga, Motorpool and Timamana. San Isidro, Capayahan, and Cawilan are in the periphery.

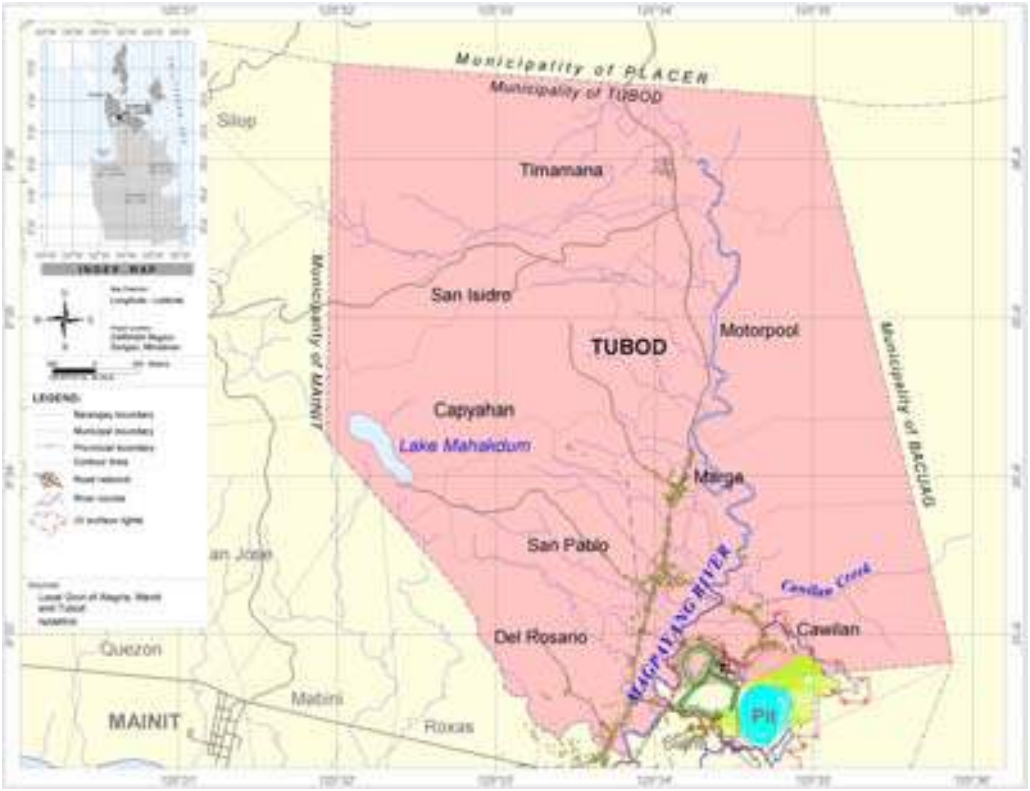

Figure 1. Political map of Tubod

Land Area and Population

As of 2007, the total population is 11,664. Population density is 2.13 persons ha^{-1}. The three (3) urban barangays, namely: Timamana, Poblacion, and San Pablo cover a third of the municipality's land area and account for 37 % of the population. Poblacion, the seat of government, is the most densely populated with 7.7 persons ha^{-1} while Timamana, the biggest barangay that occupies a fourth of the municipality has the lowest density of 1.27 persons ha^{-1}.

Table 1. Land area, population and population density, Municipality of Tubod, 2007

Barangay	Area (km^2)	2007	Population Density
URBAN	1,784.50	**4,356**	2.44
Poblacion	198.50	1,529	7.70
San Pablo	270.90	1,162	4.29
Timamana	1,315.10	1,665	1.27
RURAL	3,679.10	7,308	1.99
Capayahan	678.90	906	1.33
Cawilan	541.80	1,290	2.38
Del Rosario	496.10	1,249	2.52

Barangay	Area (km^2)	2007	Population Density
Marga	682.90	1,382	2.02
Motorpool	798.70	1,485	1.86
San Isidro	480.70	996	2.07
Total	5,463.60	11,664.00	2.13

Sources: MPDO and NSO

Over a twelve-year period from 1995 to 2007, Tubod's population grew by an average of 1.1 % per year, less than half of the Philippine average of 2.24 %. With the exception of Poblacion and Cawilan, the population in the other barangays registered increases over the three censal years. The decrease in population from 1995 to 2000 in these two barangays is attributable to the closure of Surigao Consolidated Mining Corporation in 1991.

As of 2000, the average household size in Tubod is 5.05, slightly higher than the national average of 5.

Table 2. Population and household population, Municipality of Tubod, 2007, 2000 and 1995

Barangay	Population			No. of Households		Average Household Size	
	2007	2000	1995	2000	1995	2000	1995
TUBOD	**11,664**	**10,923**	**10,318**	**2,165**	**2,022**	5.05	5.10
Urban	**4,356**	**4,239**	**4,009**	**840**	**785**	5.05	5.11
Poblacion	1,529	1,455	1,515	294	293	4.95	5.17
San Pablo	1,162	1,280	1,009	238	200	5.38	5.05
Timamana	1,665	1,504	1,485	308	292	4.88	5.09
Rural	**7,308**	**6,684**	**6,309**	**1,325**	**1,237**	5.04	5.10
Capayahan	906	775	690	160	133	4.84	5.19
Cawilan	1,290	1,101	1,243	203	227	5.42	5.48
Del Rosario	1,249	1,302	1,221	249	238	5.23	5.13
Marga	1,382	1,370	1,199	272	232	5.04	5.17
Motorpool	1,485	1,368	1,214	276	248	4.96	4.90
San Isidro	996	768	742	165	159	4.65	4.67

Source: NSO

As of 1995, Boholano is the predominant dialect spoken by 71 % of the population. Surigaonon is the mother tongue of a fifth (22 %) of the population. Minor dialects spoken include Cebuano, Butuanon, and Tagalog.

Crop Production

Tubod's economy is agriculture-based. Three-fifths (3,345 ha) of the land area is planted to various crops. Coconut is the predominant crop, occupying 2,912 ha or 88 % of the total agricultural land. Rice is the major food crop planted to 393.02 ha. Of this, 365 ha or 93 % is irrigated. The Department of Agriculture (DA) considers the municipality as a major rice producing area. Seven (7) of its nine (9) barangays are key grain producers: Timamana, Motorpool, Marga, Cawilan, Poblacion, San Pablo, and Del Rosario.

Fishery

Lake Mahacdum is the main source of freshwater fish in Tubod. Carps and tilapia are grown in fish cages. The fisherfolks employ the traditional fishing methods such as hook and line, spear gun and gill nets. Most of the fishermen in the municipality come from Capayahan.

Commercial Establishments

Municipal Treasury records show that as of May 2002, there are 181 commercial establishments operating in Tubod. Three-fourths (78 %) are sari-sari or variety stores. Other business establishments include: eatery and refreshment 3, pharmacy 2, copra buyer 9, consumer cooperatives 2, tailoring 1, beauty parlor 1, and bakeries 3.

Industry

Two mining companies are currently exploring in the area. These are Greenstone Resources Corporation in Cawilan and Silangan Mining in Timamana. Other industrial establishments include rice mills, small welding shops, blacksmiths, and wooden/bamboo furniture manufacturing.

Electricity

The Surigao Del Norte Electric Cooperative (SURNECO) supplies electricity to the municipality. As of 2001, it has provided power to 90 % of the urban households and 78 % of the rural households.

Cooking Fuel

Majority of the households use wood, bamboo and charcoal as cooking fuel. A third of the households use liquefied petroleum gas (LPG) and a tenth use electric stove for cooking.

Communications

TELECOM and PHILCOM provide telephone lines with national and international direct dialling services. SMART cell phone signal is available in the whole municipality. There is one post office manned by one person.

The Philippine National Police use radio transceivers that cover the whole Caraga region. The local government provides handheld radios to the Municipal Health Office, Mayor's Office, and the nine Barangay Captains.

Road Network and Transportation

Tubod has a total road network of 48 km. This consists of 7 km national road, 17.4 km provincial road, 5.5 km municipal road, and 18.2 km barangay road. Seventy percent of the roads is gravel filled; twenty percent, including the entire National Road, is concrete; and the balance is earth filled.

Buses going to different areas in Mindanao ply the National Highway. There are also multi-cabs and air-conditioned vans that take passengers to Surigao City. Tricycles transport people within the municipalities and barangays.

Educational Facilities

Brgy. San Isidro has a primary school each. The other barangays have complete elementary schools. The Tubod National High School and Timamana National High School provide secondary education to the municipality residents.

Health Facilities

The Rural Health Unit is located in Brgy. Poblacion. Only two (2) out of nine (9) barangays have health centers. These are Timamana and Capayahan. The services rendered by these health facilities are discussed at length in the Public Health section.

Protective Services

The Tubod government employs 9 policemen. The police station is equipped with a patrol jeep, communication facilities, and long firearms. Assisting the police force are some 67 Barangay Tanods or guards stationed in their respective areas.

From 1997 to 2001, a total of 486 crimes were committed in the municipality. A third constituted alarms and scandals; 23 % involved physical injury; 17 % murder; 15 % theft and 6 % robbery.

Sports and Recreation

The municipality has a new 1,550 m^2 gymnasium located in the Poblacion. There is a municipal park, recreational garden, and a cockpit. All barangays except Capayahan have basketball courts. The multi-purpose drying pavements in some barangays are likewise used for recreational and sports activities. Barangays Poblacion, Timamana, Capayahan, Cawilan, Marga, Motorpool, and San Isidro have multi-purpose buildings for social and official functions.

Tourism

There are a number of potential tourist spots in Tubod. The most notable is the Songcoy Cold Spring in Marga which is about 1.4 km from the National Highway. The other tourist attractions are the 26-ha Lake Mahacdum situated at the foot of Mt. Maniayaw and the historical mass graves of local freedom defenders during the 1924 Colorum Uprising.

Social Welfare

The municipality has one Social Welfare Officer who implements programs for the indigent families, malnourished children, out of school youth, women, senior citizens, disaster victims and the disabled. She also supervises the operations of the Day Care Centers located in each of the nine (9) barangays.

Mainit

Mainit, literally meaning “hot”, is a town by the Lake Mainit. It is approximately 44 km from Surigao City. Located in the southwestern part of the province within the grid 9^o 26’ to 9^o 35’ north latitude and 125^o 26’ to 125^o 32’ east longitude, it is bounded on the north by the municipalities of Sison and Placer; on the south by the municipality of Alegria and Agusan del Norte Province; on the east by the municipalities of Tubod and Bacuag and on the west by the municipality of Malimono.

Mainit is a fourth class municipality. For 2008, its IRA is P 31,470,154 and the Development Fund is P 6,294,031.

History

Like Tubod, the Mamanwas were the first settlers of Mainit. According to oral tradition and unpublished studies, the Mamanwas were already living in the area as early as the 1800s. They originally settled near Lake Mainit, in what is now Barangay San Isidro. They were gradually pushed to the hinterlands by the migrants from Luzon and Visayas.

Mainit’s political history started in 1904 when the Americans created it as a barrio of Placer, Surigao. In 1906, it was claimed by Agusan Province as part of its territory and was declared as a separate municipality. The territorial conflict was settled six months later when Mainit was returned to Placer. On 1 January 1931, it became a Municipality by

virtue of Executive Order 290 dated 27 December 1930. Antonio Mozar was its first mayor. Two barrios of Mainit became separate municipalities. These are Tubod (1958) and Alegria (1968).

Political Subdivisions

Figure 2. Political map of Mainit

The Municipality of Mainit has a land area of 15,354 ha distributed in 21 barangays. The five urban barangays occupy 28 % of the land area and the sixteen (16) rural barangays cover 72 %.

Land Area and Population

Table 3 gives the land area and the creation dates of the barangays.

Table 3. Land area, population and population density, Municipality of Mainit, 2007

Barangay	Land Area (km^2)	Population 2007	Population Density (persons ha^{-1})	% to Total Land Area	Date Created	How Created
MAINIT	**15,353.8**	**23,952.0**	**1.6**			
Urban	4,212.0	12,709.0	**3.0**	27.43%		
Magpayang	595.0	1,498	**2.5**	3.88%	11/15/1956	Prov'l Board Resolution
Magsaysay	867.0	1,733	**2.0**	5.65%	3/16/1960	RA 3590
Matin-ao	965.0	3,810	**3.9**	6.29%	11/15/1956	Prov'l Board Resolution
Quezon	865.0	3,547	**4.1**	5.63%	3/16/1960	RA 3590
San Francisco	920.0	2,121	**2.3**	5.99%	11/15/1956	Prov'l Board Resolution

Barangay	Land Area (km^2)	Population 2007	Population Density (persons ha^{-1})	% to Total Land Area	Date Created	How Created
Rural	11,141.8	11,243.0	**1.0**	72.57%		
Binga	665.8	372	**0.6**	4.34%	11/15/1956	Prov'l Board Resolution
Bobonaon	668.0	259	**0.4**	4.35%	11/15/1956	Prov'l Board Resolution
Cantugas	915.0	1,373	**1.5**	5.96%	1/16/1958	Prov'l Board Resolution
Dayano	700.0	402	**0.6**	4.56%	2/16/1959	Prov'l Board Resolution
Mabini	600.0	916	**1.5**	3.91%	10/8/1960	RA 3590
Mansayao	825.0	634	**0.8**	5.37%	11/15/1956	Prov'l Board Resolution
Marayag	565.0	292	**0.5**	3.68%	10/5/1960	RA 3590
Paco	946.0	607	**0.6**	6.16%	11/15/1956	Prov'l Board Resolution
Roxas	667.0	1,348	**2.0**	4.34%	7/27/1972	Prov'l Board Resolution
San Isidro	865.0	1,455	**1.7**	5.63%	1/16/1958	Prov'l Board Resolution
San Jose	790.0	705	**0.9**	5.15%	10/3/1960	RA 3590
Siana	550.0	872	**1.6**	3.58%	11/15/1956	Prov'l Board Resolution
Silop	705.0	253	**0.4**	4.59%	6/1/1962	Prov'l Board Resolution
Tagbuyawan	515.0	342	**0.7**	3.35%	5/7/1959	Prov'l Board Resolution
Tapian	565.0	206	**0.4**	3.68%	1/16/1958	Prov'l Board Resolution
Tolingon	600.0	1,207	**2.0**	3.91%	2/16/1959	Prov'l Board Resolution

Sources: MPDO and NSO

In 2000, Mainit's household population was 23,365 distributed in 4,621 households, yielding an average household size of 5.05 (Table 4). From 2000 to 2007, population grew by 0.33 %, which is a quarter of the population increment of 1.24 % for Surigao del Norte over the same period. As of August 2007, the gross urban density is 3 persons ha^{-1} while the gross rural density is 1 person ha^{-1}.

Table 4. Population and household population, Municipality of Mainit, 2007 and 2000

Barangay	Population		Household Population 2000	Number of Households 2000
	2007	2000		
MAINIT	**23,952**	**23,417**	**23,365**	**4,621**
Urban	12,709	12,637	12,595	2,535
Magpayang	1,498	1,520	1,520	287
Magsaysay (Pob.)	1,733	1,898	1,897	381
Matin-ao	3,810	3,811	3,774	768
Quezon	3,547	3,273	3,269	663
San Francisco	2,121	2,135	2,135	436
Rural	11,243	10,780	10,770	2,086
Binga	372	405	405	79

Barangay	Population		Household Population 2000	Number of Households 2000
	2007	2000		
Bobona-on	259	169	169	35
Cantugas	1,373	1,381	1,381	246
Dayano	402	405	405	73
Mabini	916	960	960	185
Mansayao	634	588	588	121
Marayag	292	230	230	44
Paco	607	715	715	128
Roxas	1,348	1,141	1,141	218
San Isidro	1,455	1,477	1,477	307
San Jose	705	640	640	128
Siana	872	786	786	156
Silop	253	254	244	49
Tagbuyawan	342	292	292	68
Tapi-an	206	180	180	40
Tolingon	1,207	1,157	1,157	209

Source: NSO

Surigaonon is spoken by 92 % of the population. The minor dialects are Boholano (2 %) and Cebuano (1.65 %).

The dominant religion is Roman Catholic. As of 2000, 70 % of the municipality's population belonged to this religion. Those affiliated with the Aglipay and United Church of Christ in the Philippines (UCCP) constituted 11 % and 10 %, respectively. Other religions were 7th Day Adventists, Iglesia ni Cristo, and Church of the Latter Day Saints.

Crop Production

Mainit is an agricultural community. Agricultural land covers 11,852 ha or 88 % of the municipality's land area. Rice is the principal crop and coconut is the secondary crop. Approximately 1,336 ha are planted to this crop. Coconut is the second major crop with an annual production of 8,559 t and total hectarage of 7,133 ha. Brgys. Silop, Bobonaon, Marayag, and Paco are highly dependent on coconut. Banana is the third most important crop with an annual production of 575 t and area of 229 ha. Other agricultural crops include vegetables, gabi camote, cassava and other root crops.

Fishery

The municipality is located around Lake Mainit, the 4th largest lake in the country with an area of 14,700 ha. Mainit has jurisdiction over 4,425 ha. (29 %) of this lake. This area is suited to commercial production of ducks and inland fish culture. The most common freshwater species caught in the lake are carp, white goby, catfish, tilapia, mudfish, and eel. Tapyuson and other shells also abound in the lake. Fishing is the main source of livelihood in the lakeshore barangays of Tapi-an, Tagbuyawan and Mansayao. The ten (10) other barangays also derive income from fishing.

Educational Facilities

All twenty-one (21) barangays of Mainit have public elementary schools. Eight (8) have primary schools only while thirteen (13) have complete elementary schools. Brgy. Tolingon has two (2) schools, one complete elementary and a primary school at Sitio Mahayahay. Brgy. Cantugas has a complete elementary school and a Cultural Community School that caters to the Mamanwas.

There are currently two (2) private kindergarten schools. The first is the San Nicolas Academy and the second is the Early Childhood Learning Center which is run by the United Church of Christ in the Philippines. Both schools are located in the Poblacion.

There are four (4) public secondary schools and a private high school, the San Nicolas Academy. It is run by the Catholic Parish of Mainit.

The Surigao del Norte College of Agriculture used to be a tertiary school. It was downgraded to a technical school when management was transferred to the Technical Education and Skills Development Authority (TESDA) in 2004.

Health Facilities

The Mainit Main Health Center is located in the poblacion. There are four (4) Barangay Health Stations located in Brgys. Paco, Magpayang, and Matin-ao.

Protective Services

The municipality employs 17 policemen. It has no police vehicle and lacks communication facilities. Although considered generally peaceful, Mainit has unlawful activities such as illegal fishing, tree cutting, and gambling that could not be controlled due to the lack of manpower and equipment. Insurgency is a major issue.

Sports and Recreational Facilities

Public sports and recreational facilities consist of 34 basketball courts, two (2) volleyball courts, and two (2) tennis courts. There are privately owned billiard halls and two (2) cockpit arenas.

Social Welfare

Six (6) barangays, namely, Roxas, San Jose, Siana, Mabini, San Isidro, and Mansayao are covered by the Comprehensive and Integrated Delivery of Social Services (CIDSS) of the Department of Social Welfare and Development (DSWD). Projects being implemented include water and sanitation, livelihood, facilities and organization of community welfare structures.

