# **Sta. Cruz-Candelaria Mining Project**



# **DRAFT EPRMP REPORT**

November 2021

#### **EXECUTIVE SUMMARY**

1	PROJE	CT DESCRIPTION	1-10
	1.1	PROJECT LOCATION AND AREA	1-11
	1.1.1	Proximity to Protected Area	1-17
	1.2	PROJECT RATIONALE	1-18
	1.3	PROJECT ALTERNATIVES	1-19
	1.3.1	Siting	1-19
	1.3.2	Technoloay Selection/Operation Processes and design selection for storage	1-20
	1.3.3	Resources	1-20
	1.3.4	Consequences of not Proceeding	1-20
	1.4	PROJECT COMPONENTS	1-20
	1.4.1	General Lavout of Facilities	
	1.4.2	Maior Components	1-20
	1.4.3	Mineral Extraction	
	1.4.4	Support Facilities and Infrastructure Requirements	
	145	Pollution Control Devices	1-23
	1.4.5	.1 Sediment Control Structures	
	1.4.5	.2 Waste Rock Stockpile	1-23
	1.5	PROCESS TECHNOLOGY OPTIONS	1-26
	1.5.1	Description of Operations and Maintenance	1-26
	1.5.2	Description of the Pollution Control Devices and Waste Management System	1-27
	1.5.2	.1 Pollution Control Devices	1-27
	1.5.2	.2 Mine wastes and Overburden	1-28
	1.5.2	.3 Regulated Wastes	1-28
	1.6	DESCRIPTION OF PROJECT PHASES	1-29
	1.6.1	Permitting and Pre-Construction Phase	1-29
	1.6.2	Construction/Operational phase	1-29
	1.6.3	Decommissioning and Mine Closure	1-29
	1.7	PROJECT SIZE	1-30
	1.8	MANPOWER	1-30
	1.9	Indicative Project Cost	1-31
2	ASSESS	MENT OF ENVIRONMENTAL IMPACTS	2-1
-	/100200		
	2.1	THE LAND	2-1
	2.1.1	Land Use and Classification	2-1
	2.1.1	.1 Municipality of Sta. Cruz	2-1
	2.1.1	.2 Municipality of Candelaria	2-1
	2.1.1	.3 Impact in terms of Compatibility with Existing Land Use	2-2
	2.1.1	.4 Impact on compatibility with classification as an environmentally critical Area 5 Impact in Existing Land Tenure Issue/s	2-2 2_2
	2.1.1	6 Impairment of Visual Aesthetics	2-2 2-2
	2.1.1	.7 Devaluation of Land Value due to Improper solid waste management and others	
	2.1.2	Geoloav/Geomorpholoav	2-3
	2.1.2	.1 Change in Surface Landform/Topography/Terrain/Slope	2-3
	2.1.2	.2 Change in sub-surface geology/underground conditions	2-6
	2.	1.2.2.1 Regional Geologic Setting	2-6
	2.	1.2.2.2 Geomorphology	2-7
	2.	1.2.2.3 Stratigraphy	2-7
	2.	1.2.2.4 Natural Hazards	2-11
		2.1.2.2.4.1 Volcanic Activities	2-11
		2.1.2.2.4.2 Earthquakes	2-12
	212	2.1.2.2.4.3 Ground Acceleration	
	2.1.2		/2-17 c
	2.	1.2.3.1 Equeration	2-17 2_12
	213	Pedoloav	
	2.1.5	.1 Soil Erosion/Loss of Topsoil/Overburden	
	2.1.5		

2.1.3.2 Change in Soil Quality/Fertility	2-20
2.1.3.2.1 Soils of the Project Area	2-20
2.1.3.2.2 Change in Soil Quality/ Fertility	2-22
2.1.4 Terrestrial Ecology	2-23
2.1.4.1 Flora and Fauna Survey	
2.1.4.1.1 Survey Plots and Transect Description	
2.1.4.1.2 Terrestrial Flora Assessment	
2.1.4.1.3 Terrestrial Fauna Assessment	
2.1.4.1.3.1 Birds	
2.1.4.1.3.2 Mainings	2-30 2_30
2.1.4.1.3.4 Processing and Identification of the Vertebrate Fauna	2-30 2-30
2 1 4 1 4 Rindiversity Indices	2-30 2-31
2 1 4 1 5 Terrestrial Flora Biodiversity	2-32
2.1.4.1.5.1 Biodiversity Parameters	2-32
2.1.4.1.5.2 Importance Value	
2.1.4.1.5.3 Flora Diversity and Evenness	2-34
2.1.4.1.6 Terrestrial Fauna Biodiversity	2-37
2.1.4.1.6.1 Birds	2-37
2.1.4.1.6.1.1 Abundance	2-37
2.1.4.1.6.1.2 Species Richness	2-38
2.1.4.1.6.1.3 Diversity and Evenness Indices	2-38
2.1.4.1.6.2 Mammals	2-39
2.1.4.1.6.3 Herps	2-40
2.1.4.1.7 Distribution and Endemicity	2-40
2.1.4.1.7.1 Flora Distribution	2-40
2.1.4.1.7.2 Faunal Distribution	2-42
2.1.4.1.8 Conservation Status	2-43
2.1.4.2 Vegetation Removal and Habitat Loss	
2.1.4.3 Inreat to existence and/or loss of important local species	
2.1.4.4 Infect to Abundance, Frequency and Distribution of Important Species	
2.1.4.5 Hindrance to Wildlife Access	
2.2 THE WATER	
2.2.1 Hydrology/Hydrogeology	2-46
2.2.1.1 Catchment Area	
2.2.1.2 Hydrogeologic Units	
2.2.1.2.1 Old and the Rocks and Thin Alluvial Deposits	2-49 2_/10
2 2 1 3 Water Source and Water Lise	2-49 2-51
2.2.1.5 Water Source and Water Ose	2-54
2 2 1 4 1 Change in Drainage Mornhology	2-54
2.2.1.4.2 Inducement of Flooding	
2.2.1.4.3 Competition in Water Use	2-54
2.2.1.4.4 Climate Change Projections	2-54
2.2.2 Water Quality	2-57
2.2.2.1 Environmental Structures for Water Quality	2-57
2.2.2.2 Effluent Quality Monitoring	2-63
2.2.2.3 Ambient Water Quality Monitoring	2-72
2.2.2.4 Impacts and Mitigation Measure – Water Quality	2-76
2.2.3 Freshwater Ecology	2-79
2.2.3.1 Phytoplankton	
	2-81
2.2.3.2 Zooplankton	2-81 2-83
2.2.3.2Zooplankton2.2.3.3Benthic Macroinvertebrates	2-81 2-83 2-84
2.2.3.2Zooplankton2.2.3.3Benthic Macroinvertebrates2.2.3.4Fish	2-81 2-83 2-84 2-89
<ul> <li>2.2.3.2 Zooplankton</li> <li>2.2.3.3 Benthic Macroinvertebrates</li></ul>	2-81 2-83 2-84 2-89 2-89 2-89
<ul> <li>2.2.3.2 Zooplankton</li></ul>	2-81 2-83 2-84 2-89 2-89 2-89 2-91
<ul> <li>2.2.3.2 Zooplankton</li> <li>2.2.3.3 Benthic Macroinvertebrates</li> <li>2.2.3.4 Fish</li> <li>2.2.3.5 Loss of Important species and habitat</li> <li>2.2.3.6 Threat to Abundance, Frequency and Distribution of Species</li> <li>2.2.3.7 Threat to Existence or Loss of Species</li> </ul>	2-81 2-83 2-84 .2-89 .2-89 .2-89 .2-91 2-92
2.2.3.2       Zooplankton         2.2.3.3       Benthic Macroinvertebrates         2.2.3.4       Fish         2.2.3.5       Loss of Important species and habitat         2.2.3.6       Threat to Abundance, Frequency and Distribution of Species         2.2.3.7       Threat to Existence or Loss of Species         2.3       THE AIR	
2.2.3.2       Zooplankton         2.2.3.3       Benthic Macroinvertebrates         2.2.3.4       Fish         2.2.3.5       Loss of Important species and habitat         2.2.3.6       Threat to Abundance, Frequency and Distribution of Species         2.2.3.7       Threat to Existence or Loss of Species         2.3       THE AIR         2.3.1       Meteorology	
2.2.3.2       Zooplankton         2.2.3.3       Benthic Macroinvertebrates         2.2.3.4       Fish         2.2.3.5       Loss of Important species and habitat         2.2.3.6       Threat to Abundance, Frequency and Distribution of Species         2.2.3.7       Threat to Existence or Loss of Species         2.3       THE AIR         2.3.1       Meteorology	
2.2.3.2       Zooplankton         2.2.3.3       Benthic Macroinvertebrates         2.2.3.4       Fish         2.2.3.5       Loss of Important species and habitat         2.2.3.6       Threat to Abundance, Frequency and Distribution of Species         2.2.3.7       Threat to Existence or Loss of Species         2.3       THE AIR         2.3.1       Meteorology         2.3.1.2       Change in Local Climate	
2.2.3.2       Zooplankton         2.2.3.3       Benthic Macroinvertebrates         2.2.3.4       Fish         2.2.3.5       Loss of Important species and habitat         2.2.3.6       Threat to Abundance, Frequency and Distribution of Species         2.2.3.7       Threat to Existence or Loss of Species         2.3       THE AIR         2.3.1       Meteorology         2.3.1.2       Change in Local Climate         2.3.1.2.1       Baseline Meteorological Data	
2.2.3.2       Zooplankton         2.2.3.3       Benthic Macroinvertebrates         2.2.3.4       Fish         2.2.3.5       Loss of Important species and habitat         2.2.3.6       Threat to Abundance, Frequency and Distribution of Species         2.2.3.7       Threat to Existence or Loss of Species         2.3       THE AIR         2.3.1       Meteorology         2.3.1.2       Change in Local Climate         2.3.1.2       Baseline Meteorological Data	

2.3.1.2.1	1.1 Climate	2-94
2.3.1.2.1	1.2 Rainfall	2-95
2.3.1	2.1.2.1 Extreme Recorded Rainfall Events	2-95
2.3.1.2.1	1.3 Ambient Air Temperature	2-95
2.3.1	.2.1.3.1 Extreme Temperature Events	2-96
2.3.1.2.1	1.4 Wind Speed and Direction	2-96
2.3.1.2.2	1.5 Frequency of Tropical Storms	2-97
2.3.1.2.2	Projected Change in Climate	2-105
2.3.1.2.2	2.1 Projected Change of Rainfall in 2036 to 2065	2-105
2.3.1.2.2	2.2 Projected Change in Temperature in 2036 to 2065	2-106
2.4 THE PEC	PLE	2-108
2.4.1 Meth	hodology	
2.4.1.1 Oc	ular Inspection	
2.4.1.2 Se	condary Data Gathering	2-109
2.4.1.3 Inf	ormation, Education, and Communication (IEC) Activities	2-110
2.4.1.4 Pu	blic Scoping	2-114
2.4.1.5 Pe	rception Survey	2-114
2.4.1.6 Ke	y Informant Interview (KII)	2-116
2.4.1.7 Fo	cus Group Discussion (FGD)	2-117
2.4.1.8 Pu	blic Hearing	2-117
2.4.2 Resu	lts	2-118
2.4.2.1 Se	condary Data	2-118
2.4.2.1.1	Historical Profile of Zambales	2-118
2.4.2.1.2	Demographic Profile of Zambales	2-118
2.4.2.1.3	Education and Literacy	2-121
2.4.2.1.4	Agriculture	2-121
2.4.2.1.5	Livestock and Poultry	2-121
2.4.2.1.6	Fisheries	2-121
2.4.2.1.7	Religion	2-122
2.4.2.1.8	Language	2-122
2.4.2.1.9	Economy	2-122
2.4.2.1.10	Employed Persons by Major Occupation Group	2-124
2.4.2.1.11	Tourism	2-124
2.4.2.1.12	Health and Welfare	2-124
2.4.2.2 De	mography Profile of Municipalitied of Sta. Cruz and Candelaria, Zambales	2-125
2.4.2.2.1	Population by Age Group	2-126
2.4.2.2.2	Education and Literacy	2-128
2.4.2.2.3	Health	2-129
2.4.2.2.4	Employment	2-129
2.4.2.2.5	Economy	2-130
2.4.2.2.6	Housing and Shelter Profile	
2.4.2.2.7	Utilities	
2.4.2.2.8 2.4.2.2 Do	Transportation and Communication	
2.4.2.3 PO	Descention Profile of Impact Barangays	
2.4.2.3.1 ว <i>เ</i> าววา	reiception sulvey	/12-2 1 1 20
2.4.2.3.2	Polizion	2-138
2.4.2.3.3 7 / 7 2 /	Educational Profile	2-141 7_1/1
2.4.2.3.4	Encloyment	
2.4.2.3.5	Transportation and Communication	2-145 2_1/15
2.4.2.3.0	Health and Welfare	2-146
2.4.2.3.8	Water and Sanitation	
2.4.2.3.9	Community Relationship. Culture and Values	
2.4.2.4 Pe	rception on Community Facilities and Services	
2.4.2.4.1	Livelihood/ Job Opportunities	2-154
2.4.2.4.2	Health and Welfare	2-154
2.4.2.4.3	Peace and Order	2-155
2.4.2.4.4	Sanitation/ Cleanliness	2-155
2.4.2.4.5	Education	2-156
2.4.2.4.6	Infrastructure	2-156
2.4.2.4.7	Utilities	2-156
2.4.2.4.8	Facilities and Amenities	2-157
2021 EPRMP		Page iii

	2.4.2.4	.9 Commercial Services	2-157
	2.4.2.4	.10 Barangay Services	2-158
	2.4.2.4	.11 Transportation	2-158
	2.4.2.4	.12 Disaster Mitigation, Preparedness and Response	2-159
	2.4.2.4	.13 Local Government Unit and Other Government Institution Support	2-159
	2.4.2.5	Perception on the Quality of Environmental Factors	
	2.4.2.5	.1 Air	
	2.4.2.5	2 Drinking Water	2-100
	2.4.2.3	A Biver Lakes and Creek	2-101 2_161
	2.4.2.5	5 Marine/ Sea	2-162
	2.4.2.5	.6 Soil/Land	
	2.4.2.5	.7 Flora (Plants/ Trees)	
	2.4.2.5	.8 Fauna (Animal Life)	2-163
	2.4.2.6	Perception Survey- Awareness and Perception about the Mining Project	2-164
	2.4.2.6	.1 Knowledge of the Project	2-164
	2.4.2.6	.2 Understanding of the Project	2-164
	2.4.2.6	.3 Knowledge of the Expansion Plan	2-165
	2.4.2.6	.4 Source of Information	2-165
	2.4.2.6	.5 Attendance to ZDMC's Information Drive	2-166
	2.4.2.6	.6 Perception on ZDMC's Mining Project	2-166
	2.4.2.7	SUMMARY OF COMMUNITY ISSUES AND CONCERNS	2-167
3	ENVIRONM	IENTAL MANAGEMENT PLAN	3-1
_			
3	5.1 THE	LAND	3-1
	3.1.1 L	oss of Vegetation Cover	3-1
	3.1.2 H	labitat Disturbance	3-1
	3.1.3 P	hysiological Stress to Floral and Faunal Species	3-1
	3.1.4 C	hange in Community Structure	3-1
	3.1.5 V	Vildlife Species Displacement	3-2
	3.1.6 L	oss of Topsoil and Soil Erosion	3-2
	3.1.7 S	oil Contamination	3-2
	3.1.8 G	eneration of Solid Wastes	3-2
	3.1.9 C	hange in Landform	3-2
	3.1.10 A	bandonment	3-3
3	.2 Тне	WATER	3-3
	3.2.1 li	ncrease in Surface Run-off	3-3
	3.2.2 L	pecrease in Aquifer Recharge	
	3.2.3 D	Deterioration of Surface Water Quality	
	324 P	hysiological Stress to Aquatic Organisms	3-3
	325 5	necies Displacement and Change in Community Structure	3-4
2	3.2.3 J	Aip	
J	221 1	nereace in Noice Levels	2_1
	222 1	nerease in Gaspous Emissions	4-د م د
	222 r	icities in Ouseous Linissions	5-4 2 1
2	5.5.5 L	DEODE	3-4
3	0.4 IHE	rturlt	
	3.4.1 S	UCIU ECUTIOMICS	3-5
	5.4.1.1 2 / 1 2	Increase in Population	3-5 ວິເ
	2/7 n	unproyment deneration	3-5 2 C
	5.4.2 P	upile riceului	<b>3-</b> b د
	3.4.Z.I 3 // 0 0	Occupational Risks	
	343 5	mployment Generation and Improvement of Income	
	э. <del>т</del> .э с	mployment deneration and improvement of medine	
4	ENVIRONM	ENTAL RISK ASSESSMENT AND EMERGENCY RESPONSE POLICY AND GUIDELINES	4-1
4	.1 Risk	Assessment	4-1
	4.1.1 (	onseauence Ratina	
	4.1.2 I	ikelihood Ratina	
	4.1.3	Dualitative Risk Matrix	
2.02	21 EPRMP		Page iv

	4.1.4	Source of Risk and Management Measures	4-4
	4.2	Risk Management	4-9
	4.3	SAFETY PERFORMANCE	4-11
	4.4	EMERGENCY PREPAREDNESS AND RESPONSE GUIDELINES	4-11
	4.4.1	Crisis Management Plan	
	4.4.2	Emergency Procedure	
	4.4.3	Fire	
	4.4.4	Landslide and Land Subsidence	
	4.4.5	Kidnapping and Unrests	
	4.4.6	Oil/Fuel/Acid/Chemical Spills	
	4.4.7	Flooding, Storm, and Heavy Rains	
	4.4.8	Vehicular Accident	
	4.4.9	Animal Bites	
	4.4.10	Development Programs	
5	SOCIA	L DEVELOPMENT PROGRAM (SDP) FRAMEWORK AND INFORMATION. EDUCA	TION. AND
C		CATION (IEC) IMPLEMENTATION	
	F 4		F 4.4
	5.1	SOCIAL DEVELOPMENT AND MANAGEMENT PLAN	
	5.2	INFORMATION, EDUCATION, AND COMMUNICATION (IEC) FRAMEWORKERROR! E	SOOKMARK NOT DEFINED.
6	ENVIR	ONMENTAL COMPLIANCE MONITORING	6-40
	6.1	ENVIRONMENTAL PERFORMANCE	6-40
	6.1.1	The Land	6-40
	6.1.1	1.1 Terrestrial Flora and Fauna	6-40
	6.1.2	The Water	6-40
	6.1.2	2.1 Water Quality	6-40
	6.	.1.2.1.1 Freshwater	6-40
	6.	.1.2.1.2 Groundwater	
	6.1.2	2.2 Freshwater Ecology	
	6.1.3	The Decede	
	6.1.4	The People	
	6.1.5	Status of ECC Compliance	
	6.2	SELF-MONITORING PLAN	6-45
	0.3	ENVIRONMENTAL IVIONITORING PLAN	6-45
	6.4 С.Г		6-45
	0.5	ENVIRONMENTAL GUARANTEE AND MONITORING FUND COMMITMENTS	
	0.J.I 6 5 J	Environmental Monitoring Fund (EMF)	0-45
	0.5.2	בוועוו טוווופוונטו ועוטווונטוווט דעווע (בועד)	0-45
7	ABANI	DONMENT/DECOMMISSIONING / REHABILITATION POLICIES AND GENERIC G	UIDELINES7-1
8	INSTIT	UTIONALPLAN FOR EMP IMPLEMENTATION	8-1
	8.1	ENVIRONMENTAL UNIT (EU)	8-1
	8.2	CORPORATE SOCIAL RESPONSIBILITY (CSR)	8-1

# List of Tables

Table ES- 1. Project Fact Sheet         Table ES- 2. EIA Team	1 2
Table ES- 2. ETA Teant	∠ 5
Tuble 15 5. Integrated building of impacts and residual criects	0
Table 1-1: Geographical Coordinates of MPSA No: 191-2004-III.	.1-11
Table 1-2: Geographical Coordinates of Expansion Area	.1-13
Table 1-3: Direct and Indirect Impact Areas of the Expansion Project.	.1-17
Table 1-4: Distribution of Workforce per barangay	.1-30
Table 1-5: Estimated Cost per Annum of the Nickel Operations	.1-31