Aside from the CIDSS projects, the social welfare staff also supervises the operation of sixteen (16) Day Care Centers in fourteen (14) barangays.

Alegria

The Municipality of Alegria is situated at latitude 9^{o} 23' to 9^{o} 27' and longitude 125^{o} 44'30". It is bounded on the north by the municipality of Mainit, on the south by the Municipality of Kitcharao, Agusan del Norte, on the east by the Municipality of Gigaquit, and on the west by Lake Mainit. It is 48 km away from Surigao City and 75 km from Butuan City, the Caraga Regional Center.

Alegria is a 5^{th} Class Municipality with an IRA of P 22,428,428 for 2008.

History

Alegria was originally known as Sitio Anahaw. The name Alegria, meaning happy or lively in Spanish, was adopted at the suggestion of Judge Sixto Olga. He happened to pass by the place one night when the folks were having a party. The people asked him to join them in their merrymaking. Observing how happy the people were, he advised them to change the name of the place from Sitio Anahaw to "Alegria". Sitio Alegria became a municipality on 15 June 1968 by virtue of RA 5239. Its first mayor was Tomas V. Cosca, an Ilongo from Pilar, Cadiz.

Political Subdivisions

Figure 3. Political map of Alegria

Twelve (12) barangays comprise the municipality. Five (5) are urban and seven (7) are rural. As of 2007, the municipality's population is 13,369. Of this, 59 % is urban and 41 % is rural.

Land Area and Population

Table 5 shows the land area and 2007 population and population density for Alegria. Alegria has an area of 6,670 ha. The rural barangays occupy 78 % of the total area while the urban barangays cover 22 %. The overall population density is 2 persons ha^{-1}. Brgy. Poblacion has the highest population density (5 persons ha^{-1}) while Camp Edward has the lowest (0.25 person ha^{-1}).

Table 5. Land area, population and population density, Municipality of Alegria, 2007

Barangay	Land Area (ha)	Population 2007	Population Density (Persons ha^{-1})
ALEGRIA	**6,670**	**13,369**	2
Urban	1,483	7,887	5
Anahaw	160	1,128	7

Barangay	Land Area (ha)	Population 2007	Population Density (Persons ha^{-1})
Julio Ouano	186	1,707	9
San Pedro	484	2,135	4
Poblacion (Alegria)	178	1,701	10
Pongtud	475	1,216	3
Rural	5,187	5,482	1
Alipao	350	1,747	5
Budlingin	1,193	536	0
Camp Edward (Geotina)	1,530	387	0
Ferlda	1,340	326	0
Gamuton 3	175	514	3
Ombong	280	687	2
San Juan	319	1,285	4

Sources: MPDO and NSO

Alegria's population grew at an annual rate of 0.5 % from 2000 to 2007. In 2000, its household population of 12,919 was distributed in 2,350 households, giving an average household size of 5.5.

Table 6. Population and household population, Municipality of Alegria, 2007 and 2000

Barangay	Population		2000 Household Population	2000 Number of Households
	2007	2000		
ALEGRIA	**13,369**	**12,923**	**12,919**	**2,350**
Urban	7,887	7,825	7,821	1,453
Anahaw	1,128	935	935	182
Julio Ouano	1,707	1,504	1,504	287
San Pedro	2,135	2,411	2,411	448
Poblacion (Alegria)	1,701	1,604	1,600	288
Pongtud	1,216	1,371	1,371	248
Rural	5,482	5,098	5,098	897
Alipao	1,747	1,618	1,618	299
Budlingin	536	551	551	90
Camp Edward (Geotina)	387	284	284	43
Ferlda	326	298	298	48
Gamuton 3	514	464	464	78
Ombong	687	646	646	108
San Juan	1,285	1,237	1,237	231

Source: NSO

Surigaonon is spoken by 9 out of 10 residents. Minor dialects include Cebuano and Boholano.

Roman Catholic is the predominant religion (70 %), followed by Aglipay (13 %), and Iglesia ni Kristo (10 %).

Crop Production

Alegria is one of the major rice producers in Surigao. Total hectarage devoted to rice is 824.5 ha. Of this, 96 % or 791 ha is irrigated. The average area cultivated per farmer is 1.27 ha. Post-harvest facilities consist of 9 rice mills, 9 warehouses, 9 solar and 4 mechanical dryers. There are also sixteen (16) cereal traders who buy the produce of the farmers.

Coconut is another major crop planted to 1,795 ha. Banana, the third most important crop occupies 196 ha. The Sarabia variety is planted to some 193 ha while the Latundan variety is cultivated in 3 ha of land. Fifty-two (52) hectares are devoted to rootcrops such as cassava (35 ha), sweet potato (20 ha) and yam (2 ha).

Livestock

Chickens, ducks, and hogs are grown mainly for consumption. Cattle is raised for milk and meat. They are slaughtered only on very special occasions such as fiestas and weddings. Carabaos and horses are used as farm animals. Dogs are not consumed but the Department of Agriculture takes the numbers for its anti-rabies campaign. All dogs are given anti-rabies shots to eradicate rabies which is endemic in the whole Philippines.

Commercial Establishments

Sari-sari stores (small variety stores) dominate the commercial establishments. Other enterprises consist of rice mills and post-harvest facilities, copra buyers, and fertilizer and agri-supplies retailers. There is a rural bank, two (2) groceries/wholesalers, two (2) mini-hardwares, a beauty parlor, and four (4) body building/welding and vulcanizing shops in the urban barangays.

In the three (3) far-flung barangays of Budligin, Camp Edward, and Ferlda, people purchase their needs on Mondays and Thursdays which are the Tabuan or market days. There are no registered commercial enterprises in these barangays.

Utilities

Smart and Globe signals are available in the municipality. There is a cable network company and a government-run calling center and telegraph office. There is a Post Office that provides mail and money order services. PhilCom also operates a telephone station in Brgy. Ouano.

The Surigao del Norte Electric Cooperative (SURNECO) serves eight (8) out of twelve (12) barangays. These are Poblacion, Ouano, Gamuton, Anahaw, San Pedro, Ombong, San Juan, and Pongtud.

Industrial Establishments

The industrial establishments consist of a jewelry maker, a furniture maker, a cement factory, a hollow block factory, and three (3) trisikad fabricators.

Educational Facilities

There are four (4) complete elementary schools, two (2) complete primary schools, three (3) incomplete primary schools, and one(1) high school in Alegria. None of them has a library, clinic or laboratory.

Protective Services

The municipality employs ten (10) policemen to maintain peace and order. It has a fire station building but no fire personnel and fire-fighting equipment.

Sports and Recreation

The sports facilities in Alegria consist of basketball and volleyball courts. Except for Brgy. Poblacion, all the barangays have basketball courts. There are volleyball courts in Brgys. Anahaw, Ombong, and Alipao.

Tourism

There are two (2) potential tourist attractions in Alegria. These are the Pongtud Hot Springs in Pongtud and Le Mundo Waterfalls in Budligin.

Social Welfare

Two registered social workers service the needs of the women, children, senior citizens, indigents and other vulnerable groups in the 12 barangays. There are 11 Day Care Centers that cater to the 3 to 5 years old children.

Annex 8-8. Heads of agreement between JCG resources and Bremer Resources

PH 041

SIANA JOINT VENTURE
HEADS OF AGREEMENT

1. PARTIES

1.1 JCG Resources Corporation of 12th floor, Ever Gotesco Corporate Centre, 1962 CM Recto Ave, Manila ("JCG"), a corporation incorporated in the Philippines.

1.2 Bremer Resources NL of Level 1, 43 Ventnor Avenue, West Perth, Western Australia ("Bremer"), a corporation incorporated in Australia and a wholly owned subsidiary of Greenstone Resources NL, an Australian public listed company ("Greenstone").

2. BACKGROUND

2.1 JCG is the applicant for a Mineral Production Sharing Agreement registered with Mines & Geosciences Bureau Region XIII as APSA No 032-XIII covering approximately 3,321 hectares in the Municipalities of Tubod, Alegria and Mainit in the Province of Surigao del Norte ("the MPSA").

2.2 The area covered by the MPSA includes the Siana Gold Project and covers also additional adjoining ground.

2.3 Bremer wishes to examine the feasibility of recommencing production at Siana, and to explore for gold and other minerals on the MPSA area.

2.4 These Heads of Agreement ("HOA") establish the basis on which JCG and Bremer agree to conduct exploration and, if feasible, mining operations on the MPSA. These HOA replace the Heads of Agreement between the parties dated 9th November, 2001.

3. MPSA

3.1 The area of the MPSA is marked on the map appended to this Agreement.

3.2 The MPSA was lodged with MGB Region XIII on 12 September 1997.

3.3 The MPSA, when granted, will give sole and exclusive rights to explore for and mine gold and all other minerals to JCG over the area contained within it.

4. DUE DILIGENCE & TECHNICAL REVIEW

4.1 From the date of signing this Agreement, Bremer will have a period of four (4) Months within which to complete Due Diligence, as described in this Agreement.

4.2 The purpose of Due Diligence is to enable Bremer to:

4.2.1 Ascertain the status of the MPSA and establish the likely time required to have it approved and signed by the Secretary, Department of Environment & Natural Resources,

4.2.2 Establish what permits and approvals (if any) are still valid for the Siana Mine.

4.2.3 Assess the rehabilitation and environmental liabilities arising from the Siana Mine.

4.2.4 Assess surface land ownership in the MPSA area, and its effect on exploration and mining.

4.2.5 Ascertain the effect of the Indigenous Peoples' Rights Act ("IPRA") on exploration and mining in the MPSA area.

4.2.6 Ensure that no other party and that Bremer had been appraised by JCG of any and all possible claims, (including Phoenix Mining Corporation and its associates) over mining rights in the MPSA area.

4.2.7 Establish whether there are any outstanding fees or taxes in connection with the foregoing issues.

4.3 Over the four (4) month period within which it carries out Due Diligence, Bremer will also conduct a Technical Review, as described in this Agreement.

4.4 In the Technical Review, Bremer will:

4.4.1 Examine all exploration and mining data available.

4.4.2 Access the computerised data base held by Snowden & Associates and, if feasible, have that data completed and analysed.

4.4.3 Visit the MPSA area and conduct such geological appraisal and surface sampling as it deems appropriate.

4.5 Due Diligence and the Technical Review will be carried out at the expense of Bremer but JCG will provide all reasonable assistance, including all relevant documentation and exploration data under its control. Costs incurred by JCG will, subject to prior approval by Bremer, be reimbursed by Bremer.

4.6 Bremer will keep JCG informed of the progress of its Due Diligence and Technical Review, and will advise JCG promptly of any major concerns which arise out of its work. Any controversy in regard to the mining area claim subject of the Agreement shall be handled by and for the account of Bremer with the reasonable assistance of JCG.

5. INITIAL DRILLING

5.1 Bremer has the right, at its discretion, to undertake a limited drilling program ("the Initial Drilling") at the MPSA area through its affiliate Bremer (Binalbi) Corporation or another qualified entity that Bremer shall cause to be registered in the Philippines.

5.2 Prior to undertaking the Initial Drilling, Bremer will establish whether existing mining titles and permits, or the MPSA, authorise drilling at the desired locations without obtaining any further permits or approvals.

5.3 If the MPSA or existing mining titles authorise it, then Bremer must, if it wishes to undertake the Initial Drilling, do so within six months of the date of signing this Agreement.

5.4 If the Initial Drilling is not permitted by the MPSA or existing mining titles, Bremer will make application to MGB Region XIII (and if necessary, MGB Manila) and obtain at its cost authority necessary to conduct the Initial Drilling. JCG will provide Bremer with all reasonable assistance in obtaining the authority.

5.5 If Bremer and/or JCG is required to obtain approval to conduct the Initial Drilling, then the period within which Bremer has to conduct that Initial Drilling will be the later of :

5.5.1 Six months from the date of this Agreement; and

5.5.2 Three months after obtaining approval from MGB for the Initial Drilling.

5.6 Bremer will notify JCG of its intention to conduct the Initial Drilling and advise the approximate locations for the drilling to be carried out. Bremer will observe all relevant regulatory and environmental requirements and use sound and safe practices in performing the Initial Drilling including holding adequate all risks

insurance and will rehabilitate all drilling sites to their original condition on completion of the Initial Drilling.

6. EXPLORATION PERIOD

6.1 Bremer has the right, exercisable at any time within 30 days of expiry of the period allowed for the Initial Drilling by Clause 5.5.1 or Clause 5.5.2, as appropriate, to elect to proceed with exploration over the MPSA area on the terms described in this Agreement.

6.2 If Bremer wishes to exercise its right under Clause 6.1 it will notify JCG in writing, whereupon the Exploration Period will commence. Bremer has the right to assign or transfer all or part of its rights and interest under this Agreement to Bremer (Binaliw) Corporation or another qualified entity as allowed under Clause 15.3 herein if such assignment or transfer is necessary to comply with the requirements of Philippine law.

6.3 The term of the Exploration Period will be for five years from the date of the notification by Bremer referred to in Clause 6.2, or until Bremer gives notice pursuant to Clause 6.8, whichever is the earlier.

6.4 During the Exploration Period, Bremer will have sole and exclusive rights to conduct exploration (including drilling) on the MPSA area. The extent, nature and location of the exploration will be determined by Bremer in its sole discretion. The exploration activities will be undertaken by Bremer (Binaliw) Corporation or another qualified entity that Bremer will cause to be registered in the Philippines. JCG will ensure that, at no cost to Bremer, Bremer and its successors or assignees in interest as allowed under Clause 15.3 of this Agreement have at all times during the Exploration Period access to and right of way through the properties owned by Golesco Land Inc or any of its subsidiaries, affiliates and related companies for purposes of undertaking exploration and testing (including drilling) in the MPSA area.

6.5 At any time during the Exploration Period, Bremer can elect (at its sole discretion) to prepare (or have prepared) at its expense, a Bankable Feasibility Study for the conduct of mining over one or more locations on the MPSA area. For the purpose of this Agreement, "Bankable Feasibility Study" means a detailed study into the technical, commercial and economic feasibility of mining, and for the development of all associated facilities and infrastructure, in a form acceptable to a reputable international financial institution experienced in mining project financing.

6.6 Upon completion of a Bankable Feasibility Study (a copy of which will be provided to JCG), Bremer will have earned an 80% interest in all gold and other minerals in the MPSA area and JCG will have the right to a 20% interest in that gold and those minerals, subject to the terms of the MPSA and Philippines laws.

6.7 Upon notification by Bremer that it has completed the Bankable Feasibility Study and is entitled to an 80% interest in gold and other minerals in the MPSA area, JCG shall do all things requested by Bremer and permitted by law including, without limitation, applying for a Financial and Technical Services Agreement over all or part of the MPSA area to enable Bremer to obtain title to and exploit its rights, subject to this Agreement. Costs incurred by JCG in complying with any request will be met by Bremer, subject to prior approval by Bremer.

Pending the approval by the Departmental Secretary of the Philippine Department of Energy and Natural Resources of a Financial and Technical Services Agreement, as aforesaid, or in the event that such approval is not granted, it is agreed subject to Philippine Law that Bremer (or Bremer's Philippine Qualified Person nominee) shall still remain entitled to an 80% interest in gold and other minerals in the MPSA and JCG agrees to execute any agreement (including, without limitation, a beneficiation

agreement, a transfer of economic interest agreement or an agreement providing for "layered" ownership) having the effect of insuring that Bremer or its nominee as aforesaid enjoys 80% of the economic interest in the gold and other minerals in the MPSA area and any profits arising therefrom.

Where Bremer seeks to establish a "layered" ownership (in conformity with Philippine Law), JCG will be given a right of first refusal to participate in each of the other layers of ownership. This right will involve a notification period of not less than 14 days and will specify cash only contributions.

6.8 After completion of the Bankable Feasibility Study, Bremer may give JCG written notice of its intention to proceed with a mining development for gold and other minerals in the MPSA area.

6.9 Within 90 days of receipt of the notification referred to in Clause 6.8, JCG must advise Bremer in writing whether it wishes to:

(a) Participate in the mining development to the extent of its 20% interest; or

(b) Sell its 20% interest to Bremer; or

(c) Withdraw from this Agreement and receive the Net Smelter Royalty.

If JCG fails to give Bremer the necessary written notice within the 90-day period, Bremer shall send a written final notice for JCG to exercise its option or choice. Failure of JCG to exercise the option after a lapse of 7 days from receipt of the final notice shall be deemed that JCG elected option 6.9 (c) of this agreement.

6.10 Following notification by JCG of its wishes pursuant to Clause 6.9 (or its deemed election, if applicable), the provisions of this Agreement dealing with:

(a) A Mining Joint Venture;

(b) Sale of JCG Interest; or

(c) The Net Smelter Royalty

shall apply, as appropriate.

6.11 If, at the conclusion of the Exploration Period, there has been a mineral resource identified which is not capable of being mined economically at that time, but in the opinion of Bremer may be able to be mined economically in the future, Bremer may by notice in writing to JCG elect to extend the Exploration Period for a further two years. Provided Bremer makes the payments referred to in Clause 10.1(d), JCG will grant that extension.

6.12 If Bremer does not exercise its right to enter into the Exploration Period pursuant to Clause 6.1, this Agreement will be at an end and Bremer will have no further rights or obligations in respect of the MPSA and will return to JCG all exploration and mining data (including the results of the Initial Drilling, if any).

7. MINING JOINT VENTURE

7.1 If, pursuant to either Clause 6.9(a) or Clause 6.6(a), JCG elects to participate in the proposed mining development, a Mining Joint Venture will be formed with the parties holding the following interests:

Bremer or its assignee(s) as permitted by Clause 15.3	80%
JCG	20%

7.2 The Mining Joint Venture will take the form necessary to reflect the interests and intentions of the parties, and in compliance with the relevant law. Both parties will do

all things (including, if appropriate, replacing the MPSA with another form of rights to gold and other minerals on the MPSA area) necessary to achieve this outcome.

In the event that the operation of Philippine law limits Bremer's interest in the Mining Joint Venture to 60% interest only, then it is agreed that the parties will execute a supplementary agreement compliant with Philippine Law having the effect (by beneficiation/processing arrangements or transfer of economic interest or other means) of insuring that Bremer enjoys an 80% economic interest in the Mining Joint Venture and an entitlement to receive 80% of the profits of the Mining Joint Venture and the principles detailed in the second paragraph of clause 6.7 shall apply mutatis mutandis.

7.3 Bremer and JCG will be required to contribute to the cost of the mining development (including all associated facilities and infrastructure) in proportion to their respective interest in the Mining Joint Venture. The mining development will be carried out in accordance with plans and budgets prepared for the purpose.

7.4 Subject to Philippine Law the parties intend and agree that the activities of the Mining Joint Venture shall be undertaken by the Joint Venture Operator ("Operator") who shall report to and be accountable to the Operating Committee.

The Operating Committee shall comprise four representatives, two each nominated in writing by both the Joint Venturer and the Project Manager nominated by the Operator.

The Operating Committee shall meet at least once each quarter and unless agreed otherwise all meetings shall be in Metro Manila.

The Operating Committee shall approve annual operating budgets prepared by the Operator and submitted to the Operating Committee at least 14 days prior to the Operating Committee meeting called to consider such budget. The first budget period shall run from the date of the formation of the Mining Joint Venture until the following 30th June. Succeeding budget periods shall run from 1st July to 30th June.