Table 2-1: Land Use Allocation in Sta. Cruz, Zambales.	2-1
Table 2-2: Land Use Allocation in Candelaria, Zambales.	2-1
Table 2-3: Summary of slopes within the MPSA,	2-3
Table 2-4: Stratigraphy of the Project Site	.2-11
Table 2-5: Soil type of the Project area.	.2-20
Table 2-6: Heavy metal analysis in Municipalities of Sta. Cruz and Candelaria, Province of Zamba	les2-
22	
Table 2-7: Sediment heavy metal analysis, Cabaluan, Malabon and Lauis Rivers and Dasol	Bay,
Municipalities of Sta. Cruz and Candelaria, Province of Zambales	.2-22
Table 2-8: Result of soil fertility analysis	.2-23
Table 2-9: Geographical Coordinates of Established Monitoring Plots and Transects	.2-23
Table 2-10: The Fernando Biodiversity Scale	.2-31
Table 2-11: Top-ranked Flora Species and their Importance Value.	.2-33
Table 2-12: Checklist of Flora Species	.2-35
Table 2-13: Mammals observed in the Monitoring Site	.2-39
Table 2-14: Herps found in the Monitored sites	.2-40
Table 2-15: List of Endemic Flora Species	.2-40
Table 2-16: List of Endemic Fauna Species	.2-42
Table 2-17: List of Threatened Flora and Fauna Species observed in the Monitored Sites	.2-43
Table 2-18: Summary of water use in the Project Areas	.2-51
Table 2-19: ZDMC Settling Pond Location, Area and Capacity	.2-57
Table 2-20: ZDMC Effluent Monitoring Stations	.2-63
Table 2-21: Ambient water quality monitoring stations of ZDMC	.2-72
Table 2-22: Freshwater ecology sample sampling sites inside the proposed expansion area	.2-79
Table 2-23: Phytoplankton composition and abundance in the two sampling stations along	; the
alignment of the proposed project's site	.2-82
Table 2-24: The zooplankton composition of the two sampling stations along the alignment of	f the
proposed project's site	.2-84
Table 2-25: The macroinvertebrates composition of the two sampling stations along the alignment	nt of
the proposed project's site	.2-84
Table 2-26: The ichthyofauna composition of the two sampling stations along the alignment of	f the
proposed project's site	.2-89
Table 2-27: Climatological Normals for Zambales (1981-2010)	.2-93
Table 2-28: Climatological Extremes for Iba, Zambales (as of 2012)	.2-94
Table 2-29: Climatological monthly average wind speed and directions as PAGASA-Iba Station (1	1981-
2010)	.2-96
Table 2-30: Monitoring Data of Total Suspended Particulate (TSP)	101
Table 2-31: Monitoring Data of NO2 (2015 to 2018)	102
Table 2-32: Monitoring Data of SO2 (2015 to 2018)	103
Table 2-33: Monitoring Data of PM10 (2017 to 2020)	104

Table 2-35: Implementation of IEC Activities for the Expansion Plan2-11Table 2-36: Perception Survey Activity2-11Table 2-37: Population and Household Count2-11Table 2-38: Sampling Distribution2-11Table 2-39: Key Informant Interview Activity2-11Table 2-39: Key Informant Interview Activity2-11Table 2-40: Focus Group Discussion Activity2-11Table 2-41: Population by Sex and Age Group2-11Table 2-42: Population of municipalities of Zambales in 2015 and 20202-12Table 2-43: Top Five (5) Crops in 20162-12Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz in 20152-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz in 20152-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-2: Impacts Management Plan3-Table 3-2: Environmental Management Plan3-Table 2-51: Status of ECC Compliance6-4Table 3-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4Table 6-1: Stat	Table 2-34. Methodologies used for gathering socio-economic and demographic data	2-108
Table 2-36: Perception Survey Activity2-11Table 2-37: Population and Household Count2-11Table 2-38: Sampling Distribution2-11Table 2-39: Key Informant Interview Activity2-11Table 2-39: Key Informant Interview Activity2-11Table 2-40: Focus Group Discussion Activity2-11Table 2-41: Population by Sex and Age Group2-11Table 2-42: Population of municipalities of Zambales in 2015 and 20202-12Table 2-43: Top Five (5) Crops in 2016.2-12Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-53: Allocation on Number of Respondents2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-3Table 3-2: Impacts Management Plan3-1Table 3-3: Environmental Management Plan3-1Table 5-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4	Table 2-35: Implementation of IEC Activities for the Expansion Plan	2-110
Table 2-37: Population and Household Count2-11Table 2-38: Sampling Distribution2-11Table 2-39: Key Informant Interview Activity2-11Table 2-39: Key Informant Interview Activity2-11Table 2-40: Focus Group Discussion Activity2-11Table 2-41: Population by Sex and Age Group2-11Table 2-42: Population of municipalities of Zambales in 2015 and 20202-12Table 2-43: Top Five (5) Crops in 20162-12Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-2: Impacts Management Plan3-1Table 3-3: Environmental Management Plan3-1Table 3-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4	Table 2-36: Perception Survey Activity	2-115
Table 2-38: Sampling Distribution.2-11Table 2-39: Key Informant Interview Activity2-11Table 2-39: Key Informant Interview Activity2-11Table 2-40: Focus Group Discussion Activity2-11Table 2-41: Population by Sex and Age Group2-11Table 2-42: Population of municipalities of Zambales in 2015 and 20202-12Table 2-43: Top Five (5) Crops in 20162-12Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-2: Impacts Management Plan3-Table 3-3: Environmental Management Plan3-Table 5-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4	Table 2-37: Population and Household Count	2-115
Table 2-39: Key Informant Interview Activity2-11Table 2-40: Focus Group Discussion Activity2-11Table 2-41: Population by Sex and Age Group2-11Table 2-42: Population of municipalities of Zambales in 2015 and 20202-12Table 2-43: Top Five (5) Crops in 20162-12Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-2: Impacts Management Plan3-Table 3-3: Environmental Management Plan3-Table 3-1: Status of ECC Compliance6-4Table 3-1: Status of ECC Compliance6-4Table 3-1: Status of ECC Compliance6-4	Table 2-38: Sampling Distribution	2-116
Table 2-40: Focus Group Discussion Activity2-11Table 2-41: Population by Sex and Age Group2-11Table 2-41: Population of municipalities of Zambales in 2015 and 20202-12Table 2-42: Population of municipalities of Zambales in 2015 and 20202-12Table 2-43: Top Five (5) Crops in 20162-12Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-3: Environmental Management Plan3-1Table 5-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4	Table 2-39: Key Informant Interview Activity	2-116
Table 2-41: Population by Sex and Age Group2-11Table 2-42: Population of municipalities of Zambales in 2015 and 20202-12Table 2-43: Top Five (5) Crops in 20162-12Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-2: Impacts Management Plan3-1Table 3-3: Environmental Management Plan3-1Table 3-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4	Table 2-40: Focus Group Discussion Activity	2-117
Table 2-42: Population of municipalities of Zambales in 2015 and 20202-12Table 2-43: Top Five (5) Crops in 20162-12Table 2-43: Comparable Fisheries Production in 2018 and 20192-12Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects.3-Table 3-2: Impacts Management Plan.3-Table 3-3: Environmental Management Plan.3-1Table 5-1: Stat. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!BookmarTable 6-1: Status of ECC Compliance.6-4Table 6-1: Status of ECC Compliance.6-4Table 6-1: Status of ECC Compliance.6-4Table 6-2: Environmental Monitoring Plan.6-4	Table 2-41: Population by Sex and Age Group	2-119
Table 2-43: Top Five (5) Crops in 2016.2-12Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 2018.2-12Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-1Table 3-3: Environmental Management Plan3-1Table 3-4: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4	Table 2-42: Population of municipalities of Zambales in 2015 and 2020	2-120
Table 2-44: Comparable Fisheries Production in 2018 and 20192-12Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-45: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-46: Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-1Table 3-3: Environmental Management Plan3-1Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!Bookmarnot defined.6-4Table 6-1: Status of ECC Compliance6-4	Table 2-43: Top Five (5) Crops in 2016	2-121
Table 2-45: Mortality Statistics of Zambales in 20182-12Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-2: Impacts Management Plan3-Table 3-3: Environmental Management Plan3-Table 5-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4Table 6-2: Environmental Monitoring Plan6-4	Table 2-44: Comparable Fisheries Production in 2018 and 2019	2-122
Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 20152-12Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-53: Allocation on Number of Respondents2-13Table 3-54: Summary of Issues and Concerns2-16Table 3-2: Impacts Management Plan3-1Table 3-3: Environmental Management Plan3-1Table 5-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4Table 6-2Environmental Monitoring Plan6-46-4	Table 2-45: Mortality Statistics of Zambales in 2018	2-125
Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 20152-12Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-53: Allocation on Number of Respondents2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-1Table 3-2: Impacts Management Plan3-1Table 5-1: Status of ECC Compliance6-4Table 6-1: Status of ECC Compliance6-4Table 6-2: Environmental Monitoring Plan6-4	Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 2015	2-126
Table 2-48: List of Schools in Candelaria and Sta. Cruz2-12Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-53: Allocation on Number of Respondents2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-2: Impacts Management Plan3-1Table 5-1: Stat. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!Bookmarnot defined.6-4Table 6-1: Status of ECC Compliance6-4	Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 2015	2-126
Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz.2-12Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity.2-13Table 2-53: Allocation on Number of Respondents2-13Table 2-54: Summary of Issues and Concerns.2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-2: Impacts Management Plan3-1Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!Bookmarnot defined.6-4Table 6-1: Status of ECC Compliance.6-4	Table 2-48: List of Schools in Candelaria and Sta. Cruz	2-128
Table 2-50: Population of Host and Neighboring Barangays2-13Table 2-51: Population of Impact Barangays and Age Group2-13Table 2-52: Perception Survey Activity2-13Table 2-53: Allocation on Number of Respondents2-13Table 2-54: Summary of Issues and Concerns2-16Table 3-1: Summary of Environmental Impacts and Residual Effects3-Table 3-2: Impacts Management Plan3-Table 3-3: Environmental Management Plan3-1Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!Bookmarnot defined.6-4Table 6-1: Status of ECC Compliance6-4Table 6-2: Environmental Monitoring Plan6-4	Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz	2-129
Table 2-51: Population of Impact Barangays and Age Group       2-13         Table 2-52: Perception Survey Activity       2-13         Table 2-53: Allocation on Number of Respondents       2-13         Table 2-54: Summary of Issues and Concerns       2-16         Table 3-1: Summary of Environmental Impacts and Residual Effects       3-         Table 3-2: Impacts Management Plan       3-         Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!       Bookmar         not defined.       6-4         Table 6-2: Environmental Monitoring Plan       6-4	Table 2-50: Population of Host and Neighboring Barangays	2-135
Table 2-52: Perception Survey Activity.       2-13         Table 2-53: Allocation on Number of Respondents       2-13         Table 2-54: Summary of Issues and Concerns       2-16         Table 3-1: Summary of Environmental Impacts and Residual Effects       3-         Table 3-2: Impacts Management Plan       3-         Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!       Bookmar         not defined.       6-4         Table 6-2: Environmental Monitoring Plan       6-4	Table 2-51: Population of Impact Barangays and Age Group	2-136
Table 2-53: Allocation on Number of Respondents       2-13         Table 2-54: Summary of Issues and Concerns       2-16         Table 3-1: Summary of Environmental Impacts and Residual Effects       3-         Table 3-2: Impacts Management Plan       3-         Table 3-3: Environmental Management Plan       3-1         Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!       Bookmar         not defined.       6-4         Table 6-2: Environmental Monitoring Plan       6-4	Table 2-52: Perception Survey Activity	2-137
Table 2-54: Summary of Issues and Concerns.       2-16         Table 3-1: Summary of Environmental Impacts and Residual Effects       3-         Table 3-2: Impacts Management Plan       3-         Table 3-3: Environmental Management Plan       3-1         Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!       Bookmar         not defined.       6-4         Table 6-1: Status of ECC Compliance.       6-4	Table 2-53: Allocation on Number of Respondents	2-138
Table 3-1: Summary of Environmental Impacts and Residual Effects       .3-         Table 3-2: Impacts Management Plan       .3-         Table 3-3: Environmental Management Plan       .3-1         Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!       Bookmar         not defined.	Table 2-54: Summary of Issues and Concerns	2-168
Table 3-2: Impacts Management Plan       .3-         Table 3-3: Environmental Management Plan       .3-1         Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!       Bookmar         not defined.	Table 3-1: Summary of Environmental Impacts and Residual Effects	3-7
Table 3-3: Environmental Management Plan	Table 3-2: Impacts Management Plan	3-9
Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!       Bookmar         not defined.       Bookmar         Table 6-1: Status of ECC Compliance	Table 3-3: Environmental Management Plan	3-12
not defined. Table 6-1: Status of ECC Compliance	Table 5-1: Sta. Cruz – Candelaria Mining Project IEC Projects/Activities 2018-2020Error!	Bookmark
Table 6-1: Status of ECC Compliance	not defined.	