The Operator shall convene Operating Committee meetings and shall provide at least 14 days notice to representatives and such notice shall include an agenda and any papers, reports, and documents relevant to any agenda item.

The quorum required for any meeting of the Operating Committee shall be the Project Manager (or his/her delegate) and at least one representative each from Bremer and JCG. If at a convened meeting of the Operating Committee there is not a quorum within 30 minutes of the scheduled starting time of the meeting, then the meeting shall be adjourned to the same time and at the same place 7 days later and the quorum at such adjourned meeting shall be at least one representative of either party.

The Project Manager will not have any voting rights at meetings of the Operating Committee.

At meetings of the Operating Committee, each joint venturer shall have one vote for each percentage interest held by it from time to time and one of its representatives shall be entitled to exercise that joint venturer's voting rights.

All decisions of the Operating Committee shall be by simple majority. In the event that the procedures outlined in this clause 7.4 are inconsistent with provisions of Philippine Law, then the parties agree in good faith to negotiate a set of procedures in substitution therefor which are consistent with the underlying principles.

7.5 Bremer and JCG will use all reasonable endeavours to negotiate to obtain project financing for the mining development on the most advantageous available terms. If requested to do so by JCG, Bremer will lead and manage negotiations with prospective lenders, without prejudice however, to JCG seeking other sources of finance for its equity contribution.

7.6 If Bremer is required to guarantee project financing for JCG, it will be entitled to charge JCG a commercial fee for the guarantee.

7.7 For that part of the cost of development not met by project financing, Bremer and JCG will be required to contribute equity in proportion to their respective interest in the Mining Joint Venture. If requested to do so, Bremer will provide JCG with advice and assistance in obtaining funding for its equity contribution.

7.8 If JCG is unable to secure its equity contribution for the Mining Joint Venture within 6 months of making an election pursuant to Clause 6.9, it will be deemed to have withdrawn from the Mining Joint Venture and will be entitled to receive the Net Smelter Royalty, as provided for in Clause 9.

7.9 Bremer or, if necessary, Bremer's assignee under Clause 15.3 qualified under Philippine law, will be the operator of the Mining Joint Venture and will be entitled to receive a fee for its services of not more than 15 % of all labour, employee and contractor's costs and all depreciation and amortisation expenses, to recover overhead costs. JCG will cause Gotesco Land, Inc. or any of its subsidiaries, affiliates and related companies to give Bremer or its successors or assignees in interest as allowed under Clause 15.3 of this Agreement without charge the necessary surface rights, under mutually negotiated commercial terms between Gotesco Land, Inc. and Bremer, for purposes of mineral development and extraction.

7.10 If JCG elects to participate in a Mining Joint Venture, Bremer and JCG shall immediately proceed to negotiate in good faith the following:

(a) an appropriate structure for the Mining Joint Venture (whether incorporated or otherwise); and

(b) a comprehensive Joint Venture Agreement which will embody, among others, the (1) relevant terms and conditions of this Agreement, (2) the terms and conditions of the relationship between Bremer and JCG in the Mining Joint Venture and (3) other provisions which are ordinarily contained in Joint Venture Agreements.

Until the comprehensive Joint Venture Agreement is signed, the provisions of this Agreement will govern the relationship between Bremer and JCG, including their respective successors or assignees in interest.

If, following the commencement of a Mining Joint Venture, the Operating Committee resolves to issue a cash call to the Joint Venturers (in proportion to their respective participating interests) to fund an expansion of the project or to meet some unbudgeted expense and JCG resolves not to pay or fails to pay its proportionate cash call amount within 30 days of the cash call being made (and if all reasonable efforts to raise appropriate finance have failed then JCG shall be deemed to have offered its interest for sale to Bremer and (subject to the exceptions detailed below) the provisions of clause 8 shall apply mutatis mutandis.

Bremer shall have the right (but not the obligation) in lieu of the value being determined by an independent expert, to purchase JCG's interest for a sum equal to JCG's total accrued capital contribution plus interest thereon at a rate equal to the bank overdraft rate charged by the Joint Venturer's banker on secured loans of a like amount.

Any third party acquiring JCG's interest shall be obliged to pay the cash call unpaid by JCG plus interest at a rate equal to 3% higher than the unsecured overdraft rate charged by the Operator's bank.

If no third party sale is concluded then JCG shall be deemed to have elected to withdraw from the Mining Joint Venture and it will become entitled to a Net Smelter Royalty and the provisions of clause 9 shall apply mutatis mutandis.

8. SALE OF JCG INTEREST

8.1 If, pursuant to Clause 6.9(b), JCG elects to sell its interest, notification to that effect will constitute an offer from JCG to sell its interest to Bremer.

8.2 Subject to Clause 7.10, the price for the sale and purchase referred to in Clause 8.1 will be arrived at by negotiation. If agreement on the price cannot be reached within 30 days of JCG giving notification pursuant to Clause 6.9(b), the price will be determined by an independent expert, acceptable to the Parties hereto, as being a person or institution of international reputation with experience in valuing mining developments. The parties will co-operate to ensure that the independent expert is able to provide its opinion within 30 days of being appointed.

8.3 Bremer will have the right, for a period of 30 days from the price referred to in Clause 8.2 being arrived at, to purchase the interest of JCG for the price agreed upon or decided by the independent expert. Bremer can exercise that right by notice in writing to JCG, whereupon a contract for the sale and purchase will be formed at the price determined.

8.4 Settlement of a sale by JCG to Bremer will take place within 60 days of Bremer exercising its right to purchase, or as extended by mutual consent if time to finalise financing arrangements is required.

8.5 If Bremer does not elect to purchase its interest, JCG will be entitled within 60 days to complete the sale of its interest to a third party at a price and on terms no more favourable than those refused by Bremer provided that such third party has the financial standing necessary to participate in the mining development in place of JCG and agrees to become a party to this Agreement (and any formal agreement which may replace it).

8.6 If JCG fails to complete a sale of its interest as provided in Clause 8.5 and within the 60 days allowed therein, it shall (before the expiry of the 60 day period allowed) inform Bremer and advise Bremer whether it then wishes to:

(a) Participate in the proposed mining development to the extent of its 20% interest; or

(b) Withdraw from this Agreement and receive the Net Smelter Royalty.

Failure to inform Bremer within the 60 days will result in JCG being deemed to have elected paragraph (b) to apply.

8.7 Following notification of its wishes pursuant to Clause 8.6 (or its deemed election, if applicable), the provisions of this Agreement dealing with:

(a) A Mining Joint Venture, or

(b) The Net Smelter Royalty

will apply, as appropriate.

9. NET SMELTER ROYALTY

9.1 If JCG elects, pursuant to Clause 6.9(c) or Clause 8.6(b), or is deemed to have elected, to withdraw from this Agreement, it will become entitled to the Net Smelter Royalty.

9.2 The Net Smelter Royalty is payable in respect of all gold and other minerals produced from the MPSA area. The Net Smelter Royalty is calculated by applying the Specified Percentage to the net proceeds from sale of gold or other minerals from the MPSA area after allowing for deduction of costs of:

(a) Refining the gold or other minerals;

(b) Smelting the gold or other minerals (if applicable);

(c) Transporting the gold or other minerals to the point of sale (including to the place of refining or smelting, if applicable);

(d) Selling and marketing the gold or other minerals, including commission on sales;

(e) Royalties paid to the Government (or any other party); and

(f) Excise duties, taxes (other than income or profits tax) or other levies and charges attributable to the production or sale of gold or other minerals.

For the avoidance of doubt, the costs to be deducted will not include mining, processing or treatment costs.

9.3 The Specified Percentage is:

(a) 2% where the mill head grade of the mining operation is less than 10 grams per tonne of gold; or

(b) 2.5% where the mill head grade of the mining operation is at least 10 grams per tonne of gold but less than 20 grams per tonne of gold; or

(c) 3% where the mill head grade of the mining operation is at least 20 grams per tonne of gold.

The calculation of the head grade will be based on the average head grade recovery for each semester (6 month) period.

The Specified Percentage will also be 3% if the spot price of gold is greater than US$325, regardless of the mill head grade of the mining operation.

9.4 If a mining development is undertaken pursuant to this Agreement, Bremer will provide JCG details of gold and other minerals sold for every 6 month period (or part thereof), concluding on 30 June and 31 December each year, and will pay to JCG the Net Smelter Royalty within 30 days of the end of each 6 month period.

9.5 Upon JCG electing (or being deemed to have elected) that the Net Smelter Royalty should apply, JCG will immediately be taken to have withdrawn from this Agreement and will cease to have any further rights in the MPSA area or otherwise under this Agreement. JCG will do all things reasonably required by Bremer and permitted by law to allow Bremer to assume 100% ownership of rights to gold and other minerals in the MPSA area.

9.6 Bremer will enter into a Deed with JCG to record the term of the Net Smelter Royalty as provided herein and otherwise incorporating normal mining industry provisions.

9.7 Bremer will have the right, by giving written notice of its intention to do so, to purchase from JCG its right to the Net Smelter Royalty at a price to be negotiated. If agreement of the price cannot be reached within 30 days of Bremer giving notification pursuant to this Clause, the price will be determined by an independent expert, being a person or institution of international reputation with experience in valuing royalty

interests in mining developments. The parties will co-operate to ensure that the independent expert is able to provide its opinion within 30 days of being appointed.

9.8 Determination of price by the independent expert pursuant to Clause 9.7 will be binding on both parties.

9.9 The purchase by Bremer of the Net Smelter Royalty will be completed within 60 days of the price either being agreed with JCG or determined by the independent expert, as appropriate.

10. PAYMENTS

10.1 Bremer will make the following payments to JCG:

(a) On giving notice of its intention to undertake Initial Drilling, pursuant to Clause 5.6 - US$20,000;

(b) On exercising its right to proceed with the Exploration Period, pursuant to Clause 6.2 - US$ 20,000;

(c) On each anniversary of the commencement of the Exploration Period - US$20,000;

(d) On giving notice of its intention to proceed with a mining development, pursuant to Clause 6.8 -US$250,000; and

(e) On electing to extend the Exploration Period pursuant to Clause 6.11, US$20,000 and a further US$25,000 one year thereafter.

10.2 The payments referred to in Clause 10.1(c) are conditional upon the MPSA being approved. If any such payment would otherwise fall due before the approval of the MPSA, it will be deferred and paid immediately the MPSA is approved.

11. WITHDRAWAL BY BREMER

11.1 Bremer may, at any time prior to giving notification pursuant to Clause 6.8, withdraw from this Agreement by giving JCG 60 days' notice in writing. Upon withdrawal, Bremer will cease to have any further rights or obligations under this Agreement and will return to JCG all exploration and mining data in respect of the MPSA area.

11.2 If Bremer withdraws from this Agreement, it shall no longer be responsible for any of the payments referred to in Clause 10 of this Agreement, except for any such payment which fell due prior to the time of termination.

11.3 If, by the end of the Exploration Period, Bremer has not completed a Bankable Feasibility Study and has not requested an extension in accordance with Clause 6.11 it will be deemed to have withdrawn from this Agreement.

12. UNDERTAKINGS BY BREMER

12.1 From the time it gives notice of its intention to proceed with the Exploration Period, pursuant to Clause 6.2, Bremer will be responsible for meeting all Outgoings in respect of the MPSA area. For the purpose of this Agreement, "Outgoings" means all costs, charges, fees and expenditure necessary to maintain existing mining, exploration and surface rights, and to have the MPSA or any other mining title over the MPSA area granted.

12.2 In conducting its exploration activities Bremer will give priority to using existing personnel and contractors and will consult with JCG about any such personnel or contractor which it considers unnecessary or inappropriate to utilise.

12.3 During the term of this Agreement (after commencement of the Exploration Period, pursuant to Clause 6.2), Bremer will:

(a) To the extent allowed by law, conduct an active exploration program at least sufficient to keep the MPSA or other mining rights held by JCG over the MPSA area in good standing including funding the exploration work program required by the MPSA.

(b) Ensure that it has, or has access to, the financial and technical capability to undertake exploration for gold and other minerals, and any subsequent development of a mine within the MPSA area.

(c) Keep JCG informed in writing of all significant development affecting the MPSA or its rights over the MPSA area.

(d) Provide JCG with quarterly reports on its exploration activities and meet with JCG at least twice a year to discuss activities and progress towards a Bankable Feasibility Study.

(e) Comply with all Philippines laws applicable to the conduct of exploration for gold and other minerals, and the development and operation of mines, within the MPSA area.

(f) Maintain adequate all risks insurance covering its exploration activities.

12.4 Bremer will ensure that this Agreement is registered with MGB Region XIII.

13. UNDERTAKINGS BY JCG

13.1 JCG will use its best endeavours to ensure that the MPSA is granted.

13.2 JCG will do all things necessary to ensure that the MPSA, or any other mining title over the MPSA area, remains in good standing.

13.3 JCG will not dispose of or assign or grant any third party interest of the MPSA or any other right or title which affects the MPSA area, except when mutually agreed upon in writing by the parties hereto.

13.4 JCG will advise Bremer promptly in writing of any matter which affects the MPSA, the MPSA area or any thing which may affect exploration or mining on the MPSA area. At the time of such notification, JCG will provide Bremer with copies of any correspondence or documents relevant to the matter or thing.

13.5 If, during the course of this agreement, Ever Mining Inc wishes to sell, or enter into an operating agreement, over its rights to the Mapawa Project, JCG will procure that Ever Mining Inc grants Bremer the first right of refusal over that project. This provision does not apply to the agreement with Kinloch Resources Ltd presently being considered by Ever Mining Inc.

14. WARRANTIES

14.1 JCG warrants that:

(a) it is duly incorporated under the laws of the Republic of the Philippines and is authorised pursuant to its Articles of Incorporation and By-laws to enter into and perform this Agreement.

(b) it is the applicant for the MPSA and it knows of no reason why that MPSA will not be granted.

(c) it is a "qualified person" within the meaning of the Philippines Mining Act, as it applies to applicants for Mineral Production Sharing Agreements.

(d) The MPSA application was duly completely filed and any requests from MGB relating to the MPSA have been complied with.

(e) All documents relevant to the MPSA have been made available to Bremer.

(f) Upon the MPSA being granted, it will be free to deal with the MPSA and transfer an interest to Bremer.

(g) The Tenements and properties underlying the MPSA are in good standing.

JCG warrants that all outstanding royalties and other payments (if any) due to Gotesco will be JCG's sole responsibility and that Gotesco claims no moneys are or will be due from the Mining Joint Venture.

14.2 Bremer warrants that it is duly incorporated under the laws of Australia and is authorised by its Constitution to enter into and perform this Agreement.

15. ASSIGNMENT

15.1 Neither Bremer nor JCG may assign its interest except as provided in this Agreement.

15.2 JCG may assign its interest pursuant to Clause 8.5, or to Bremer pursuant to Clause 8.3, but not otherwise.

15.3 Solely for the purpose of securing its interest in the right to gold and other minerals on the MPSA area in accordance with Philippines law, as described in Clauses 6.7 and 7.2, Bremer may assign all or part of its interest to Bremer (Binalw) Corporation or one or more qualified entities in which either Bremer or Greenstone Resources NL holds an interest as may be allowed by Philippines law.

15.4 In the event that Bremer wishes to exercise its right pursuant to Clause 15.3, it will notify JCG in writing and provide JCG with details of the assignee(s). Bremer will provide an undertaking from the assignee(s) to be bound by this Agreement and this Agreement will then apply as if the assignee(s) were Bremer.

15.5 If Bremer wishes to assign or sell all or part of its interest other than pursuant to Clause 15.3, it must first offer to JCG the right to purchase that interest on the same terms and conditions as Bremer will accept from any third party. Bremer must notify JCG in writing of the terms and conditions on which it is prepared to sell its interest.

15.6 JCG will have 60 days from receipt of the notification from Bremer to elect to purchase the interest so offered by Bremer on the same terms and conditions as it will accept from the third party.

15.7 If JCG does not exercise its right pursuant to Clause 15.6 within the 60 days referred to therein, Bremer will be entitled to sell or assign its interest to a third party at a price and on terms no more favourable that those refused by JCG, provided that any third party has at least as much financial and technical standing as Bremer.

15.8 If the sale referred to in Clause 15.7 is not effected within a further 90 days from the conclusion of the 60 day period referred to in Clause 15.6, the provisions of Clause 15.5 will apply again.

15.9 If JCG elects, pursuant to Clause 15.6, to purchase the interest to be sold by Bremer, the sale and purchase must be completed within 30 days of notification of exercise of its right to purchase by JCG.

15.10 If Bremer proceeds with a sale or assignment pursuant to Clause 15.7, it will obtain from the assignee an undertaking to be bound by the terms of this Agreement.

16. TERMINATION

16.1 If either party should default on any material obligation of this Agreement, the non-defaulting party shall give immediate written notice to the defaulting party of such default, and the defaulting party shall have thirty (30) days from such notice to rectify such default or in the event immediate rectification is not possible, to take substantial action towards rectification of such default. Failure by the defaulting party to take any material remedial action within the thirty (30) day period may result in termination of this Agreement at the written election of the non -defaulting party.

17. FORCE MAJEURE

Neither party nor the Operator shall be in breach of their respective obligations, if as a result of force majeure, it is prevented in whole or in part from performing those duties or carrying out any of its obligations pursuant to these HOA. If force majeure affects Bremer in undertaking due diligence or exploration activities the period of time allowed for the performance of thoose activities by the period by which Bremer is so affected.

"Force majeure" shall include acts of God, war, sabotage, riot, insurrection, civil commotion, national emergencies (whether in fact or in law), strikes lock-outs, or other industrial disturbance, accidents uncontrollable delays in transportation, inability to obtain necessary materials and or qualified employees and or drilling or other contractors in the open market or the effect of any applicable laws, orders, rules, or regulations any delays occasioned by the deliberations of indigenous groups or groups of traditional owners or local communities or any other matters beyond the reasonable control of the parties or the manager.

18. OTHER MATTERS

18.1 Notices shall be given by pre-paid courier or airmail or facsimile to:

Bremer Resources NL
ATTN: Managing Director
Level 1, 43 Ventnor Avenue
West Perth WA 6005

Fax: (+61-8) 9481 5950

JCG Resources Corporation
ATTN:Mr JOEL T. GO
12th floor, Ever Gotesco Corporate Centre
1962 CM Recto Ave
Manila, Philippines

Fax: (+63-2) 735 0271

18.2 This Agreement is governed by the laws of the Republic of the Philippines. Any dispute between the parties shall be resolved through arbitration before three arbitrators in accordance with the rules of arbitration of the International Chamber of Commerce. The venue for arbitration will be in Metro Manila, Philippines. The decision of the arbitrators shall be final and binding on Bremer and JCG. Proceedings to enforce the arbitrators' decision may be commenced in any court of competent jurisdiction in the Republic of the Philippines. Any party which seeks to resolve a dispute other than through arbitration as aforesaid or seeks to determine or enforce rights through any court (except to enforce the arbitrators' decisions) shall be in breach of this HOA and their rights to vote at meetings of the Operating Committee, to count for quorum purposes, or to receive cash distributions, will be suspended.

18.3 Bremer and JCG intend this Agreement to be binding on them.

18.4 Bremer shall undertake an Environmental Baseline Study ("EBS") in relation to the lands the subject of the MPSA. The objective of the EBS shall be to determine the nature and scope of JCG's outstanding environmental/rehabilitation obligations under Philippine mining and environmental laws and the costs of discharging those obligations.