Table 6-2 Environmental Monitoring Plan 6-4	Table 6-1: Status of ECC Compliance	6-41
Tuble 0 2. Environmental Monttoling Flattering	Table 6-2. Environmental Monitoring Plan	6-46

# List of Figures

Figure 2-11: Peak horizontal acceleration amplitudes (g) in medium soil. 10% probability of exceed in 10 years	edance 2-15
Figure 2.12: Peak horizontal acceleration amplitudes (g) in rocks 10% probability of exceedance	$a_{in} 10$
vore	2_15
Figure 2-13: Cround Shaking Hazard Man	2-13 2_17
Figure 2-14: Liquefaction Hazard Man	2-17 2_18
Figure 2-14. Equelaction Hazard Map	2 10
Figure 2-16: Soil Map of the MDSA	2 21
Figure 2-10. Join Map of the Mi JA	2 25
Figure 2-17. Terrestrial Flora and Fauna Sampling Stations	2 26
Figure 2-10. Land Cover Map	2 27
Figure 2-19. Froximity of Froject Area to Frojected Area.	2 20
Figure 2-20. Stratified Nesled-Quadrat Method	2 2 2
Figure 2-21: Additional te of Flora Species in the Assessed Plate of ZDMC	2 22
Figure 2-22: Species Richness of Flora Species in the Assessed Plots of ZDMC.	2-33
Figure 2-23: Diversity of Flora Species in the Assessed Plots in ZDMC	2-34
Figure 2-24: Evenness of Flora Species in the Area.	2-34
Figure 2-25: Abundance of birds in the vicinity of THPAL	2-37
Figure 2-26: Species Richness and Families of Birds in All Transect Lines.	2-38
Figure 2-27: Diversity Indices in all Transects Assessed	2-39
Figure 2-28: Evenness values of birds in the assessed transects.	2-39
Figure 2-29: Geographic Distribution of Flora Species Found in the Monitoring Sites	2-40
Figure 2-30: Geographic Distribution of Fauna Groups presently observed in the Monitored Are	as2-42
Figure 2-31: Location of Sampling Stations in relation to Project Site	2-45
Figure 2-32: Mine Catchment Area	2-47
Figure 2-33: Direction of Water Runoff within the ZDMC Project Area	2-48
Figure 2-34: Regional Hydrogeologic Map	2-50
Figure 2-35: Record of Groundwater/Surface Water Withdrawal	2-52
Figure 2-36: Location of Water Sources with NWRB Water Permits	2-53
Figure 2-37: Climate Change Projections (2020 & 2050) - Seasonal Temperature Increase in Zar	mbales
Province	2-56
Figure 2-38: Climate Change Projections (2020 & 2050) – Seasonal Rainfall Change	2-56
Figure 2-39: ZDMC Environmental Structures and Rehabilitation Status as of September 2017	2-59
Figure 2-40: Malimlim Environmental Stuctures as of February 2019	2-60
Figure 2-41: H3 Environmental Structures as of May 2019	2-61
Figure 2-42: Airstrip Environmental Structures	2-62
Figure 2-43: Simplified Settling Ponds Flow Diagram	2-65
Figure 2-44: Effluent Water Quality Sampling Stations of ZDMC	2-66
Figure 2-45: Trend chart of pH monitoring data of effluent from settling ponds	2-67
Figure 2-46: Trend chart of total suspended solids (TSS) monitoring data of effluent from settling	ponds 2-67
Figure 2-47: Trend chart of oil $\ell_{T}$ grease (Ol-C) monitoring data of effluent from settling ponds	2-07 2_68
Figure 2-48: Trend chart of manganese (Mn) monitoring data of effluent from settling ponds.	2_68
Figure 2-49: Trend chart of manganese (Mr) monitoring data of effluent from settling ponds	2_69
Figure 2-50: Trend chart of cadmium (Cd) monitoring data of effluent from settling ponds	2_69
Figure 2-50: Trend chart of lead (Pb) monitoring data of effluent from settling ponds	2-07 2_70
Figure 2.52: Trend chart of rickel (Ni) monitoring data of offluent from settling ponds	2 70
Figure 2.52: Trend chart of hovevalent chromium ( $Cr(VI)$ ) monitoring data of effluent from a	2-70
nonde	2_71
Figure 2.54: Ambient Water Quality Monitoring Man	2-71 2 72
Figure 2-55: Trend chart of DO monitoring data of ZDMC freshwater stations	∠-73 2_74
Figure 2-56: Trend chart of pH monitoring data of ZDMC freshwater stations	····∠-74 2_74
ingure 2 00. There chart of primornioning data of 2Divic nestiwater stations	∠-/4

<ul> <li>Figure 2-58: Trend chart of NDS monitoring data of ZDMC freshwater stations</li> <li>2-75</li> <li>Figure 2-60: Freshwater Ecology Stations in Googte Map</li> <li>2-80</li> <li>Figure 2-61: Freshwater Ecology Stations in Googte Map</li> <li>2-81</li> <li>Figure 2-62: The comparison of phytoplankton density on the two sampling sites based on phyla. 248</li> <li>Figure 2-63: Climate Map of Luzon</li> <li>2-94</li> <li>Figure 2-64: Monthly average rainfall and number of rainy days from 1981 to 2010.</li> <li>2-95</li> <li>Figure 2-65: Plot of mean monthly air temperature and relative humidity for PAGASA-Iba Station.</li> <li>2-96</li> <li>Figure 2-66: Highest recorded daily temperature and mean maximum monthly temperature for PASASA-Iba Station.</li> <li>2-96</li> <li>Figure 2-67: Frequency Map of Cyclones in the Philippines.</li> <li>2-97</li> <li>Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016).</li> <li>2-98</li> <li>Figure 2-70: Monitoring Data of NO2 (2015 to 2018)</li> <li>2-99</li> <li>Figure 2-71: Monitoring Data of SO2 (2015 to 2018)</li> <li>2-99</li> <li>Figure 2-72: Monitoring Data of SO2 (2015 to 2018)</li> <li>2-99</li> <li>Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018) - 2.100</li> <li>Figure 2-74: Manoticing Data of SO2 (2015 to 2020)</li> <li>2-100</li> <li>Figure 2-75: Comparative Population in 2015 and 2020.</li> <li>2-119</li> <li>Figure 2-76: Map of Zambales Province.</li> <li>Figure 2-78: Zambales' Municipalities Scores, 2020.</li> <li>2-123</li> <li>Figure 2-78: Zambales' Municipalities Scores, 2020.</li> <li>2-131</li> <li>Figure 2-78: Comparative Population in 2015 and 2020.</li> <li>2-132</li> <li>Figure 2-78: Comparative Population in 2015 and 2020.</li> <li>2-132</li> <li>Figure 2-78: Comparative Population in 2015 and 2020.</li> <li>2-133</li> <li>Figure 2-78: Comparative Population in 2015 and 2020.</li> <li>2-132</li> <li>Figure 2-78: Comparative Population in 2015 and 2020.</li> <li>2-133</li> <li>Fi</li></ul>	Figure 2-57: Trend chart of TSS monitoring data of ZDMC freshwater stations	2-75
Figure 2-59: Trend chart of Nickel monitoring data of ZDMC freshwater stations       2-76         Figure 2-60: Freshwater Ecology Stampling Stations       2-80         Figure 2-61: Treshwater Ecology Sampling Stations       2-81         Figure 2-62: The comparison of phytoplankton density on the two sampling sites based on phyla. 2-82       2-94         Figure 2-64: Monthly average rainfall and number of rainy days from 1981 to 2010.       2-95         Figure 2-64: Monthly average rainfall and number of rainy days from 1981 to 2010.       2-96         Figure 2-64: Trequency Map of Cyclones in the Philippines.       2-96         Figure 2-66: Highest recorded daily temperature and mean maximum monthly temperature for PASASA-lba Station.       2-96         Figure 2-67: TSP Monitoring Data (2014 to 2019).       2-98         Figure 2-67: TSP Monitoring Data of NO2 (2015 to 2018)       2-99         Figure 2-71: Monitoring Data of SO2 (2015 to 2018)       2-99         Figure 2-74: Project dange in rainfall for the province of Zambales (Data Source: PAGASA, 2018)       2-100         Figure 2-75: Comparative Population in 2015 and 2020.       2-119         Figure 2-76: Map of Zambales Province       2-123         Figure 2-78: Zambales' Municipalities Scores, 2020       2-123         Figure 2-78: Candearia Annual Regular Revenue from 2009 to 2016       2-130         Figure 2-80: Kind of Fuld for Lighting       2-132	Figure 2-58: Trend chart of BOD5 monitoring data of ZDMC freshwater stations	2-75
Figure 2-60. Freshwater Ecology Stations in Coogle Map.       2-80         Figure 2-61. Freshwater Ecology Sampling Stations       2-81         Figure 2-61. The comparison of phytoplankton density on the two sampling sites based on phyla. 2-82       Figure 2-63. Climate Map of Luzon       2-94         Figure 2-63. Climate Map of Luzon       2-94       Figure 2-65. Plot of mean monthly air temperature and relative humidity for PAGASA-Iba Station.       2-96         Figure 2-66. Highest recorded daily temperature and mean maximum monthly temperature for PASASA-Iba Station.       2-96         Figure 2-67. Frequency Map of Cyclones in the Philippines.       2-97         Figure 2-68. Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016).       2-98         Figure 2-67. Trequency Data of NO2 (2015 to 2018)       2-99         Figure 2-72. Monitoring Data of SO2 (2015 to 2018)       2-99         Figure 2-73. Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018) -107       2-106         Figure 2-74. Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018) -107       2-120         Figure 2-76. Map of Zambales Province       2-120         Figure 2-77. Annual Regular Revenue       2-123         Figure 2-78. Angergation by Age Group in Candelaria       2-127         Figure 2-78. Zambales' Municipalities Scores, 2020       2-123         Figure 2-79. Aggregation by Age Group in Sa. Cruz	Figure 2-59: Trend chart of Nickel monitoring data of ZDMC freshwater stations	2-76
Figure 2-61: Freshwater Ecology Sampling Stations       2-81         Figure 2-62: The comparison of phytoplankton density on the two sampling sites based on phyl. 2-82       Figure 2-62: Climate Map of Luzon       2-94         Figure 2-63: Climate Map of Luzon       2-95       Figure 2-65: Plot of mean monthly air temperature and relative humidity for PACASA-Iba Station.       2-95         Figure 2-66: Highest recorded daily temperature and mean maximum monthly temperature for PASASA-Iba Station.       2-96         Figure 2-67: Frequency Map of Cyclones in the Philippines       2-97         Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016).       2-98         Figure 2-70: Monitoring Data of NO2 (2015 to 2018)       2-99         Figure 2-71: Monitoring Data of NO2 (2015 to 2018)       2-99         Figure 2-72: Monitoring Data of SO2 (2015 to 2018)       2-90         Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018)       2-106         Figure 2-74: Monitoring Data of SO2 (2015 and 2020)       2-100         Figure 2-75: Map of Zambales Province       2-120         Figure 2-76: Map of Zambales Province       2-120         Figure 2-77: Annual Regular Revenue       2-127         Figure 2-78: Aggregation by Age Group in Sta. Cruz       2-127         Figure 2-84: Type of Materials (Outer Wall of the House)       2-131         Figure 2-84: Cand	Figure 2-60: Freshwater Ecology Stations in Google Map.	
Figure 2-62: The comparison of phytoplankton density on the two sampling sites based on phyla. 2-82         Figure 2-63: Climate Map of Luxon       2-94         Figure 2-64: Monthly average rainfall and number of rainy days from 1981 to 2010.       2-95         Figure 2-66: Highest recorded daily temperature and relative humidity for PAGA5A-Iba Station.       2-96         Figure 2-66: Highest recorded daily temperature and mean maximum monthly temperature for       2-96         Figure 2-67: Frequency Map of Cyclones in the Philippines       2-97         Figure 2-67: Stemothy Cimatology of Tropical Cyclone Tracks (1948 – 2016).       2-98         Figure 2-70: Monitoring Data of NO2 (2015 to 2018)       2-99         Figure 2-72: Monitoring Data of SO2 (2015 to 2018)       2-99         Figure 2-72: Monitoring Data of SO2 (2015 to 2018)       2-99         Figure 2-72: Monitoring Data of PM10 (2017 to 2020)       2-100         Figure 2-75: Comparative Population in 2015 and 2020       2-119         Figure 2-76: Map of Zambales Province       2-123         Figure 2-78: Aggregation by Age Group in Candelaria       2-127         Figure 2-78: Aggregation by Age Group in San. Cruz       2-127         Figure 2-78: Map of Zambales Province       2-130         Figure 2-78: Aggregation by Age Group in Candelaria       2-127         Figure 2-79: Aggregation by Age Group in San. Cruz       2-127	Figure 2-61: Freshwater Ecology Sampling Stations	2-81
Figure 2-63: Climate Map of Luzon       2-94         Figure 2-64: Monthly average rainfall and number of rainy days from 1981 to 2010.       2-95         Figure 2-65: Plot of mean monthly air temperature and relative humidity for PAGASA-Iba Station.       2-96         Figure 2-66: Highest recorded daily temperature and mean maximum monthly temperature for       2-96         Figure 2-67: Frequency Map of Cyclones in the Philippines       2-97         Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016).       2-98         Figure 2-71: Monitoring Data (704 to 2019).       2-98         Figure 2-71: Monitoring Data of NO2 (2015 to 2018)       2-99         Figure 2-72: Monitoring Data of S02 (2015 to 2018)       2-99         Figure 2-74: Projected change in trainfall for the province of Zambales (Data Source: PAGASA, 2018)       2-106         Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018).       2-107         Figure 2-76: Comparative Population in 2015 and 2020.       2-123         Figure 2-77: Annual Regular Revenue       2-123         Figure 2-78: Zambales' Municipalities Scores, 2020       2-127         Figure 2-78: Aggregation by Age Group in Candelaria       2-127         Figure 2-80       Aggregation by Age Group in Sta. Cruz       2-127         Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016       2-130	Figure 2-62: The comparison of phytoplankton density on the two sampling sites based or	n phyla2-82
Figure 2-64: Monthly average rainfall and number of rainy days from 1981 to 2010.	Figure 2-63: Climate Map of Luzon	
Figure 2-65: Plot of mean monthly air temperature and relative humidity for PAGA5A-Iba Station 2-96 Figure 2-66: Highest recorded daily temperature and mean maximum monthly temperature for PASASA-Iba Station	Figure 2-64: Monthly average rainfall and number of rainy days from 1981 to 2010	2-95
96         Figure 2-66: Highest recorded daily temperature and mean maximum monthly temperature for         PASASA-Iba Station.       .2.96         Figure 2-67: Frequency Map of Cyclones in the Philippines.       .2.97         Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016).       .2.98         Figure 2-69: TSP Monitoring Data (2014 to 2019).       .2.99         Figure 2-71: Monitoring Data of NO2 (2015 to 2018)       .2.99         Figure 2-72: Monitoring Data of NO2 (2015 to 2018)       .2.99         Figure 2-74: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018)       .2106         Figure 2-75: Comparative Population in 2015 and 2020.       .2112         Figure 2-76: Map of Zambales Province.       .2120         Figure 2-77: Annual Regular Revenue       .2123         Figure 2-78: Zambales' Municipalities Scores, 2020.       .2123         Figure 2-79: Aggregation by Age Group in Sta. Cruz       .2127         Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016       .2130         Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 2016       .2132         Figure 2-84: Type of Roof Materials (Outer Wall of the House)       .2132         Figure 2-85: Crud of Fuel for Lighting       .2133         Figure 2-86: Torue of Water Supply for Drinking       .2133         Figure 2	Figure 2-65: Plot of mean monthly air temperature and relative humidity for PAGASA-Iba	a Station 2-