Upon the completion of the EBS, the parties shall meet and negotiate in good faith how the resolution of the discharging of these obligations shall be effected.

IN WITNESS WHEREOF, the parties hereby signed these presents on the 6th day of June 2002.

JCG RESOURCES CORPORATION
OF
By:

SIGNED IN THE PRESENCE

Name: Joel T. Go
Position: President

Witness
Name

BREMER RESOURCES NL
OF
By:

SIGNED IN THE PRESENCE

Name: Gregory Charles Edwards
Position: Managing Director, Greenstone Resources NL And Authorised Signatory of Bremer Resources NL

Witness
Name:

ACKNOWLEDGEMENT

REPUBLIC OF THE PHILIPPINES)
MAKATI CITY, METRO MANILA) S.S.

BEFORE ME, a Notary Public for and in MANILA on this ___ day of _____ 2002, personally appeared the following:

NAME	Passport N°	ISSUED ON/AT
Bremer Resources NL	E7588327	28th December 2001
Gregory Charles Edwards		Perth, Australia

known to me and to me known to be the same person who executed the foregoing instrument and he acknowledged to me that the same is his free and voluntary act and deed and that of the corporation he duly represents.

WITNESS MY HAND AND SEAL on the date and place first above written.

ANTONIO [illegible] MALONZO
NOTARY PUBLIC [illegible] MANILA.
[illegible]
TIN [illegible]
UNTIL DEC. 31 2002

Doc. N° 209
Page N° 42
Book N° III
Series of 2002

ACKNOWLEDGEMENT

REPUBLIC OF THE PHILIPPINES)
MAKATI CITY, METRO MANILA) S.S.

BEFORE ME, a Notary Public for and in PASIG on this 26 day of 06 2002, personally appeared the following:

NAME	COMMUNITY TAX CERTIFICATE N°s	ISSUED ON/AT
JCG Resources NL		
Joel T Go	15897250	2-05-02 Mla.

known to me and to me known to be the same persons who executed the foregoing instrument and he acknowledged to me that the same is his free and voluntary act and deed and that of the corporation he duly represents.

WITNESS MY HAND AND SEAL on the date and place first above written.

ANTONIO S. MALONZO
NOTARY PUBLIC
[illegible]
ON JAN. 2 [illegible]
TIN 106-[illegible]
UNTIL DEC. 31 2002

Doc. N° 105
Page N° 22
Book N° III
Series of 2002

Annex 8-9. Deed of assignment between JCG Resources, Bremer Resources and Greenstone Resources Corporation

SIANA JOINT VENTURE

DEED of ASSIGNMENT

1. PARTIES

1.1 **JCG Resources Corporation** of 12th Floor Ever Gotesco Corporate Centre, 1962 CM Recto Ave., Manila, the Philippines (**"JCG"**) a corporation incorporated in the Philippines.

1.2 **Bremer Resources NL** of Level 1, 43 Ventnor Ave., West Perth, Western Australia, (**"Bremer"**) a corporation incorporated in Australia and a wholly owned subsidiary of Australian public listed company **Red 5 Limited,** also of Level 1, 43 Ventnor Ave., West Perth, Western Australia (**"R5L"**). (formerly known as Greenstone Resources NL).

1.3 **Greenstone Resources Corporation** of 05896 Nonang Street, Villa Corita Sub-Division, Surigao City, the Philippines, (**"GRC"**) a corporation incorporated in the Philippines and a wholly owned subsidiary of R5l.

2. BACKGROUND

2.1 Pursuant to the terms of a Heads of Agreement ("HOA") between JCG and Bremer dated 6th June 2002, JCG agreed (inter alia) for Bremer to undertake exploration activities over certain lands now the subject of Mineral Production Sharing Agreement number 184-2002-XIII

2.3 Furthermore the HOA provides that following the completion of the aforesaid exploration activities and subject to the terms and conditions of the HOA including the completion of a Bankable Feasibility Study a Mining Joint Venture between the parties may arise.

2.4 Furthermore the HOA provides (via clause 15.3) that Bremer may assign its interest in the HOA (including its rights to undertake Mining Joint Venture activities) to a qualified entity in which R5L (previously known as Greenstone Resources NL) holds an interest as may be allowed by Philippines law.

2.5 Bremer wishes to assign its interest in the HOA (including its right to undertake Mining Joint Venture activities) to GRC (which is a wholly owned subsidiary of R5L), JCG agrees to such assignment and the parties wish by this deed to record the terms and conditions of their agreement.

3. ASSIGNMENT

3.1 Bremer hereby assigns and transfers all of its right, title and interest under the HOA to GRC and GRC hereby accepts such assignment and transfer.

3.2 GRC covenants with JCG that it will discharge all of the obligations of Bremer under the HOA and that it will be bound by the HOA.

3.3 Bremer covenants to guarantee the performance of the aforesaid covenants of GRC and for the avoidance of doubt acknowledges that in the event that GRC fails to perform any of the obligations imposed on Bremer pursuant to the HOA, then Bremer shall remain liable to JCG.

3.4 JCG hereby consents to and agrees to the assignment referred to in clause 3.1 above.

4. CONFIRMATION OF HOA

4.1 The Parties confirm in all respects the terms and conditions of the HOA.

5. OTHER MATTERS

5.1 Notices shall be given by pre paid courier or air-mail or facsimile to JCG and Bremer at the addresses specified in the HOA or to any change of address notified in writing and to GRC at

Greenstone Resources Corporation
ATTN: Managing Director
Level 1, 43 Ventnor Ave.,
West Perth,
Western Australia 6005

Fax: (+61 8) 9481 5950

5.2 This Deed of Assignment is governed by the laws of the Republic of the Philippines. Any dispute between the Parties shall be resolved through arbitration before three arbitrators in accordance with the Rules of Arbitration of the International Chamber of Commerce. The venue for arbitration shall be Metro Manila, Philippines. The decision of the arbitrators shall be final and binding on the parties.

IN WITNESS WHEREOF the parties hereby signed these presents on the day of 2003.

JCG RESOURCES CORPORATION

By:

Name: Joel T. Go

SIGNED IN THE PRESENCE OF

Witness
Name

BREMER RESOURCES NL
By:

Name: Gregory Charles Edwards
Position: Managing Director,
Red 5 Limited, And Authorised
Signatory of Bremer Resources NL
And Greenstone Resources Corporation

SIGNED IN THE PRESENCE OF

Witness

Name

Greenstone Resources FAX NO. : +63 86 826 1286 Nov. 03 2003 02:13PM P4

ACKNOWLEDGEMENT

REPUBLIC OF THE PHILIPPINES)
MAKATI CITY, METRO MANILA) S.S

BEFORE ME a Notary Public for and in MANAUE CITY on this 1 SEP day of 2003, personally appeared the following:

NAME	Passport No.	ISSUED ON/AT
Bremer Resources NL Greenstone Resources Corporation		
Gregory Charles Edwards	E7588327	26th December 2001 Perth, Australia

known to me and known to be the same person who executed the foregoing instrument and he acknowledged to me that the same is his free and voluntary act and deed and that of the corporations he represents.

WITNESS MY HAND AND SEAL on the date and place first above written.

CONCEPCION M. JUATAS
NOTARY PUBLIC
UNTIL DEC. 31 2003
PTR NO. 0132037
ISSUED AT PASIG CITY ON 1-2-03
IBP NO. 555541

Doc No. 124
Page No. 25
Book No. II
Series of 2003

ACKNOWLEDGEMENT

REPUBLIC OF THE PHILIPPINES)
MAKATI CITY, METRO MANILA) S.S

BEFORE ME a Notary Public for and in MANAUE CITY this 1 SEP 2003 day of 2003, personally appeared the following:

NAME	COMMUNITY TAX CERTIFICATE Nos.	ISSUED ON/AT
JCG Resources Corporation Joel T. Go	20789779	17 Feb '03 MLA

known to me and known to be the same person who executed the foregoing instrument and he acknowledged to me that the same is his free and voluntary act and deed and that of the corporation he represents.

WITNESS MY HAND AND SEAL on the date and place first above written.

CONCEPCION M. JUATAS
NOTARY PUBLIC
UNTIL DEC. 31 2003
PTR NO. 0132037
ISSUED AT PASIG CITY ON 1-2-03
IBP NO. 555541

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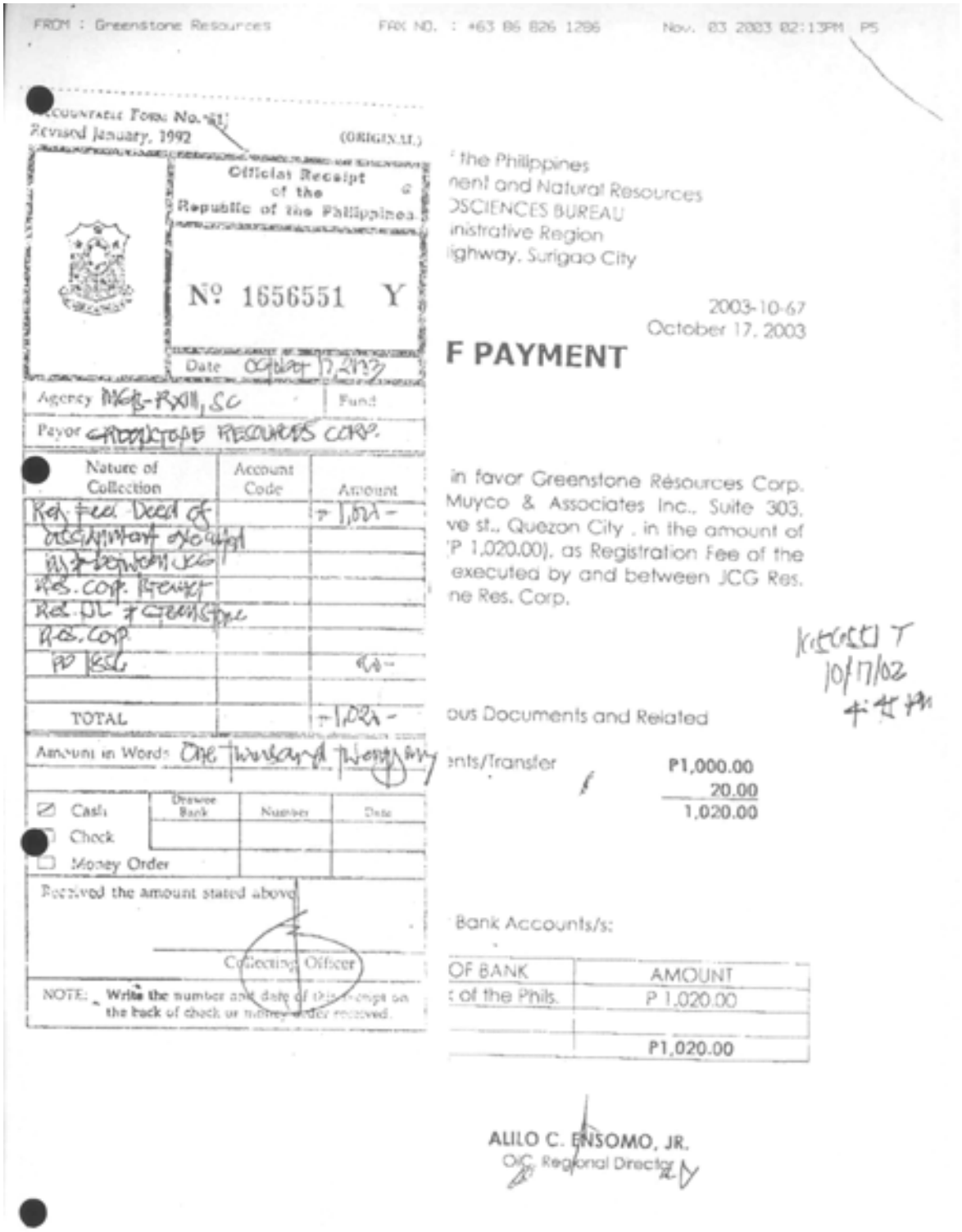

FROM : Greenstone Resources FAX NO. : +63 86 826 1296 Nov. 03 2003 02:13PM P5

Accountable Form No. 51
Revised January, 1992 (ORIGINAL)

Official Receipt
of the
Republic of the Philippines

No. 1656551 Y

Date October 17, 2003

Agency MGB-RXIII, SC Fund

Payor GREENSTONE RESOURCES CORP.

Nature of Collection	Account Code	Amount
Reg. Fee. Deed of		₱ 1,000 -
Assignment of Right		
in favor Greenstone		
Res. Corp. Receipt		
Reg. Fee Greenstone		
Res. Corp.		
PD 1856		20 -
TOTAL		₱ 1,020 -

Amount in Words One Thousand Twenty Only

	Drawee Bank	Number	Date
☑ Cash			
☐ Check			
☐ Money Order			

Received the amount stated above

Collecting Officer

NOTE: Write the number and date of this receipt on the back of check or money order received.

the Philippines
nent and Natural Resources
OSCIENCES BUREAU
inistrative Region
ighway, Surigao City

2003-10-67
October 17, 2003

F PAYMENT

in favor Greenstone Resources Corp.
Muyco & Associates Inc., Suite 303,
ve st., Quezon City , in the amount of
'P 1,020.00), as Registration Fee of the
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ALILO C. ENSOMO, JR.
OIC Regional Director

FROM : Greenstone Resources FAX NO. : +63 86 826 1286 Nov. 03 2003 02:15PM P1

GREETINGS..

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
MINES AND GEOSCIENCES BUREAU
REGION XIII CARAGA

THIS IS TO CERTIFY THAT THE FEE HAS BEEN PAID, THE FOREGOING INSTRUMENT WAS RECORDED IN THIS OFFICE AT 4 O'CLOCK AND 45 MINUTES P.M. ON THE 17th DAY OF OCT. 2003 AND WAS DULY RECORDED IN BOOK NO. 1 OF THE RECORDS OF Misc Doc. Deed of Assignment OF THIS REGION, ON PAGES 18 AS DOCUMENT NO. 2

FILING FEE PAID UNDER OFFICIAL RECEIPT NO. 1058551 Y DATED OCT. 17 2003 IN THE AMOUNT OF P 1,020.00 TO.

ALILO C ENSENO, JR
NO. REGIONAL DIRECTOR

COLATILLA

The Registration of this document is ministerial on the part of this Office. Its validity shall be the full responsibility of the contracting parties executing subject [illegible] and received in this office.

Annex 8-10. Highlights of meeting with officials of brgys. Cawilan, Siana, and Dayano

Highlights of Meeting with Officials of Brgys. Cawilan, Siana, and Dayano
Kapihan sa Mainit, 9:00 a.m., 24 April 2008

Greg Edwards of GRC – He delivered the welcome address. He encouraged everyone to participate.

Mark Saclag of EMB – He explained the EIA process and the purpose of the meeting.

Rolando Cuaño of BMP – He recalled the past activities of the EIA for the Siana Gold Project such as the community timelining meeting with local leaders and the Second-Level Scoping in January 2005; community presentations and discussions on the Project and participatory livelihood assessment in February 2005; environmental baselining activities conducted with the help of some local residents from February to April 2005; and the household survey in May 2005. He said that the EIA process had to await the finalization of the Project definition. Now that the Project is fully defined, the EIA process can resume.

He explained to the participants the major Project components such as pit dewatering, open pit mining, tailings pond and waste rock dump development, and underground mining. He showed these components on a map where the location of households are also indicated.

Marita Cuaño of BMP – She talked about studies conducted on the social aspects of the project. She presented the highlights of the May 2005 social survey and asked the participants for updates. The updates provided by the participants are shown in the following table.

Barangay	Number of households	
	May 2005	April 2008*
Dayano	73	80+
Siana	153	Almost 200[1]
Cawilan	203	258[2,3]

* - From Barangay chairmen
1 – The increase in number of households was due to children marrying and putting up their own houses.
2 - The increase in number of households was due to former residents returning to the community, knowing that the mine will start soon and hoping to benefit from it.
3 - Many Mamanwas (20 families) leaving near the hospital. In 2005, there were only 10.

She asked how much does each family earn? The participants answered farmers earn P1,000 a month; those working in the mine earn P5,000 a month.

How many families are into gold panning? About 30 % of the families in Siana and Cawilan.

What do they use in panning, mercury or cyanide? The reply was they bring the ore to CIL plants in Boyongan or Placer. There is a CIL plant in Siana. Small scale miners sell the ore to processors.

How much is the gold? About P1,100 per gram. The gold dust is about P750

How many grams does one family get? – It varies.

Do panners use mercury? – No.

Open Forum

Brgy. Kgwd. Virgilio Elsisura of Cawilan – Who is the real owner of the Siana property? I heard the Gotesco owns it.

Greg Edwards – He detailed the historical ownership of the Siana property. MPSA together with the surface rights were transferred from JCG to Merrill-Crowe (Metrobank).

Brgy. Kgwd. – Does that mean that Gotesco has no more rights over the property? The problem is there is a person, Mr. Marcel Bagondol, who claims to be Gotesco's caretaker. He had the old staff house torn down.

Love Manigsaca of GRC – I already referred this matter to Merill-Crowe. We have go through the legal process to settle this matter.

Brgy. Kgwd. - Mr. Bagondol also asks ½ of the gross income from copra farmers as Gotesco's share.

Brgy. Kgwd. Alfredo Pagapong of Siana – I have a farm located southwest of the open pit. Water from Dayano is limited during summer. Will the proposed operation affect our irrigation water?

Marita Cuaño – How big is the farmland being irrigated by Dayano?

Brgy. Kgwd. - About 70 ha. During summer, we have to ration the water which at the time comes from a spring.

Rolando Cuaño – From the start, water from the pit will be distributed to the farmer's irrigation. During operation, the dewatering from bores will continue to supply the community potable water supply and also the irrigation.

Brgy. Kgwd. – During SURICON time, they also did that, but the water going to the river was dirty. I hope it will not happen this time.

Ricky Oclarit of GRC – We have mitigating measures to make sure that the sediment will not go to the river.

Marita Cuaño – Once the plans are ready, GRC will present the programs to you so you will understand the dewatering system better. The EIA is not yet complete; we will explain to you the results of the EIA as soon as they are ready.

Brgy. Kgwd Virgilio Elsisura of Cawilan – In case GRC operates, what happens to the people living in the Duplex?

Rolando Cuaño – The area is located near the waste dump. Noise and dust impacts from the operations will be assessed. If the noise level is high, mitigating measures will be recommended, but if the impact is too much for the people, then they will have to be transferred, in a proper manner.

Brgy. Kgwd. Bernadeth Sanchez of Cawilan – According to Mr. Bagondol, he was authorized by Gotesco to be the property custodian. Therefore, he is the only one that can authorize occupation of the houses.

Greg Edwards – Gotesco no longer owns the property and these people claiming to be custodians have no authority.

Dr. Madelo – As far as Pagundol is concerned, he has no more rights over the area. The next time he comes, I suggest that barangay officials should be the one to deal with him. I will also inform the Mayor about this. We can file a case of extortion against him.

Bebot Gonzales of GRC – I can give a copy of the agreement between JGC and Merill-Crowe which you can show to Bagondol

Brgy. Chairman Reynaldo Juanite of Cawilan – Bagondol does not want to listen to us. I suggest if GRC can issue a statement addressed to Bagondol stating that he has no rights over the property.