Figure 2-66: Highest recorded daily temperature and mean maximum monthly temperature for       PASASA-Iba Station.       2-96         Figure 2-67: Frequency Map of Cyclones in the Philippines.       2-97         Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016)       2-98         Figure 2-69: TSP Monitoring Data of NO2 (2015 to 2018)       2-99         Figure 2-71: Monitoring Data of SO2 (2015 to 2018)       2-99         Figure 2-72: Monitoring Data of PM10 (2017 to 2020)       2-100         Figure 2-73: Project change in temperature for the province of Zambales (Data Source: PAGASA, 2018).       2-106         Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018).       2-107         Figure 2-75: Comparative Population in 2015 and 2020.       2-113         Figure 2-76: Map of Zambales Province       2-123         Figure 2-77: Annual Regular Revenue       2-123         Figure 2-78: Zambales' Municipalities Scores, 2020       2-123         Figure 2-80: Aggregation by Age Group in Sta. Cruz       2-127         Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016       2-130         Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 2016       2-132         Figure 2-83: Type of House/Building.       2-132         Figure 2-84: Stunce of Water Supply for Drinking       2-133         Figure 2-85: Sucree o	96	
PASASA-Iba Station.       2-96         Figure 2-67: Frequency Map of Cyclones in the Philippines.       2-97         Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016).       2-98         Figure 2-71: Monitoring Data of NO2 (2015 to 2018).       2-99         Figure 2-71: Monitoring Data of PM10 (2017 to 2020).       2-100         Figure 2-71: Monitoring Data of PM10 (2017 to 2020).       2-100         Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018).       2-106         Figure 2-74: Monitoring Data of PM10 (2017 to 2020).       2-110         Figure 2-75: Comparative Population in 2015 and 2020.       2-120         Figure 2-76: Map of Zambales Province       2-120         Figure 2-77: Annual Regular Revenue       2-123         Figure 2-78: Aggregation by Age Group in Candelaria       2-127         Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016       2-130         Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 2016       2-130         Figure 2-83: Type of Construction Materials (Outer Wall of the House)       2-131         Figure 2-84: Type of Roof Materials.       2-132         Figure 2-87: Kind of Fuel for Lighting       2-133         Figure 2-89: Opulation of 15 Impact Barangays       2-136         Figure 2-90: Population of 15 Impact Barangays       2-1	Figure 2-66: Highest recorded daily temperature and mean maximum monthly tem	perature for
Figure 2-67: Frequency Map of Cyclones in the Philippines       2-97         Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016)       2-98         Figure 2-69: T5P Monitoring Data (2014 to 2019)       2-99         Figure 2-70: Monitoring Data of NO2 (2015 to 2018)       2-99         Figure 2-71: Monitoring Data of SO2 (2015 to 2018)       2-99         Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018)       2-100         Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018).       2-117         Figure 2-75: Comparative Population in 2015 and 2020.       2-113         Figure 2-76: Map of Zambales Province       2-123         Figure 2-77: Annual Regular Revenue       2-123         Figure 2-78: Cambales' Municipalities Scores, 2020       2-123         Figure 2-79: Aggregation by Age Group in Sta. Cruz       2-127         Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016       2-130         Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 2016       2-132         Figure 2-84: Type of Roos Materials.       2-132         Figure 2-84: Type of Roos Materials.       2-132         Figure 2-87: Kind of Fuel Kuet Supply for Drinking       2-133         Figure 2-88: Source of Water Supply for Cooking       2-134         Figure 2-90: Pop	PASASA-Iba Station.	
Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016).2-98Figure 2-69: TSP Monitoring Data of NO2 (2015 to 2018)2-99Figure 2-71: Monitoring Data of SO2 (2015 to 2018)2-99Figure 2-72: Monitoring Data of PM10 (2017 to 2020)2-100Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018)2-106Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018)2-107Figure 2-75: Comparative Population in 2015 and 2020.2-113Figure 2-76: Map of Zambales Province2-123Figure 2-77: Annual Regular Revenue2-123Figure 2-78: Zambales' Municipalities Scores, 20202-123Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 20162-130Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 20162-133Figure 2-84: Type of Construction Materials (Outer Wall of the House)2-131Figure 2-85: Type of House/Building2-132Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-87: Kind of Fuel for Lighting2-134Figure 2-89: Source of Water Supply for Cooking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Popula	Figure 2-67: Frequency Map of Cyclones in the Philippines	
Figure 2-69: TSP Monitoring Data (2014 to 2019)       2-98         Figure 2-70: Monitoring Data of NO2 (2015 to 2018)       2-99         Figure 2-71: Monitoring Data of SO2 (2015 to 2018)       2-90         Figure 2-72: Monitoring Data of SO2 (2015 to 2020)       2-100         Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018)       2-106         Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018).       2-119         Figure 2-76: Map of Zambales Province       2-120         Figure 2-76: Map of Zambales Province       2-123         Figure 2-76: Map of Zambales Province       2-123         Figure 2-77: Annual Regular Revenue       2-123         Figure 2-78: Zambales' Municipalities Scores, 2020       2-123         Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016       2-130         Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 2016       2-130         Figure 2-83: Type of Construction Materials       2-132         Figure 2-84: Type of Roof Materials       2-132         Figure 2-86: Tenure Status of the Housing Unit and Lot       2-133         Figure 2-87: Nind of Fuel for Lighting       2-134         Figure 2-90: Population of 15 Impact Barangays       2-136         Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group<	Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016)	
Figure 2-70: Monitoring Data of NO2 (2015 to 2018)       2-99         Figure 2-71: Monitoring Data of SO2 (2015 to 2018)       2-99         Figure 2-72: Monitoring Data of PM10 (2017 to 2020)       2-100         Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018)       2-106         Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018).       2-107         Figure 2-76: Map of Zambales Province       2-120         Figure 2-78: Zambales' Municipalities Scores, 2020       2-123         Figure 2-80: Aggregation by Age Group in Sta. Cruz       2-127         Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016       2-130         Figure 2-84: Type of Construction Materials (Outer Wall of the House)       2-131         Figure 2-85: Type of House/Building       2-133         Figure 2-86: Tenure Status of the Housing Unit and Lot       2-133         Figure 2-87: Kind of Fuel for Lighting       2-134         Figure 2-88:	Figure 2-69: TSP Monitoring Data (2014 to 2019)	
Figure 2-71: Monitoring Data of SO2 (2015 to 2018)2-99Figure 2-72: Monitoring Data of PM10 (2017 to 2020)2-100Figure 2-73: Project change in reinfall for the province of Zambales (Data Source: PAGASA, 2018)2-100Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018)2-107Figure 2-75: Comparative Population in 2015 and 2020.2-119Figure 2-76: Map of Zambales Province2-120Figure 2-77: Annual Regular Revenue2-123Figure 2-79: Aggregation by Age Group in Candelaria2-127Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 20162-130Figure 2-83: Type of Construction Materials (Outer Wall of the House)2-131Figure 2-85: Type of House/Building2-132Figure 2-86: Thore of Materials (Outer Wall of the House)2-133Figure 2-87: Kind of Fuel for Lighting2-133Figure 2-87: Source of Water Supply for Drinking2-134Figure 2-98: Source of Water Supply for Drinking2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-95: a) Ype of School and b) Status of Tenure2-140Figure 2-95: a) Type of School and b) Status of Tenure2-140Figure 2-97: Religion2-144Figure 2-97: Religion2-144Figure 2-97: Religion2-144Figure 2-97: Religion2-144Figure 2-97: Religion2-144Fig	Figure 2-70: Monitoring Data of NO2 (2015 to 2018)	2-99