Love Manigsaca – We will inform Merrill Crowe so the company will take legal action as soon as possible.

Ronnie Orcullo of GRC – He informed the participants that lumber from the demolished guest house will be sold by Mr. Bagondol.

Dr. Madelo – If he is going to transport the lumber, do not allow him to pass.

Soniefe Lopez – She suggested that the agreement be given during the Barangay Session and they will invite Mr. Bagondol and GRC staff.

She said that many in Cawilan don't have jobs. All they do is to plant crops. In case the operation pushes through, what happens to their plants?

Rolando Cuaño – Once we ascertain what plants or lands will be affected, we will present to you our findings. From there, negotiations between you and GRC can commence.

Brgy. Kgwd. Dioschar Patagan of Siana – If GRC will operate, will GRC need additional lands? Will there be an expansion?

Rolando Cuaño – As per GRC's plan, the operation will not expand to the rice paddies. GRC will confine its operations within the property of Merill-Crowe.

Ariel Odtojan, Siana SK Chairman – Is it possible that the community will be deformed after operation?

Marita Cuaño – The government requires mining companies to submit a final mine rehabilitation plan. This plan will say what will happen to the infrastructures. The plan will be discussed with the community.

Greg Edwards – The mine will not wait for closure to commence rehabilitation. As soon as areas are cleared of any activities, rehabilitation works will begin.

Mark Saclag – The participation of the youth is important. Once an ECC is issued, an MMT is formed composed of representatives from different sectors. You are needed to monitor the operation of GRC.

Ariel – One of our requirements in school is a scientific study. Will GRC allow us to study its operation?

Greg Edwards – GRC will help you.

Brgy. Chairman Reynaldo Juanite of Cawilan – All Project facilities and activities will be confined within the mine property?

Rolly Cuaño – No activities are planned outside of the mine property except the access road from the National Highway.

Edwin Mullaneva of EMB – I would like to inform the body that there are two existing CIL plants with ECC in Timamana and Tubod.

Brgy. Kgwd. Dioschar Patagan of Siana – How about the employment policy?

Greg Edwards – We will stick to the employment policy previously agreed upon by the six barangays.

Highlights of Meeting with Sectoral Representatives of Brgys. Cawilan, Siana, and Dayano
Kapihan sa Mainit, 2:00 p.m., 24 April 2008

Greg Edwards, Mark Saclag, Rolando Cuaño, and Marita Cuaño repeated their presentations.

Open Forum

Joel Pacatang of Cawilan Farmers and Irrigators Association – How much water will be dewatered? What is the timeframe?

Greg Edwards – The water in the pit now is very clean. We drink it. Some water will be given to the farmers for irrigation. Some will be supplied as potable water. Some will go to Dayano River.

Marita Cuaño – The results of the dewatering study will be presented to you and the farmers for review and comments.

Maria Ajoc of Siana – Where will the water from the pit and tailings pond go?

Rolando Cuaño – Water from the pit which is clean goes to Dayano River. Water from the tailings pond is first detoxified of cyanide prior to discharge. It will also flow to Dayano River and then Magpayang River.

Cenecio Ongue of Dayano Irrigators Association – We accept that the project will proceed. But there were problems during SURICON days. Silt from SURICON reached our farmlands. Will GRC pay for damages in case siltation happens?

Mark Saclag – He explained the responsibilities of the ECC holder and the role of the MMT. He also discussed the use of Environmental Monitoring Fund (EMF) and Environmental Guarantee Fund (EGF).

Marita Cuaño – She explained the mechanics of the EGF and how the fund is released to recipients.

Cenecio Ongue – Assuming that the palay was paid, will the company also pay for the damaged land because it cannot be replanted? Who determines the price of palay?

Mark Saclag – The palay will be paid and the land is rehabilitated. If you cannot plant in the next cropping season, you will be compensated for lost income. The prices of palay and land are based on fair market value.

Leticia Serrano – We own 3 ha near the tailings dam which we bought for P0.30 per sq m, and P300 per sq m if planted to coconuts. Will GRC pay for our plants? And if the land will be used by the company, can we still pass and harvest the coconuts?

Greg Edwards – The company's policy is, if the company does not use the land yet, you can use it. Our practice is to notify you at least three months before the company will use the land.

Isabel Garcia – If GRC operates, can our sons work?

Greg Edwards – Our employment policy is that primary impact barangays are given a certain percentage on employment. This will also be followed by our contractors.

Ronnie Orcullo (former Brgy. Chairman of Dayano) – During the previous administration what we and Brgy. Chairmen Ajoc of Siana and Guilalas of Cawilan did was, out of the 95% of total project employment for the barangays, we gave 10% each for the three secondary impact barangays of Magpayang, del Rosario, and Pongtud. The remaining 65% was allotted to the three primary impact barangays based on population at 18% for Dayano, 23% from Siana, and 25% for Cawilan.

Joel Pacatang of Cawilan – The rice production program seems unfair because there was no consultation on the recipients.

Ricky Oclarit – GRC consulted with the Barangay Councils. In fact, the Councils were given the task to determine the recipients based on guidelines and lot specification by GRC.

Titing Gabeon – During operation, what will happen to Purok Bulawanon?

Marita Cuaño – That will depend on the results of the EIA since the area is close to the waste rock dump.

Teofilo Peñaflor of Dayano Farmers Association – With the present hiring practice, an applicant needs a certification from the Barangay Chairman. The applicant cannot be hired without the certification.

Marita Cuaño – This is to make sure that the applicant is really a resident of the said barangay.

Teofilo Peñaflor – There are many applicants but the job openings are few. If one is not close to the Barangay Chairman, he cannot work. That's the practice in UPD now.

Greg Edwards – There will be fair hiring opportunity for all residents of affected barangays.

Simon Barrios, Jr. of Cawilan - In case we have a complaint against GRC, whom shall we approach?

Mark Saclag – You can go to the MMT, EMB, MGB or DENR. You can also approach Ricky Oclarit of GRC.

Annex 8-11.

TRANSCRIPTION OF THE OPEN FORUM OF THE PUBLIC HEARING ON THE EIA OF GREENSTONE RESOURCES CORPORATION'S SIANA GOLD PROJECT

BARANGAY SIANA COMMUNITY HALL

DECEMBER 5, 2008

EMB Caraga Regional Director Ester Olavidez: set the rules of Public Hearing and served as the Facilitator

DENR Asst. Sec. Jeremias Dolino, DENR representative

MGB Caraga Regional Dir. Alilo Ensomo, MGB Representative

GRC Managing Director Gregory C Edwards, Head of GRC Panel in the Open Forum

Dr. Daisy Serrano, Head of the EIA Review Committee formed by DENR-EMB Central Office with Review Committee member Engr. Paulo Tidalgo and MGB Resource Person Engr. Reynaldo Zabala in attendance.

Engr. Jess Addawe, Head of EMB Central Office delegation

Dr. Rolando Cuaño and Marita Cuaño, BMP Environment & Community Care, Inc.

Calinico Lazarte:

Bisaya:

Ako si Calinico Lazarte, lupulupyo sa Barangay Siana. Natagbaw ko sa mga pahayag no, aduna koy pangutana, mubo ra kaayo ma'am. Kanang kung pananglitan, kung mopadayon kining mining operation sa Greenstone. Kaming mga tawo nga namuyo diha sa kilid sa tailings pond, unsa may inyong pahayag sa opinyon diha kay gikulban ko nga maniguro lang ako kay morag delikado?

I'm Calinico Lazarte, a resident of Barangay Siana, I am satisfied with the presentations. My question is: if the mining operation will push through, what will happen to us residents who are living near the foot of tailings pond # 3 since

according to the presenters, the tailings pond dike wall will be raised. Are we going to be relocated or will we remain in the area that we are now occupying?

Hearing Officer:

Bisaya:

Ang imong pangutana morag naa moy pagduha-duha, kaninyo diha duol man dapit anang tailings pond, so kamo ba padahawaon? O diha ra ba gihapon mo kay naa naman mo namuyo? Kinsa may makatubag ani?

So the question is: are they going to be relocated? Who will answer the question?

Mike Alapan:

Tagalog:

Ang Kompanya po ay gumagawa ng paraan para sa mga ganyang problema, may plano po ang kompanya na magkaroon ng relocation area para po sa mga maapektuhan ng operation ng kompanya, tapos gagawa din po tayo (GRC) ng mga bakod o harang sa paligid ng tailings pond para hindi maapektuhan ang mga nakatira malapit sa tailings pond.

The Company is looking into that problem. The Company is preparing the relocation plans and area for residents that will be affected during the mining operation. Part of that plan is the consideration of safety aspects like the construction of mitigating fences or building a rock wall aside from the dike wall of the tailings pond facility so that residents living near the tailings pond will be safe and will not be affected.

Calinico Lazarte:

Tagalog:

Ang sa akin lang, pwede ba na iba bukod sa relokasyon? Kase kung relokasyon, ayaw ko, kase gusto kong pumunta na ng Maynila.

I don't want relocation, my option is to be paid out and I want to transfer to Manila.

Mike Alapan:

Tagalog:

May relocation po tayo (GRC) kung sakaling maapektuhan ang ilan sa inyo sa operasyon ng kompanya. Huwag po kayo mag-alala, kung sakaling maapektuhan ang isa sa inyo, sisiguraduhin po ng kompanya na ibabalik ang mga nawala sa inyo o ang dating pamumuhay na nakasanayan nyo. Katulad na nga lang po na kung masira ang bahay, ire-relocate kayo ng kompanya, o kapag nasira ang pamumuhay, palayan o fishpond, aayusin po ng kompanya iyan.

We have relocation plans for affected residents because the company has prepared a relocation plan that is safe for the residents that will be affected by the operation. The company will make sure that affected residents will be given just and fair compensation.

Cheryl W. Zamora (GRC ComRel):

Tagalog:

Sir, ang ibig niyang sabihin ay kung may option po ba daw na babayaran sila o irelocate? Kase ayaw na po daw niya sa Siana, pupunta na po siya ng Maynila.

According to Mr. Lazarte, what are the options? Are they going to be paid out or be relocated? Since Mr. Lazarte doesn't want to live in Siana anymore.

Hearing Officer:

Bisaya:

Ako lang pagsabot sa iyang mga tubag kung kinahanglanon jud, nga makuan sa ilang operasyon, kanang maapektuhan ka sa ilang operasyon, so dili kinahanglan na irelocate ka. Siguro pagabayaran ka kung gusto ka kinahanglanon. So nay relocation nga ilang himoon. Kung dili na siguro irelocate, butangan siguro og mga wall or mga fences sama sa koral. Tan-awon nila na o ila istudyuhan kung maayo ba og naay relocation, klaro?

In my understanding, according to the one who answered the question, the company will pay the affected residents or relocate them if needed, and in case they don't need to be relocated, the company will build walls or fences as mitigating/safety measures, and the company is still doing the study to assure safety nets are in place and if there will be residents that need to be relocated.

Aurelio M. Espeja:

Tagalog:

Magandang umaga po. Kanina nabanggit na po ni Dr. Rolly Cuaño na kung anuman pong negosasyon na mamagitan sa kompanya at sa mga maapektuhan ng operasyon ng kompanya, yun po ang susundin ng kompanya. Ang sinasabi naman po ni Mike Alapan ay sa pangangailangan na masiguro ang kaligtasan ng mga nakatira malapit sa tailings pond, magtatayo po ng bakod sa paanan ng tailings pond na sa kasaysayan ng mina dito sa Pilipinas, ang GRC lang po ang nagiisa at kauna-unahang gagawa ng paglalagay ng bakod sa paanan ng tailings pond para lang masiguro ang kaligtasan ng mga nakatira malapit sa tailings pond.

According to the presentation of Dr. Rolly Cuaño, whatever the results of the negotiation between affected residents and the company will be followed. What Mr. Alapan had mentioned earlier are safeguards to those who are living near the foot of the tailings pond. In case that it is needed, the company will construct a retaining fence so that they will be safe and not be affected and I think it will be the first of its kind in the Philippines since most of the tailings ponds constructed are built with dikes only with no retaining fences or walls.

Mike Alapan:

Tagalog:

Ayon din po kay Mr. Edwards, isang paraan din po para hindi masyadong makaapekto ang operasyon ng kompanya sa kalapit na mga baranggay, ang operasyon po sa may tailings pond ay hindi po sa gabi kungdi sa araw lang mangyayari upang makasiguro na ligtas ang operasyon at mababantayan ng mabuti ang trabaho. At bukod pa sa mga bakod na itatayo, may berm o isa pang paraan ng pagbakod sa tuktok ng tailings pond para masiguro na hindi lalabas ang naiipon sa tailings pond. Isa pang paraan para masiguro natin na ligtas ang pagtra-trabaho sa tailings pond, hindi po araw-araw ang trabaho sa tailings pond, mag-iischedule po ang kompanya ng mga araw sa isang taon, halimbawa, limang lingo sa isang taon lang para magtrabaho sa tailings pond para hindi masyado makaapekto sa kalapit baranggay ang operasyon sa tailings pond.

According to Mr. Edwards, there is also a way of minimizing the disturbance due to company's operation by limiting construction of the tailings pond embankment during day time only, to make sure that the operation will be safe and shall be monitored religiously. Aside from the fences that will be constructed near the foot of the embankment, a berm will also be constructed that will serve as another stability measure that will make it safer and in fact we are still doing further studies to assure its safety. Another thing also, the construction of tailings pond embankment will not be done daily but on a schedule, say 5 weeks a year, to minimize effects on the community.

Aurelio M. Espeja:

Tagalog:

Isa pang bagay na sinisiguro namin, magbubuo po ang kompanya ng Environmental Monitoring Team na magbabantay at magoobserba araw-araw sa mga nangyayari at mga ginagawa sa tailings pond para masiguro na wala tayong maapektuhan. Ang Environmental Monitoring Team ay binubuo ng kinatawan ng GRC at may koordinasyon sa mga kalapit baranggay na maapektuhan ng mina, sinisuguro po namin na mabubuo yan ng tama.

One more thing, we would like to assure that the company will create an in-house environmental monitoring team which will monitor the activity daily to assure that no instability and environmental problems occur. The environmental monitoring team will be composed of GRC personnel and in coordination especially with the host barangays that will be affected. We will assure everybody that such a team will be properly created

Simon Barrios:

Bisaya:

Good morning ma'am. Ako si Mr. Simon Barrios, CVO sa Baranggay Cawilan. Ang akong pangutana, bahin sa kanang last nga gi explain sa atong engineer nga irehab na ang kompanya, humana na ang operasyon, nakuha na tanan ang mineral. So nagpasabot tapos na ang kompanya, wa na, di gi rehab. So pag rehab nan kompanya kana nga plastar karon sa kompanya, kana nga area, mapabilin ba gihapon na nga gipanag-iya nan kompanya? O may option ba sila nga basin ipanghatag sa mga nangabilin o ibalik sa gobyerno?

I am Mr. Simon Barrios, a CVO of barangay Cawilan. My question is regarding the post operation period, on the aspect of rehabilitation. Will the company retain ownership of the land and property or will it be given to anybody (former landowners) or be given back to the government?

Hearing Officer:

Tagalog:

Ang pangutana ni manong Simon kung after sa operasyon, naa bay option ang kompanya nga ibaligya ang property o ipanghatag sa mga tawo nga lumulupyo sa baranggay?

The question is that after the operation, is there an option for the company to sell out the property or are you going to give it to the people within the baranggay or to the government?

Aurelio M. Espeja:

Tagalog:

Ang kompanya ay mago-operate sa ilalim ng provisions ng Mining Act of 1995. Ang kompanya ay kinakailangan na magkaroon ng decommissioning plan na nagsasaad na ang rehabilitasyon ay mangyayari sa umpisa pa lang ng operasyon, ibig sabihin ay tuloy-tuloy ang pagrerehab ng mina habang may operasyon. Ngayon kung matapos na ang mina, isasaad po sa decommissioning plan ang mga hakbang ng kompanya sa mga maiiwan nitong mga pag-aari, ang kompanya po ay uupo at makikipagusap sa mga kalapit baranggay at kinatawan ng gobyerno para sa pagsasaayos ng decommissioning plan at ipapasa po ito sa MGB. Kaya po bago po kami bigyan ng permit to operate ng MGB, sisiguruhin muna nila na sumusunod ang kompanya sa batas sa pagmimina at may nakalaan na pondo para sa rehabilitation. Kaya nga po sa bagong batas ng pagmimina ay sinisiguro po ng gobyerno na hindi kayo maapektuhan kung sakaling tumigil ang operasyon ng kompanya. Sinasabi po ng ating Managing Director, hindi po kasama sa ECC ang pagbubungkal o pagaayos ng lupang pagtataniman, pero kung gusto niyo po na pagandahin o gawing pwedeng sakahan o pagtaniman ang lupa na maiiwanng kompanya, gagawin yan ng kompanya. Sabi ko nga po, uupo kami sa inyo upang makasiguro kayo ng gagawin talaga naming yung mga isasaad sa decommissioning plan pag nagoperasyon na ang kompanya. May pondo po na nakalaan sa plano. Yun po ang kasiguruhan ng kompanya sa inyo.

The Company will operate under the provisions of Mining Act of 1995. The company is required to have a decommissioning plan that will be implemented at the start of operations, meaning the rehabilitation will continue during operations. At the end of mine life, the decommissioning plan will state the steps to be taken by the company on the property. The company will sit down and talk with the barangays and government representatives to finalize the decommissioning plan for submission to the MGB. So before we will be given the permit to operate by the MGB, they will ensure that we comply with the mining law and that there are funds for rehabilitation. So in the new mining law, the government ensures that you will not be adversely

affected in case the company stops operations. According to our Managing Director, the ripping and fixing of soil for community agriculture is not part of the ECC. However, if you want the company to do it on the land to be left behind, the company will do it. As I said, we will sit down with you so you can be assured we will do what is written in the decommissioning plan when the company starts operations. Funds have been set aside for the plan. That is the company's assurance to you.

Lito Vernal:

Tagalog:

Ako si Lito Bernal, Punong Barangay sa Magpayang, ang sa akin lang po ay tanong ng isa sa residente ng aking barangay na nangyari noong panahon ng operasyon ng SURICON kasi hindi sila makapunta dito.Sabi nila noong operasyon ng SURICON ang kanilang lupa binuldos ng taga SURICON, binayaran daw sila pero hindi nila tinanggap kasi sobrang mura daw ang bayad, ngayon ang sabi nila na mag operasyon na daw ang Greenstone, babayaran ba daw sila kasi sakop ang lupa nila sa Cawilan?

I am the Barangay Captain of Barangay Magpayang.This is just a question from one of my constituents. During SURICON operation, the constituent's parcel of land was bulldozed by SURICON Mining. They were offered payment but they refused to accept it because the compensation was very low. If Greenstone will operate, are the landowners going to be paid by the company for damages or the cost of their lands?

Hearing Officer:

Who is going to answer the question?

Aurelio M. Espeja:

Tagalog:

Uulitin po namin, ang hangarin po ng kompanya ay kung ang lupa ay maapektuhan ng kompanya, ang kompanya po ay handang magbayad sa kung anuman po ang halaga ng naapektuhan ng kompanya. Hindi po kami gagalaw ng inyong lupain kung hindi kami nakipagusap muna sa inyo. Kaya meron po tayo ng tinatawag na environmental group, at comrel group na makikipagusap muna bago galawin ang inyong lupain. At kung sakaling aksidenteng nagalaw naming ang lupa nyo dahil sa operasyon, sisiguraduhin po ng kompanya na babayaran po namin ang lupang naapektuhan. Isinasaad po sa batas na dapat kaming maging responsableng kompanya ng mina kaya susundin po namin ang nakasaad sa batas.

We will repeat, the company's commitment is that if land is adversely affected by the company, the company is ready to pay whatever amount of damages. We will not disturb any land without prior negotiations with you. That is why there is an environmental group and comrel group which will talk with you before any land disturbance. And in case our operation accidentally disturbed your land, the company will ensure that the damage is compensated. The law provides that we should be a responsible mining company and we will follow that.

Hearing Officer:

Bisaya:

Ang pangutana nila e klaro lang. Bayaran ba ninyo kadtong yuta nila kadtong sa SURICON pa? Mauna katong gusto nila nga e klaro kay sa una pa man to sa SURICON, og bag-o naman ni nga kompanya, gusto nila nga maniguro kung babayaran ba ninyo?

They just want clarification: will the company pay for their piece of land affected by SURICON Mining's operation?

Aurelio M. Espeja:

Tagalog:

Siguro nga po marami ang nakaranas ng ganito sa panahon ng SURICON, ang kompanya po ay inaako at inaayos na ang naging problema ng SURICON, ginagawa po naming lahat para maging maayos ang operasyon natin. Pero hindi po namin pwedeng akuin lahat ng pagkakamali ng SURICON tulad na lang po ng tanong ninyo sa bayad dahil maiipit po ang kompanya sa dahilan po na hindi alam ng kompanya ang detalye ng namagitan sa inyo at ng SURICON. Sa ngayon po ay inaayos na namin ang mga problema na iniwan ng SURICON tulad na lang sa environment at iba pang pagkukulang ng SURICON, pero uulitin ko po, hindi po lahat ay aakuin ng kompanya.

Maybe, a lot of people experienced this during SURICON time. Our company assumed and fixed the problems of SURICON - we did everything so our operations will be smooth. But we cannot own all problems of SURICON like your question on compensation because it will prejudice the company. The company does not know the details of what transpired between you and SURICON. So now, the company is fixing the problems left behind by SURICON like those on environment and others. But I will repeat, not all will be owned by the company.

Mary Ajoc (Resident of Brgy. Siana):

Bisaya:

Ako lamang pangutana kung kay mahibaw-an man gayod nga mo operate na kuno mo. Dili nab a mo mohilabot og lain pang lupa nga ma-estroso na usab diri sa Siana kay gamay na rakan ra ba ni ang inyong tuoron kana rakan inyon yuta nga na deklara na sa SURICON to Greenstone. Dili na kamo mohilabot sa iban. Kana rakan inyong yuta nga gipanglongagan ron? Dili na mo mamalit og lain? Amo na amo pangutana.

My question is, because to our knowledge, the company will really start operations. So our question is, if the company will no longer move other lands that will disturb Barangay Siana? We hope that you will limit your operations to company-owned lands to reduce the effects on land.

Hearing Officer:

Are you going to buy other land aside from the property that your company has acquired from the SURICON?

Mike Alapan:

Tagalog:

Kung bibili po ang kompanya ng iba pang lupa, doon lang po sa lupa na maapektuhan ng operasyon tulad na lang ng gagawin namin na daanan simula sa may highway papunta ng mina (mine access road). Para po sa ating lahat ang gagawing daanan, pero bago po gumalaw ng lupa ang kompanya, makikipagusap muna ang GRC sa may-ari ng lupa para bilhin ang lupa na maapektuhan. Babayaran po namin ang mga lupa sa tama at respetadong presyo na pabor po para sa inyo, hindi katulad ng dating presyo na sobrang maliit.

If the company will purchase other lands, this will be confined only to those lands to be affected by operations like what we will do for the road which will start from the highway going to the mine. The road to be built is for all of us, but before the company will disturb land, GRC will talk first to the landowner for purchase of the affected land. We will pay for the land at the correct and acceptable price that will favor you, unlike the old price which is very low.

Aurelio M. Espeja:

Tagalog:

Sa tanong mo na kung sa lupa lang ba ng kompanya kami mag-ooperate, tama po na doon lang kami mag-ooperate. May kaunting bahagi ng open pit na malalawakan pa pero sakop pa din sa loob ng lupa ng kompanya. Ang plano po ng kompanya ay magmina lamang sa loob ng lupa ng kompanya at hindi na lalabas pa sa sakop nitong lupa.

To your question whether the company will operate only within company-owned land, it is correct that we will confine our operation there. There is a small portion in the open pit for widening but this is still within company land. The plan of the company is to mine only within company land and not to go beyond its held land.

Antonio Peñaflor:

Tagalog:

Ako si Tony Peñaflor, residente ng barangay Siana, Ang tanong ko lang po, Kung sakaling matuloy ang operasyon ng Greenstone, yung mga tanim naming na nasa loob ng Greenstone, babayaran ba o hindi?

I am Tony Peñaflor, resident of Brgy. Siana. My question is, in case Greenstone will operate, will our plants within Greenstone be paid or not?

Hearing Officer:

Are you going to pay for all those planted vegetations inside the company's land?

Greg Edwards:

I have a special deal with those who have planted crops in our property and we said to them that we will give you 3 months notice and we would give you compensation before we needed that land. I would like to encourage people to keep planting agricultural and other crops on our land because it is only fair that they have a livelihood while they were not yet employed with us. Ok? So keep planting. We are going to give you 3 months notice and then you will need to harvest before then please.

Aurelio M. Espeja:

Tagalog:

Malinaw po ba? Sabi ng ating Managing Director, habang hindi po naming ginagamit ang lupa ng kompanya, pwede nyo po taniman. Pero sa oras po na kailanganin na ng kompanya, bibigyan po naming kayo ng paunang tatlong buwan na pasabi at palugit para anihin ang inyong tanim. Kung hindi abutin ng palugit ang ani, babayaran po namin ang tanim ninyo.

Is that clear? According to our Managing Director, while the land is not yet being used by the company, you can plant. But when the land will be needed by the company, we will give you three months notice and time to harvest your plantation. If you will not be able to harvest within the time, we will pay for your plants.

Ramie Antonio:

Bisaya:

Ako si Ramie Antonio kanhi trabahanti dati sa SURICON, taga Siana. Kadtong una nga meeting diri, ang kadtong daang mga trabahanti, katunga ray gibayad sa SURICON. Unya, nagmeeting diri ang Greenstone, nga agreeable ba sa Greenstone kay sa primirong meeting, dili sila magoperation kung dili mabayaran kadtong mga trabahante

nga katunga ray nabayad. Baryan ba sa Greenstone ang katunga? Kay dili man sila gusto nga magoperasyon sila naay kuan. Amo rana akong pangutana kay ga-meeting man diri mao na.

I'm Ramie Antonio, an old SURICON employee, resident of Siana. we were only paid by SURICON half of the service pay based on our length of service. And in our last meeting with GRC, I remember that there was an agreement that before GRC will operate, GRC will pay half of the salaries that SURICON owes us. So, *will GRC pay for the other half?*

Hearing Officer:

Are you going to pay for the salaries?

Mike Alapan:

Tagalog:

Hindi po namin pwedeng pasukin yung ganung problema ng SURICON, hindi naman po kami ang SURICON para magbayad ng sweldo nyo, kami po ay ang Greenstone Resources Corporation.

We cannot assume SURICON's problems. We are not SURICON who can pay your salaries. We are Greenstone Resources Corporation.

Ramy Antonio:

So, we will not be paid but are we going to be employed in GRC?

Mike Alapan:

Tagalog:

Gaya po ng sabi ni Mr. Edwards, 95% po ng trabahador ay manggagaling sa mga host baranggay ng GRC. Hindi po lahat ng problema ng SURICON ay kayang gawin ng GRC. Ang alternatibo po ng GRC sa hindi pagbayad ng sweldo ng SURICON sa mga dating empleyado ay ang pagbibigay ng trabaho sa inyo. 95% ng magiging empleyado ng GRC ay sa mga host baranggay. Kung iisipin po natin, marami sa kompanya ng mina sa Pilipinas ay sa labas kumukuha ng empleyado. Mali po yun, dahil kayo po ang apektado ng minahan, dapat kayo ang makinabang sa pagkakaroon ng trabaho. Kaya nga po, 95% dito kami sa host baranggay kukuha ng empleyado. Kung may kwalipikado sa posisyon na trabaho, kukunin po at isasanay sa kanyang magiging trabaho. At kung may mga engineer na angkop sa trabaho, kukunin po sila ng GRC.

As Mr. Edwards said, 95 % of the workers will come from the host barangays of GRC. Not all of SURICON's problems can be assumed by GRC. GRC's alternative to the non-payment of salaries by SURICON to its former employees is to provide you jobs. Ninety-five percent of future GRC employees will come from the host barangays. If we think about it, many of the mining companies in the Philippines get their employees from the outside. That is wrong, because it is you who will be affected by mining. It is you who should benefit from employment. That is why we will take 95 % of the employees from the host barangays. If there is someone qualified for the job, we will get him and train him on his new job. And if there are engineers suited to the job, GRC will take them in.

Hearing Officer:

Bisaya:

Ako lang ifollow up ha kay iklaro lang kay basin di masabtan. Kay naa man gud mga pangutana after. Ako na iklaro sa kompanya, nag-ingon sila nga 95% sa mga trabahante kuhaon diri sa host community. Mao na ang panghuna-huna sa kuan pero are you going to qualify that? Kung waray qualified diri sa tulad ng kanang

engineer. Ug unsa pa nang mga operator diha, walay qualified, diri ba gihapon mokuha o mokuha na sa gawas? Klaruha na.

Just a point of clarification, the company said that they are going to hire 95% of its workers from the host barangays. You have to clarify that only the qualified can be hired and if there are no workers with the required skills available at the host communities, then the company will hire from the neighboring communities. You have to clarify this one.

Mike Alapan:

Tagalog:

Sa pagkuha po ng empleyado ng kompanya, kung meron po na mga kwalipikado sa posisyon, dito po kami kukuha sa host baranggays. Kung meron naman po na mga engineers o teknikal na tao, halimbawa po, kung may mining engineer dito sa host baranggay, bibigyan po namin siya ng prayoridad para sa trabaho. Sa napagusapan din po base sa MOA sa mga host baranggays, kung ano po ang napagkasunduan sa paraan at porsyento ng mga kukunin sa bawat baranggay, yun po ang susundin ng kompanya.

In the hiring of employees by the company, if there are people qualified for the position, the company will hire from the host barangays. If there are engineers or technical people, for example, if there is a mining engineer here in the host barangay, we will give him priority for the job. Based on what was discussed in the MOA with the host barangays, whatever is agreed upon on the means and percentage of employees to be hired from each barangay, that is what the company will follow.

Greg Edwards:

We have been writing contracts for all the work we do here, contracts for mining, contracts for the construction of the mill plant, and construction for all other things on the mine. One of the clauses in these contracts is that the contractors that are paid by us (GRC) to do this work must abide by our employment policy.Do you understand? They will not bring people from outside; because I have seen other companies take 1,200 people from Manila to go to a mine. That is wrong! So we are making it so our contractors employ from our community. (Crowd applauds).

Hearing Officer:

Bisaya:

So klaro na. Kung walay qualified mukuha sa uban nga mga neighboring baranggay. Kung naay mo apply nga dili pa siya na-train, itrainman nila depende sa iyang qualification.

So it is clear. If there are no qualified, the company will get from the other neighboring barangays. If somebody will apply but he is not yet trained, he will be trained depending on his qualifications.

Virgo Apusaga (Brgy. Secretary of Pungtod):

Madam Chairman, being the facilitator of this open forum, Barangay Pungtod will suggest or motion that this open forum will temporarily recess to give way for lunch as some of our listeners and colleagues are hungry. I would like to move for a short recess for lunch and resume after eating.

Hearing Officer:

There is a motion to have lunch break but as the food is not yet prepared, the panel reserves for a couple of questions, if it is ok (All concerned unanimously approved the requests). Question and answer continued.

Rosario Mijares (BHW of Barangay Siana):

Bisaya:

Ang pangutana karon, gihisgutan man ni Dr. Cuaño nga duna tay stocks from province to municipality and barangay, ingon si Dr. Cuaño nga after 3 years started na ang greenstone resources corporation sa pag deposit sa five (5) Million nga stocks sa barangay, municipality & province. Ang pangutana karon kay ge-assure man sa GRC nga dunay assurance na ihatag. Do we have an assurance to give that amount? So ang pangutana kining 5M nga para sa atong barangay, authorized ang MGB so ang akong gusto motubag ini ang MGB. So kini nga amount maka benefit ba ang tanan baranggay Del Rosario, Magpayang, Pungtod, Siana, Dayano & Cawilan. Kung dili ba kaha ni mukadto kay seryuso ka gigutom naman ta, dili kaha ni mukadto sa kamot ni Jok-Jok Bolante?

Dr. Rolly Cuaño stated about the excise tax that will be paid to the province, municipalities and barangays. The company assured that they are going to pay such tax. The question is that after 3 years GRC will start to deposit the 5 million. My question is addressed to the MGB Director that if this amount will provide benefits to the host barangays, it will not fall into the hands of people like Jok-Jok Bolante?

Dir. Alilo C. Ensomo:

Bisaya:

Ok salamat manang Rosario, adtong imo tagalong na 5 million amo adto e deposito nan kompanya sa government bank. Tagtawag nato na Social Development Management Plan (SDMP) part adto nan 5 million, so ato na an paghimo nan SDMP. Nag gikan ni sa ijo, sa kada barangay magplano an CTWG, ijo ini isang-at sa CTWG ang mga livelihood sanan infra project. Tag require nan kompanya na mag submit nan 5 years SDMP. Jaon sa 5 years, kada tuig, ila eaccomplish sigun sa plano. Pero balikon ko, ang plano mag gikan sa ijo, kung uno na livelihood project, kung uno na infra project ang ijo gusto himuon sa ijo barangay. Ang kwarta nakangayan ini sa ngayan sa kompanya, pero jaoy amo MOA ang kompanya sanan an bangko na dili nila mawithdraw ang kwarta kung dili ijo mga proyekto na tag sumiti paga-aprobahan sa CTWG e-concur nan MFRC sa amo na level, usa pa ang chairman, kung ako ang chairman or director, mo pirma ako nang withdrawal na pwede sila maka kobra sa bangko. So ajaw kaguol kay dili mukadto kan Joc Joc Bolante ang kwarta. So jaoy guidelines na muprotier jaon na kwarta kay kita raba puro mga surigaonon. Kinahanglan na kana na proyekto dapat sa ijo. Amo jaon siguradohon.

The fund you mentioned is the amount that will be deposited by the company to a government depository bank. It is called SDMP fund and maybe, part of it is the millions you have mentioned. SDMP is formed through proper planning and consultations with the host barangays through the Community Technical Working Group (CTWG). The barangays will submit to the CTWG the livelihood plans and infrastructure project proposals. The company is required to submit the 5 years development plan. Yearly, they (the company) will comply and implement the projects as stipulated in the SDMP plan and submit for MGB audit. The plan will come from the barangays on whatever infrastructure and livelihood projects that will be done in the barangay within 5 years and so on. The fund in the bank will be in the name of the company, but we (MGB-13) will have a MOA with the Company and the Bank that they (the money) cannot be withdrawn if the projects submitted are not approved by the CTWG, and concurred by MRFC. This means that before I can sign the withdrawal of the money as chairman of the MRFC, we will check it based on the SDMP program and its scheduled implementation. In addition, there will be guidelines that will be followed in the use or utilization of the funds that will protect it from any malversation.

Mrs. Rosalita Ammarille (Siana):

Bisaya:

Ako si Saling Amarille taga Purok Hilltop, Siana, Mainit. Ang ako pangutana kadtong kay Sir Mike. Ako nakabasa diri nga dunay maapektuhan daw sa baranggay Siana para sa relocation. Sir, ma-relocate ba ang purok Hilltop?

I am Saling Amarille, resident of Purok Hilltop, Siana, Mainit. My question is addressed to Sir Mike. I read here that Brgy. Siana will be affected by the relocation. Sir, will Purok Hilltop be relocated?

Greg Edwards:

We have not finalized the final design of the tailings dam. The tailings pond was designed by a company (a contractor) in Manila called GHD, a very big consultancy in Manila. We believe that there will be some relocations in the area around Harrison bridge, and we believe there will be some relocations near Hill Top, and also some relocations (very few we think) just north of the waste dump in Cawilan, very few, I think less than 10 (for Cawilan). We believe that we cannot give you the final number but we believe that the number is somewhere between 39 and about 50 to 55; I think it will end up something like 40 (relocations). But that is all I can tell you. But in the next 1 or 2 months, I will come here to sit with you and with a number of other people here, including the Cuaños. We will sit down with those people we think will be affected and we will explain the relocation package. I have given each of the Barangay Kapitans and their councils a plan of what the designs of the buildings (houses) look like and they are very gwapa (Crowd applauds).

Mike Alapan:

Tagalog:

Naiintindihan po ba natin? Sa ngayon hindi pa po kami makakapagbigay ng eksaktong bilang ng mga mare-relocate, pero kung mayroon po dapat ma-relocate dahil maapektuhan ng kompanya, gagawin po ng GRC iyon.

Do we understand? At the moment, the company cannot provide you the exact numbers of people that will be relocated. But if there will be people for relocation because they will be affected by the company, GRC will do it.

Badong Odtojan (Siana):

Bisaya:

Ako si Badong, taga Siana. Gihisgutan man dinhi ang relocation sa mga tawo na ma-affected, kini ra ako sige tanaw kay gusto man ipabalhin ang mga tawo sa mga bakante na mga lingkoranan. Dili man gani mubalhin ang mga tawo. Lisod gayud ang mga tawo, pabalhinon ba. Ang mines sa tailings pond, tailings 2 , tailings 3 and 4, nay mga balay sa kilid. Instead na e-raise ang elevation sa tailings pond, pwede man tingali na eabante ang ilang development adto dapit sa north, sa tailings pond 4? Kay murag wala may mga tawo nga madislocate. Instead na etaas ang elevation sa tailings pond, kay nakabati ko nga ang tailings pond will be raised by 15 meters, ah, ato nalang nah esibog sa northern portion sa tailings pond 4, ang development, dakuan ba.

I am Badong from Siana. I'm just concerned about the people who will be affected by the operation and will be relocated because of the tailings pond's activity. Is there an option that instead of raising the tailings pond embankment, would it be possible that it will be constructed inward or going to the north-side of the tailings pond number 4 so that nobody will be relocated?

Mike Alapan:

Tagalog:

Tungkol po sa tanong nyo sa tailings pond 3 at 4, na kung maari na gamitin na lang ng GRC ang TSF4 para sa concentrate at huwag na ang TSF3, iyon po ay magiging mas mahirap naman po para sa atin. Ang dami po ng tails na manggagaling sa mina ay napakalaki para sa TSF4 lang. Kung TSF4 lang po ang gagamitin natin, mas magiging delikado po sa ating lahat dahil baka umapaw ang tailings pond. Sa ngayon po, inaayos at pinopolido pa din namin ang plano sa tailings pond para mas higit na ligtas at makayanan ng tailings pond ang mga kemikal at tails na manggagaling sa mina.

Regarding your question on tailings pond 3 and 4, if GRC will just use TSF4 and not TSF3 - that will be more difficult for us. The volume of tails to come from the mine is so big for TSF4 only. If we will use only TSF4, it will become more dangerous for all of us because the tailings pond may overtop. Right now, we are still fixing and polishing our plan for the tailings pond so it will be more than safe and the tailings pond can handle the chemicals and tails coming from the mine.

Aurelio M. Espeja:

Tagalog:

Ang design sa ating tailings pond ay hindi masyadong matarik and pagtatayo nito, medyo pinahalang ng konti para mas maging matatag ang mga harang nito. Bukod pa doon, may itatayo tayo na bakod para siguradong ligtas ang tailings pond. Kaya kahit po magtaas pa tayo ng ilang metro, ligtas po tayo sa tails at base po sa aming plano, yun po ang pinakamagandang gawin para masiguro ang kaligtasan nating lahat.

Our design for the tailings pond is not so steep and the raising of this is slightly offset to strengthen the dike. Aside from those, we will build a fence to ensure safety of the tailings pond. So even if we raise a few more meters, we are safe from the tails. And based on our plans, that is the best action to ensure the safety of us all.

Kaiser Recabo (LMDA Director):

Bisaya:

Ah marajaw na hapon sa ato hurot. Ako si Kaiser Recaiso, project director nan Lake Mainit Development Alliance. Ah, actually dili ni siya pangutana. It's a matter of comments and recommendation with regards to the EIS. One thing to say,ah, I would like to say na kadtong catchment area nan Lake Mainit is not 38,000 has. But 17,000 has. Tapos kadtong 15,000 na data sa Lake Mainit surface is not 15,000 but we are using the BFAR data so if I have to use the data, you have to take a footnote or an asterisk, these are the data, the BFAR data or whatever para kung dis-a ni nakuha nga data, at least maklaro ba, dili siya confusing, kay basi makaingon sila how much into catchment. I have received a copy of the EIS, I would like to recognize also the effort of Greenstone in the conduct of the study kay maayo ang coordination namo sa Greenstone sa consultant. So ang ako lang naa koy mga recommendation base for sa EIS so medyo taas taas man ning mga comments gud, for example kadtong sa, dili rakan siguro nako ekuan, I try to set out, just to give my recommendation ka basi kadtong sa summary na basi nay dili mu jive na data even the facts set that are given to the community does not jive with the EIS. I don't know if first draft ba, second draft or final draft ba, I don't know. Something is kuan ba, sa ato data nga kinahanglan mu jive so we have also recommendation with regards to making measures.

What I have to present is just a matter of comments and recommendations with regards to the EIS. One thing that I would like comment is that to correct the data like Lake Mainit catchment area is not 38,000 has. but 7,000 has. About the Lake Mainit surface, it's about 10,000 has. based on the BFAR data. I would like to suggest that if you want to use a data, you have to stipulate a footnote or asterisk as to where this data came from to avoid confusion. I have received a copy of EIS and I would like to recognize the effort of GRC in the conduct of the EIA study because we have good coordination with GRC and the Consultants. I have

recommendations to present for consideration in the EIS preparations but it's quite long and maybe it is included in executive summary. Maybe I can send out these recommendations to the preparer or proponent or EMB as the case maybe.

Hearing Officer:

Sir, in order for your comments and recommendations to be official, you can submit all your comments and recommendations to the EMB and the preparer.

Che-che Rodrigues:

Bisaya:

Good afternoon to each and everyone, ako si Che-che Rodriguez Purok Secretary sa Purok Bulawanon sa Barangay Cawilan, as what I have heard ganina maam nga bayaran ang mga area nga affected during the operation, ang sa amo maam nga ang Duplex Area is one of the company Properties. Ang nagpuyo dinha is more more than 70 families in time nga gamiton na ninyo ang area sa duplex so unsay may inyong pamaagi, aron matabangan mi in time nga gamiton na ninyo ang area? Pareho ba ang system namo sa residential area nga bayaran ba o ma-relocate ba usab?

In the presentation, it was said that the company will pay for the areas/lots that will be affected. For us living at the housing compound owned by the Company, what are the plans of the Company for us? Are we going to be paid? Relocated? What is the plan of the company for us?

Greg Edwards:

Thank you for the question. We have had this question many times. Our policy is, for those who are living in the duplex area, which is part of the company land, we do not want you to move. That is yours. There have been issues in the past that someone in the community has been extorting you or getting money from you. They call it rental but it is not! We don't want you to pay! I'm going to ask Mr. Manigsaca explain in a minute, but there will be a few relocations in the southern part of the duplex area and apart from those, there will be none. Our plan is also with your permission only is to rehabilitate an area of the old waste dump and flatten it off to make it more useful for agriculture, but that is your decision. If you want us to do that, we'll do that in the first year of the development. Not the operation but the first year of the development. We will flatten it off so that within one year of starting you use that (land), I think it's about 15 hectares approximately and you can decide what you plant there but we will put good top soil on top with a very good base coarse underneath so you should be able grow any crops there. I'm now going to ask Mr. Manigsaca to explain the issues that we have in duplex area and for people not to be worried.

Love Manigsaca:

Bisaya:

Fluent ko sa Visayan language mao nga magbinisaya ko ug estorya. Gipaabot sa amo nga naay gamay nga concern kining mga gapamuyo sa duplex nga naa kunoy mga karaang empleyado sa previous operator sa Siana project nato nga ga-claim nga sila kuno gihapon and rightful owner or assignee sa mga properties. Pero kana nga butang amo nang giklaro sa among joint venture partner, ang Merrill Crowe Corp. nga usa ka subsidiary sa Metrobank nga sa pagkakaron nakapangalan ang MPSA sa Siana Project. Ang ilang giingon, other than the MPSA assignment, naa pud silay lain nga agreement with the Gotesco group nga nakaasign sa ila (Metrobank) and mga properties and in fact in the process sila nga ma transfer sa ila ang mga titulo sa properties and tenements sa old Gotesco. Sa pagmatuod sa ilang point (Merril crowe) nagpadala sila ug sulat nga amo pung gipanghatagan ang mga Barangay Kapitan or Chairmen nga ila gyung gi-state explicitly nga silay rightful owners ani nga mga properties. Mao nga unsa ang ila nga decision thru Greenstone mahitungod ani nga mga properties, maoy among sundon.

I am fluent in the Visayan language so I will answer in Visayan. It has come to our attention, through people living in the duplex area, that there are concerns regarding certain people who worked with the previous Siana Mine operator claiming that they (Gotesco) are still the rightful owner/assignee of the property. We have already clarified this issue with our joint venture partner, Merrill Crowe Corp. (MCC), a subsidiary of Metrobank. As of now the MPSA of Siana is in MCC's name. According to MCC, other than the MPSA, they also have an agreement with the GOTESCO group that all properties of the latter in Siana are assigned to MCC and in fact, aside from the agreements, they are now in the process of transferring titles of the properties, land areas and tenements of the old GOTESCO to Merrill Crowe Corporation. To prove their claim, MCC had sent us a letter, which we provided a copy to the concerned Baranggay Captains/Chairmen in the area, declaring that they are the rightful owner of the Siana Mine properties of GOTESCO. Hence, whatever is their (MCC) decision on the properties thru Greenstone will prevail.

Hearing Officer:

Lunch Break.

Mrs. Isabelita Garcia:

Bisaya:

Kanus-a man magsugod ang operasyon sa Greenstone? Ang akong mga anak, makatrabaho ba sila?

Since Greenstone will operate, when will it start? Will my children have a chance to be employed?

Hearing Officer:

There is a question here which says "When is Greenstone going to start?" As to the question about employment, the company has already given the answer that as long as the applicant is qualified, then he will be considered for acceptance.

Aurelio M. Espeja:

Tagalog:

Kami naman po ay naghihintay lang sa inyong pagsang-ayon sa proyekto ng GRC. Kung papayagan niyo po kami at lumabas na po ang aming ECC, maguumpisa na po ang aming pagde-develop ng mina. Nakaplano po na tatanggalin namin ang tubig sa open pit ng anim na buwan at sa taginit po namin gagawin iyon. Kaya kung papayag po kayo sa proyekto ng GRC, sa tag-init pwede na po kami magumpisa.

Actually, we are only waiting for your approval of GRC's project. If you will allow us and our ECC comes out, we will start to develop the mine. It is in the plan to dewater the open pit in six months and we will do that during the dry months. So if you will allow GRC's project, during the dry season we can already start.

Kaling Odtojan:

I'm Mr. Odtojan, a resident of this barangay and one of the administrators of Dep. Ed. Mainit District. My concern is just a request addressed to Mr. Greg Edwards, that the Dep. Ed of Mainit is requesting to maximize the program of adopting a barangay, not only the host baranggays, so that our school children coming from other barangays will benefit also.

Greg Edwards:

We have a MOA that was organized by Mr. Manigsaca in which we will be adopting each of the schools within our (host) baranggays. On another thing, I mentioned to LMDA Director Kaiser Recabo, that we also want to adopt the northern part of Lake Mainit. Currently we are testing the waters in Lake Mainit, we want to add to that and to help with other matters especially the baranggay or area at the northern part of Lake

Mainit. Back to the schools that we are going to adopt, we want to start it as soon as we have the green light for the operation. And as part of that there is a list of things that we are going to do like providing computers and extra equipment to schools on top of what we already do. We have already supplied school books, pen, paper, and maintenance of schools and we want to add to that during our operation by supplying high quality and technically advanced equipment to the schools so that they will be the most technologically advanced schools in the district.

Maui Sendiong:

Bisaya:

Kining akong pangutana ma'am, related ni sa acquisition sa lupa nga napalit sa Suricon kaniadto, kining akong pangutana kung pananglit mo acquired ba ang Greenstone kung operation ka ang kompanya, oila may palit nila sa mga hectare or sq. meter ba kay sa una sa akong mahibaw-an ang palit sa SURICON per sq meter morag tag 30 centavos ra mao na nga kining akong pangutana, para ni sa mga tawo nga may mga yuta kay basi possible nga mapalit sa Greenstone kung mag fully operation na, naa pay dugang naku nga pangutana, sa nahitabo sa kaniadto sa SURICON ang Tailings Dam sa SURICON kaniadto mga chemicals ra gyud na, pero nahitabo to sa una mga 1980's to sa nag-operate pa ang Surigao nga nag-overflow ang ilang tailings dam nag contain sa mga chemicals gikan sa planta, nahitabo na tungod sa kakusog sa ulan, panahon sa December hangtod Enero, Febrero, mi overflow hangtod sa suba sa Magpayang paingon sa Danao! Ang resulta ana nahitabo kaniadto nay mga carabao nga naapektohan sa maong chemical nga nangamatay dili tanan may mga carabao ug mga isda diha sa Danao! Na karon lakip ang uban nga ipa check sa laboratory test sa Bureau of Fisheries nga tinuod ba nga gikan ba gyud sa SURICON ang resulta ana sa laboratory test, kung tinuod ba nga gikan ba gyud sa SURICON, ang resulta ana dili ko makaingon o dili pud makaingon nga dili gikan gyud kuno sa SURICON na karon akong pangutana kung mahitabo na pud na duna na puy mga matay sa mga kabao ug uban pang mga mananap ug ma damagepud ang mga rice field diha sa Magpayang kay daku-daku man nga area, unsa may ika garantiya sa Greenstone nga ilang tulubagon ngadto sa mga damage niha nahitabo, kung pananglit kintahay nga kanang kwarta niha gideposito diha sa bangko nha gitagana para ana nga mga panghitabo kung daku-daku ang kantidad modugang ba ang SURICON?

My question is related to acquisition of land. If they (the company) are going to acquire additional land, how much are they going to pay per sq.m. or per hectare? Also, an overflow of tailings pond happened during the previous operation (SURICON) due to heavy rainfall and according to some people, but I don't know how true it is, livestock and animals died due to intoxication from chemicals accompanying the waters. Now, if such bad incident will happen again when Greenstone will operate, are they going to pay for the damages? If the amount of damages is greater than what is placed in the bank for damages, is the company willing to pay more?

Love Manigsaca:

Bisaya:

Akong tubagon and unang pangutana kabahin sa presyo kung mopalit ug additional nga yuta. Ang presyo sabutan na sa duha ka partido o kanag gitawag ug arms length transaction. Pero be rest assured nga ang presyo nga i-offer sa Greenstone would be better than the fair market value of the property. Kung aware ta, naay gitawag nga zonal value nga maoy gigamit sa mga assessors. Medyo mubo ang presyo ana. Then naa poy gitawag ug fair market value nga maoy presyo sa mga similar assets. Medyo taas na sya kumpara sa zonal value. Ang i-offer sa Greenstone in case mopalit ug dugang nga yuta would be higher or mas generous kay sa fair market value para happy ta tanan or a win-win situation.

I'm going to answer the first question. In case the company will acquire or purchase additional land, rest assured that we are going to pay for it above the fair market value. You are aware of the land zonal value and fair market value but as I said, our offer will be generous and definitely, will be higher than the fair market value. The objective of the company is to have a win-win situation.

Aurelio M. Espeja:

Tagalog:

Doon naman po sa posibilidad na umapaw o lumabas ang tails sa tailings pond, bago po pumunta ang mga concentrate ng mina sa tailings pond, dumadaan po muna sya sa cyanide detoxification plant. Sa proseso po ng cyanide detoxification, ibaba po ang delikadong concentrate ng cyanide sa mababang lebel na nasa DENR standard. Sisiguruhin po ng in-house Environmental Monitoring Team ng GRC bukod pa sa MMT na babantayan ang tailings pond araw-araw. At kung may maaapektuhan man dahil lumabas ang tubig galing sa tailings pond, mayroon pong ilalaan ang kompanya na pondo na tinatawag na Mine Waste and Tailings Fee. Sa pakikipag-koordinasyon sa MGB, magkakaroon ng investigative and assessment team para maging tama at patas ang patingin at pagbayad sa naapektuhan ng tailings pond spill. Bukod pa doon, aayusin ng kompanya ang anumang nasira o naapektuhan ng spill. Ayon po iyon sa batas ng mina kaya hindi po kami pwede lumabag doon.

Regarding the possibility of tails overflow from the tailings pond, before the mine concentrate goes to the tailings pond, it passes the cyanide detoxification plant. During the process of cyanide detoxification, the dangerous concentration of cyanide is brought down to lower level that complies with the DENR standard. The in-house Environmental Monitoring Team of GRC will assure, aside from the MMT, the monitoring of the tailings pond daily. And if there will be adverse effects from the release of water from the tailings pond, the company will set aside a Mine Waste and tailings Fee. In coordination with the MGB, an investigative and assessment team will be formed to ensure the correct and fair investigation and compensation of the tailings pond spill. Aside from that, the company will fix any damage or effects of the spill. That is according to the mining law; hence, we cannot violate it.

Mike Alapan:

Tagalog:

Isa pa sa kasiguruhan na kung sakaling lumabas ang tubig galing sa tailings pond, gaya ng report ko kanina, meron tayong itatayo ng cyanide detoxification. Ang ibig sabihin po ay binababa natin ang concentration ng cyanide base sa standard na 0.1 mg/l level bago pumunta sa tailings pond. Ang kompanya po ay gagastos ng ganon kalaki para lang masiguro na ligtas at pwedeng inumin ang tubig na galing sa planta.

Another assurance in case of tailings pond spill, as I reported a while ago, we will put up a cyanide detoxification. What this means is the concentration of cyanide will be brought down to the standard of 0.1 mg/L level before it goes to the tailings pond. The company will spend that much to ensure safety and potability of water coming from the plant.

Edgar Mosura:

Bisaya:

Pangutana ning ako maam kabahin sa pagkabutang namo diha sa Harrison Bridge, ma relocate ba mi? Kanang daghan mi ngbalay diha, kanang yuta diha sa kompanya pa na, kay ang akong amahan ngtrabaho man sa SURICON kani-adto, kanang balay ra ang amo diha kay sa SURICON paman nga lupa, unsa may mahitabo namo kung mag-operate na ang Greenstone?

We are living in the company owned land at Harrison Bridge area. What will happen to us? Are we going to be relocated?

Hearing Officer:

Your query is about relocation plan; I believe that such concern was already answered by the company many times already so we are going to entertain another question.

Leopoldo T. Suyman (RSI-MHO Tubod):

Bisaya:

E-grab nalang nako ni usa ka opportunidad kay naa man atong ASEC sa DENR. Akong pangutana mao kini, kung maobserbahan nato ang Makati wala silay gold diha, wala na silay mga palayan pero asenso man sila. Ang punto nako mao kini ang mga dagko nga kompanya instead dia sila diri ngdaut sa atong lugar, didto ang ilang opisina sa Metro Manila. So ang Manila na karon o ang Makati sa SURICON kung nakahinumdom mo tua ang ilang opisina didto ang area nga ilang gidaut, kung inyong na obserbahan miasenso ba og sakto? Ang akong pangutana diha ASEC wala ba moy mga plano para ana kay dapat kung asa siya nakinabang didto lang tana siya pud mag-base wala ba kayomh ganung mga plano?

I would like to take this opportunity to ask (a question of) the Assistant Secretary of DENR since he is present. If we observe Makati City, it does not have mining operations or vast farm lands but it is a very progressive place. My point is all big companies are doing their operations somewhere else while their offices are in the cities like Makati. The places that they have mined have less progress compared to where their offices are located. My question is, would it be possible that the mining firm should establish their offices where they are operating?

ASEC. Gerry Dolino:

Bisaya:

Actually kasi may balaod tayo, naay puy nakabutang sa balaod as fee no, nga asa ang ilang head office adto sila magbayad ng tax, mao btiaw kasagaran adto sila magbayad nang tax sa Makati kay tua man ang ilang head office sa Makati. Pero nay certain moves in mining companies. Like for example Tampakan mayron pang isa ang Sagittarius Mines na gi establish nila ang ila office sa Gen Santos City. So don cila nagbayan sa ila mga tax. Actrually kung naa sa inyo ang balaod kung asa, para sa amu kung as ang Head Office didto magbayad ug tax. Pag walay balaod nga nag-iingon nga adto ka sa Makati magbutang sa imong head office. So nasakop man sa Municipal Government o Provincial Government naa sa City Ordinance kung unsa nga company that you can establish your head office dinhi sa lugar nato.

Actually there is a law that mandates companies to pay their taxes in the place where their Head office is located, like Makati. But there are certain moves by the mining companies like Tampakan and Sagittarius Mines where they establish their offices in General Santos City, so they pay their taxes in the area. Actually it's up to the company. The law says that you pay your taxes where your head office is located but there is no law that mandates you to put your Head Office in Makati or in any other city. It depends on the move of the municipal and provincial government to make an ordinance requiring mining companies to put their Head Offices in the place where they operate.

Leopoldo T. Suyman:

Tagalog:

Naobserbahan ko kasi Sir, hindi lang ito nangyayari sa Surigao, almost lahat ng kompanya, sinisira nila yung kung saan sila kumukuha ng income. Sana kung saan sila nakikinabang na probinsya, doon sila dapat magopisina.

I observed, Sir, this happens not only in Surigao. Almost all companies destroy the place where they get the income. Hopefully, in the province where they get the income, that is where they hold office.

Greg Edwards:

Let me tell you about the policy of this Company. When we first came here, the registered office of Greenstone is in Surigao City and not in Manila. (Crowd applauds). We will have a major administration office here in Siana and Tubod (Cawilan). Third, almost all of our workers in our small office in Manila are Visayan from your community. I've been bringing people from this community to work in Manila for our office there. (Crowd applauds). We have very few Tagalog speaking people there. In our office we only speak Visayan/Surigaonon. (Crowd applauds).

ASEC.Gerry Dolino:

Bisaya:

Naa man moy nakit-an minahan diha diba? Naa nay problema ilaha. Because all taxes due to the national government. So katong inyo geingon na asa kuhaa ang mina, na unta una ibayad an taxes sa manila, 60% man ni goes to manila man and 40% sa local government man, shared sa provincial, municipal and mga barangay. So ang bill ni Domogan, 60% nalang direcho kay an 40% direct to the provincial, municipal and baranngay, unfortunately hangtod karon wala pa na approbahan aang bill, so sa last meeting namo sa Mindanao Development Council kanang MDC mao nay usa ka ahensya sa gobyerno nga tanang secretary ng DENR, DA, DTI og uban pa compose of 15 including the Department of Foreign Affairs 15 members mao nay mo solve sa mga problema kung dili na kaya I solve sa local so ipadala na sa MDC so ang last make ng MDC by the agreement of Department of Finance and BIR na in the absence of the law ikarga na na sa Provision Act every year ikarga para direct gihapon mahatag sa inyo problema lang niana mag prepare ka ng budget mag prepare ka ng release. so kung ma approve tana ang Domogan dili na kinahanglan sa provision act kay yearly man provision act. So mihangyo mi sa tanan, ang league of municipalities, league of governors misuporta na sa Domogan Bill. Sa congress walay problema, ang sa senate nlang. untana ma approbahan na sa inyong tabang inyong yango ngoon ang inyong mga congress nga tabangan nga maapprove dayon ang Domogan Bill kay para man na sa inyong tanan noh.

ASEC Dolino presented the general rule in sharing and paying taxes. Taxes are generally paid where the project/business office is located. If the office is in Manila, the company should pay in Manila (60% should go to Manila). However, there is a new bill passed in the Congress sponsored by Congressman Domogan stipulating that the settlement or payment of taxes should be made where the project is located. In a recent meeting with the Mineral Development Council wherein 15 secretaries of different departments were represented, they asserted the said move but in the absence of the new bill (as the bill is still in the Philippine Senate), an agreement was forged between the Department of Finance and BIR wherein the LGU sharing of taxes be included in the provisions of the Appropriations Act, budgeted for local LGUs. In this scheme, taxes can still be directly allocated to each LGU but each LGU needs to prepare an annual budget. Once the Domogan Bill is approved, the Appropriations Act will be superseded. ASec Dolino is requesting the support of the bill especially from the League of Municipalities and Governors for the approval of the Domogan Bill. He is also encouraging everyone to lobby the bill with Congressman Romarate (also a signatory to the Domogan Bill) to fast track its approval at the Senate.

Salis Salino:

Tagalog:

Ako may edad na, 68 anyos na ako, Ako ay plant operator sa panahon ng Suricon. Kung mag-ooperate ang Greenstone pwede pa ba akong magtrabaho?

I am 68 yrs. old. During SURICON operation I worked as mill plant operator. Now if Greenstone will operate, can I still work?

Greg Edwards:

We don't discriminate with age (of an employee). We have many of our workers that are over 65 and they are still some of our best workers, Tatay Simo where are you? Haman kaw? (Crowd applauds). Ok, we don't discriminate with age and we don't expect anyone to leave our company until they cannot work anymore.

Dominador Lopez:

Bisaya:

Maayong hapon sa tanan, taga Dayano ko Doming Lopez. Ako pangutana ma'am, daghan man ang giandam nga mga pribiliheyo ang Greenstone Mining para sa mga katawhan, indibidwal ba ang makadawat niana kay nakahibalo naman ta nga kwarta na ang hisgutan naa man si Joc Joc Bolante moapil, so dili ipaabot sa mga tawo nga dunay indibidwal nga madawat nila nga pribiliheyo? Kay kung ato pang ikuan, lain naman Joc Joc namay moapil.

We heard a lot of privileges coming from the operation of Greenstone. Will these privileges be received individually by the people in the area?

Aurelio M. Espeja:

Tagalog:

Malaking aspeto po ang pera kaya hindi po natin muna paguusapan yan. Sa aspeto naman ng pagkakaroon ng trabaho, mayroon po tayo binuong MOA na pinagusapan ng GRC at mga baranggay para masunod ng bawat panig ang nakasaad sa MOA at maging masaya ang bawat panig. Kung tungkol naman po sa pera, ang kompanya naman ay hindi maglalabas ng pera kung wala sa alituntunin natin. Hindi pwedeng galawin ng baranggay ang pondo kung walang pinasa na plano at hindi nakasaad sa SDMP. Susuriin po ng GRC mabuti ang paglalaanan ng pondo para masiguro na tama ang paggamit sa pera.

Money is a major item which we will not talk about first. In the aspect of having jobs, we formed a MOA that GRC discussed with the barangays so that both sides can follow what is stated in the MOA and that both sides would be happy. With respect to money, our company will not release funds if it is outside company policy. The barangay cannot spend the funds in the absence of submitted plans and if not included in the SDMP. GRC will examine closely the object of disbursement to ensure the proper use of funds.

Greg Edwards:

I think this is the time that while we are talking about money to the community and employment, we explain something very important. We have explained this to the barangay councils and the municipalities. For all of the rest of you; this is so important that's why I want you to understand every single word of it. I am now going to ask Lolot (Manigsaca) to explain about it. Listen carefully because this is very important and special.

Love Manigsaca:

Bisaya:

Sa corporate structure sa Siana project, naay concept nga gi spearhead ang Managing Director kabahin sa Greenstone employees retirement fund. Kita tanan aware nga kung empleyado ta sa usa ka kompanya, naay mandated nga employees retirement plan. Pero unsa man ning gi provide nga retirement plan sa gobyerno per R.A. 7641? Di kayo ko sigurado sa R.A. number. Ang giingon ini is naay makuhang retirement ang mga employado nga nakatrabaho na ug 35 years sa kompanya or over 65 years old na ang edad. Pero ang atong makuha ra is ½ month for every year of service. Amo nang gi-estoryahan diri sa kumpanya ug ang opinion sa Managing Director is gamay ra kaayo na labi na nga gapamahal ang mga palaliton. So ang concept sa Managing Director para mas financially secure ang mga empleyado nga mo retire is mohimo ug atong tawagon lang sa

pagkakaron ug modified retirement fund. Ang giingon sa gobyerno is kada kompanya mag recognize ug balayronon para sa retirement sa mga empleyado ug mag set aside ug pondo para anang retirement fund. Ang kantidad depende sa ma determine nga liability sa actuaries. Pero ang Greenstone ang himoon is more than that. Gawas sa retirement fund, gahimo mi ug mechanism nga ang employee retirement fund is also an investor in the project. So as investor unsa may mga rights sa investor? Ang usa ani is naa syay katungod nga makakuha ug dividendo or bahin sa kita sa kompanya. Amo ni nga gi compute ug among nakitan nga mas dako ni kaysa normal nga retirement fund. Kini nga kwarta nga i-put up sa company, i-set aside ni sa sa usa ka trust fund nga i–manage independently sa usa ka banko, pananglitan sa BPI or Metrobank. Dili ni controlado sa kumpanya unya ang disbursement ani subject to the rules nga I set sa mga representative sa empleyado ug kumpanya. Pwede nato ma butang ang partial vesting pananglitan. Unsa man ning vesting? Mao ni ang mechanism nga maghatag ug abilidad sa mga empleyado nga makuha ang portion sa ila nga retirement plan maski wala pa sila mo retire. So, unsa may implication aning gitawag natong modified retirement plan sa mga empleyado nga at the same time investor pud sya sa project? Kay magadawat man ug dividendo ang fund, among gi determine nga at the end of the mine life, mas dako ang pondo sa fund kumpara sa normal nga retirement plan. Kaning fund, available ni sa mga empleyado for distribution. And kung naay mo retire sa wa pa matapos ang mina, sigurado nga naa gyud syay makuha mga retirement nga mas dako kumpara sa normal retirement plan. So through the fund, ang mga empleyado mismo nahimo pud nga indirect shareholder sa kumpanya.

As part of the corporate structure for the Siana Gold Project, through our Managing Director, we will also have our retirement plan for the employees. We know that there is a government mandated retirement plan for all employees working in a company like GRC. This stipulates that employees who have rendered 35 years of continuous service or are 65 years of age have the mandatory retirement equivalent to 1/2 month of present salary for every year of service. We have discussed this in the company and determined that the sum of money to be received by a retiring employee will not be enough to defray his cost of living and medical needs, particularly now that the cost of medicines is rising. So, the Managing Director thought of creating a retirement scheme that will financially secure Greenstone employees. For now, we will just call the scheme as a Modified Employees Retirement Fund. It is termed as such because this is something unique from other retirement plans. In this scheme, the retirement fund will also be an investor in the project at no cost on the part of the employees. As an investor, the fund shall have rights of the distribution of profits of which we have determined the amount to be much higher (in monetary terms) than the fund that can accrue under a normal retirement plan.

This fund will not be controlled by the Company. The money shall be deposited in a trust account of a local bank and availment of this shall be subject to the rules and regulations to be set both by the management and the employees. Also, to make availment easier and simpler, we may include provision of vesting. Vesting is a retirement plan mechanism wherein an employee can partly avail his retirement plan even before his actual retirement. Normal vesting starts after five (5) years of continous service and percentages of availment are pre-agreed.

So what is there for us (employees) in this so called modified retirement plan? Because the fund will directly participate in the profit sharing of the project, the amount of the fund would be much bigger than a normal retirement plan, as mentioned earlier. These profits shall be available to the employees for distribution through vesting or actual retirement. Through the fund, the employees indirectly become investors to the project.

Virgo Apusaga:

I just want to clarify one thing being part (a member) of the host community. What is the sequence of accepting employment being part of the benefits to the host community?

Hearing Officer:

What is the process of accepting applicants?

Love Manigsaca:

Bisaya:

Nahisgutan na nato ganina ang MOA on Community Assistance Program sa Greenstone. Naa ni syay twelve (12) points ug ang usa ani kabahin sa employment policy. Ang allocation kada barangay, 3 ka primary impact barangays ug 3 ka secondary impact barangay gisabutan na atong meeting nga gi held sa Mainit atong miaging Octobre. Ang una nga reference sa pagkuha is ang MOA. Ang ikaduha is ang kinahanglan sa kompanya. So diri na namo tan-awon kung na tagbo ba sa job applicant ang mga skills ug level sa edukasyon nga required sa kompanya para sa posisyon. So makasabot pod mo nga mag suffer baya ang kompanya kung mo hire mi ug applicante nga di niya kaya ang mga gikinahanglan sa ana nga trabaho. Kinahanglan naa puy proper alignment between unsay gikinahanglan sa kompanya ug unsay available sa barangay. Pero all things equal, mas naay weight siempre ang may rekomendasyon.

We've already talked about the MOA a while ago. The Memorandum of Agreement on Community Assistance Programs contains 12 points and one of which is about employment. In the said MOA percentages have been agreed as to the number of employees per barangay. Such agreement was done by the host barangays in their meeting last October in Mainit. In terms of hiring process, the first basis would be the MOA. Second would be recommendation or references. Third will be the company, who will screen the applicant's qualification and suitability to the job. Everybody understands that the company will also suffer if we hire an applicant who does not suit the position. All things equal however, those with proper recommendation and references will have advantage in securing the job.

Rosario Mijares:

I just want to suggest that what I'm going to say will be included in the MOA. For example, my piece of land was bought by the company, then after the operation or after the area was being abandoned by the company, would it be possible that the previous land owner can re-occupy it, even temporarily, instead of other people that will surely cause conflict to the community?

Hearing Officer:

The question is, they wanted it to be included in the MOA that if there is land bought by the company and they are going to pay for it, that after the operation of the company, can the owner re-occupy the land?

Greg Edwards:

The only land that the company will buy is the access road. What we want is that the road that we are constructing will basically be given to the community after the operation, and even during the operation it can be used as a community road. When we are buying land for the access road, we are going to keep it because we want to make sure that it will be an access road serving the community forever. When we are designing the road or any other infrastructure, we are designing it to the best industry practice. So when we put a road in, for example, our plan is to build it so that it can last for a long time. We want to leave infrastructure here that will last much longer than we are here. We probably won't buy any more land, but if we will use other land, we probably be using it in a way that would give it back to the community (after the operation ceases) .

ASEC Gerry Dolino:

Bisaya:

Adto nako magclosing remarks kanang walay tawo. Una sa tanan I would like to congratulate those who are responsible for this open forum, this public hearing especially to Greenstone and ang gwapo kayo tong gi-istorya ni Greg na ang iyang head office naa diri Surigao. I would like to congratulate all of you because it seems na pabor mo sa mina, tinuod ba? Mao na di kayo mo mglisod magexplain kay kahibaw man ko na-assign man

ko diri nang dugay diri sa Mindanao, kahibaw ko na mina ni Siana, kahibaw sad ko na tanan nakasabot sa mina, so di nami sa SURICON maglisod pagpasabot. Pero sige pa nato hisgutan katong sauna ba, adtong una man gud tulo na kabuok. We started at 137, panahon nang "martial law" na amend to nang Bill 416, tapos kining ato balaod karon 7942, jutay pa kayo na mina na nakaoperate. Greenstone ang usa sa mina ato, usa ka mina na amo unta gebantayan na mahimo modelo, nadisgrasya man, so daku kaayong syang pildi sa gobyerno kay gesara siya wala mo-abot og 1 year, so na-alkanse ang kompanya at least nabaligya karon. Akong ge-istorya ninyo kadtong nahitabo, gamay ra to na part sa amo na nakadaut but because it has certain adverse impact to the environment na may namatay duha ka sakong isda o tulo man siguro pero isa na ato sa gobyerno ug isa ka tuig kapin so that is how strict the new mining law, mao nang kami sad mo-esplikar sad sa inyona kaning new mining hatagan sad ninyo ug chance to operate. The new type of mining that operate the new mining law so kung unsay deperensiya kung inyong suma-totalon tanan gipang esplikar ninyo, tulo ra nah ka bagay ang importante wala ni sauna na balaod. In fact, kining ato 7942 law is considered one of the best in the world especially sa environmental protection, sauna panahon sa SURICON wala man siguro sila nag-ECC because the EIS law started 1994, so pasabot ang balaod karon dili na e-apply katong na-agi na, katong una ng Bill 416 kung inyong madumduman ang protection ra jud sa ato law, the exploration. Karon sa mining law, kadumdum mo katong bangko nga gilingkuran nga tulo kabuok haligi? Mao nay getawag namo bangko management o school management. Tulo kabuok importante kayo na factors sa mining law. No. 1 is economic. Kinahanglan muuswag ang communidad. Ikaduha, protection nang environment. Kay importante kayo ato environment. Ika tulo, ang social equity. Tulo ra nah siya. Kung mawala ang usa, tumba ang mina. Mao nang tulo ka importante sa mining. Economic Development, Environmental Protection and Social Equity.

Ah, kita mo aning akong bracelet? Napalit nako ni sa Canada katong one of our trips under the Philippine Canadian Economic Environment Management Program. Gepabisita mi sa usa ka mining company, pero dugay na nahuman. Para ma sustain ang communidad, ang mining company, yung mga trabahante, ila gehimo or geconvert nila ang minaham into a tourist attraction. Nagbibinta cla nang ganitong mga bracelet. Wa nay mina. So namaligya nalang sila mga produkto na gikan sa minahan. Inyo nang estoryahan ug tinuod kay usa nah sa makasustinar sa communidad so gamiton nato ang kompanya, ah, swerte kayo ang Surigao kay in this time. Dose kabuok mining company ang nag operate dinhi sa Surigao. Swerte ang Surigao, siguro minahal kayo nang Diyos kay bisag wala tay oil diri sa Surigao, pero naa man tay mina. Anugon kayo ang companya kung dili nimo madevelop for example sa Saudi or sa Middle East, naa silay oil so ilang gedevelop mayo mao niasenso jud sila. Kung dili nato edevelop ang atong companya so unsa nay matabo nato? Wa gihapon noh? Importante lang bantayan nato kanunay, kung project nang gobyerno, walay gagong gobyerno magbuhat proyekto na makadaut sa mga tawo. Kay an tawo parte sa gobyerno. Walay gobyerno kung walay tawo. So congratulations sa inyo tanan. Kaning inyo proseso karon, mao ni among getanaw. Geexplain naman lahat kanina. Untana inyo bantayan mga development diri kay para man ni sa inyo. Kinahanglan mutabang kamo bantay. So part an tawo, part an gobyerno sa development sa companya. So daghang salamat kaninyong tanan ug maayong hapon.

First of all, I would like to congratulate those who are responsible for the success of this open forum, this public hearing, especially to Greenstone. It was great to hear from Greg Edwards that he has established GRC's main office here in Surigao. I would also like to congratulate you (host baranggays) because you have shown your support for the mining project of GRC. And it was good to know that the people here knew a lot about mining, so it was not difficult for us to explain important matters of the project to you. When I was assigned here in Mindanao for a long time, I knew the history of this place. And I know every person here knows something about mining. Still, we keep on bringing back SURICON and the old ways of mining. I would like to elaborate to you the history of mining; we started with mining law of 137, then it was amended during martial law with Bill 416. And now we have the RA 7942, in which few mining companies are operating in this law. One of them is Greenstone. There was one mining company which we thought could be an asset and be a model for future mining companies here in Surigao. But unfortunately, an accident occurred and the company was forced to shut down after one year of operation. There was an adverse impact on the environment because of the intoxification over these lands. So that is one of the reasons the government developed and amended the new 7942 mining law. So I'm asking all of you to give Greenstone a chance to operate here and help develop not only these lands but help increase the economic diversity of this city. They (GRC) are now under the new mining law which is considered one of the best mining laws in the world,

particularly with the protection of the environment. During the time of SURICON, there was no ECC to protect the environment and the people, but today's mining law entails the EIS system in which GRC is applying now. There are three (3) important factors that incorporates today's mining law. First is the economics. Second is the protection of environment which is very important to all of us. And third is the social equity. These aspects serve as pillars for the new mining law. If one fails, mining will not succeed.

Did any of you notice my bracelet? I bought it from Canada during one of our trips in the Philippine Canadian Economic Environment Management Program. We visited there a mined out area. Surprisingly, the community still benefits from it. The mine site managed to sustain productivity to the community by converting the old mine site into a tourist attraction. This should serve as an inspiration to this company and to all of you because this city is truly blessed. There are 12 mining companies operating in this city at present, soon you will be able to compete with foreign investors such as Saudi or Middle East. They have oil, and you have mining. So we should help one another. Our time is now. You need to develop, and that is what we are doing. Allow your government to help you because you are part of the government, there is no government without the people. So once again congratulations to all of you. As the company had explained to you, we will be facilitating your development. But all of you should help in the development process of this project. The community has a big part in making this project successful . The government and the community are part of the success of this company. Thank you and have a good day.

The public forum adjourned at exactly 3:00 PM.

----------END OF QUESTIONS AND ANSWERS-----

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