Figure 2-72: Monitoring Data of PMI0 (2017 to 2020)	Figure 2-71: Monitoring Data of SO2 (2015 to 2018)	2-99
Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018)2-106 Figure 2-75: Comparative Population in 2015 and 2020	Figure 2-72: Monitoring Data of PM10 (2017 to 2020)	2-100
Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018).2-107 Figure 2-75: Comparative Population in 2015 and 2020	Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA 2018)	2-106
Figure 2-75: Comparative Population in 2015 and 2020.2-119Figure 2-76: Map of Zambales Province2-120Figure 2-77: Annual Regular Revenue2-123Figure 2-78: Zambales' Municipalities Scores, 2020.2-123Figure 2-78: Aggregation by Age Group in Candelaria2-127Figure 2-80 Aggregation by Age Group in Sta. Cruz2-127Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016.2-130Figure 2-83: Type of Construction Materials (Outer Wall of the House)2-131Figure 2-84: Type of House/Building2-132Figure 2-85: Type of House/Building2-132Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-86: Source of Water Supply for Drinking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group.2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members.2-139Figure 2-96: a) Type of Scholar Adp on b) Status of Tenure.2-140Figure 2-96: a) Type of Scholar Adp on b) Status of Tenure.2-141Figure 2-97: Religion2-141Figure 2-96: a) Type of Scholar Adp on b) Status.2-142Figure 2-97: Religion2-144Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-142Figure 2-104: Respondents2-143Figure 2-105: a) Type of Scholar Adp on the status of Tenure.2-143Figure 2-104: Respondent Adp on the status of Tenure.<	Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA	2018) 2-107
Figure 2-76: Map of Zambales Province2-120Figure 2-76: Map of Zambales Province2-123Figure 2-77: Annual Regular Revenue2-123Figure 2-78: Zambales' Municipalities Scores, 20202-123Figure 2-79: Aggregation by Age Group in Candelaria2-127Figure 2-79: Aggregation by Age Group in Sta. Cruz2-120Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 20162-130Figure 2-83: Type of Construction Materials (Outer Wall of the House)2-131Figure 2-84: Type of Roof Materials2-132Figure 2-85: Type of House/Building2-132Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-86: Source of Water Supply for Drinking2-134Figure 2-87: Kind of Fuel for Lighting2-136Figure 2-98: Source of Water Supply for Cooking2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group.2-136Figure 2-92: a) Gender and b) No. of Household Members2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-94: a) Birthplace and b) Ethnic Origin2-141Figure 2-97: Religion2-141Figure 2-97: Religion2-141Figure 2-97: Religion2-142Figure 2-102: Aloxanal Materian2-142Figure 2-102: School and b) Satus of Tenure2-142Figure 2-102: School and b) Satus of Tenure2-142Figure 2-103: Occupational Attainment2-142Figure 2-104: Respondents working in the	Figure 2-75: Comparative Population in 2015 and 2020	2-119
Figure 2-77:Annual Regular Revenue2-123Figure 2-77:Annual Regular Revenue2-123Figure 2-77:Aggregation by Age Group in Candelaria2-127Figure 2-79:Aggregation by Age Group in Sta. Cruz2-127Figure 2-81:Candelaria Annual Regular Revenue from 2009 to 20162-130Figure 2-82:Sta. Cruz Annual Regular Revenue from 2009 to 20162-131Figure 2-83:Type of Construction Materials (Outer Wall of the House)2-131Figure 2-85:Type of Roof Materials2-132Figure 2-86:Tenure Status of the Housing Unit and Lot2-133Figure 2-87:Kind of Fuel for Lighting2-133Figure 2-88:Source of Water Supply for Drinking2-134Figure 2-99:Population of 15 Impact Barangays2-136Figure 2-90:Population of 15 Impact Barangays2-136Figure 2-92:a) Gender and b) Age of Respondents2-139Figure 2-93:a) Civil Status and b) No. of Household Members2-139Figure 2-95:a) Years of Residency and b) Status of Tenure2-140Figure 2-95:a) Type of School and b) Type of House2-141Figure 2-97:Religion2-143Figure 2-97:Religion2-143Figure 2-101:Altainment2-143Figure 2-102:Chool and b) Status2-143Figure 2-103:Cocupational Classification on Education2-144Figure 2-104:Respondents2-143Figure 2-105:Altainment2-144Figure 2-104: <td>Figure 2-76: Map of Zambales Province</td> <td>2-120</td>	Figure 2-76: Map of Zambales Province	2-120
Figure 2-78: Zambales' Municipalities Scores, 20202-123Figure 2-78: Zambales' Municipalities Scores, 20202-123Figure 2-78: Zambales' Municipalities Scores, 20202-127Figure 2-79: Aggregation by Age Group in Sta. Cruz2-127Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 20162-130Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 20162-131Figure 2-83: Type of Construction Materials2-132Figure 2-84: Type of Roof Materials2-132Figure 2-85: Type of House/Building2-132Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-87: Kind of Fuel for Lighting2-133Figure 2-88: Source of Water Supply for Drinking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-95: a) Viars of Residency and b) Status of Tenure2-140Figure 2-95: a) Type of School and b) Status of Tenure2-141Figure 2-97: Religion2-144Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-144Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-77: Annual Regular Revenue	2-123
Figure 2-79: Aggregation by Age Group in Sta. Cruz2-127Figure 2-80Aggregation by Age Group in Sta. Cruz2-127Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 20162-130Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 20162-130Figure 2-83: Type of Construction Materials (Outer Wall of the House)2-131Figure 2-84: Type of Roof Materials2-132Figure 2-85: Type of House/Building2-133Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-88: Source of Water Supply for Drinking2-134Figure 2-89: Source of Water Supply for Cooking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-95: a) Years of Residency and b) Status of Tenure2-140Figure 2-95: a) Type of School and b) Statisfaction on Education2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Cocupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-143Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-78: Zambales' Municipalities Scores 2020	2-123
Figure 2-80Aggregation by Age Group in Sta. Cruz2-127Figure 2-80Aggregation by Age Group in Sta. Cruz2-127Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 20162-130Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 20162-130Figure 2-83: Type of Construction Materials (Outer Wall of the House)2-131Figure 2-84: Type of Roof Materials2-132Figure 2-85: Type of House/Building2-133Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-87: Kind of Fuel for Lighting2-133Figure 2-89: Source of Water Supply for Drinking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-139Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-130Figure 2-95: a) Years of Residency and b) Status of Tenure2-140Figure 2-96: a) Type of School and b) Statisfaction on Education2-142Figure 2-97: Religion2-143Figure 2-98: Educational Attainment2-142Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-79: Aggregation by Age Group in Candelaria	2-127
Figure 2 of tigge gated for the formal formation of the fo	Figure 2-80A garegation by Age Group in Sta Cruz	2_127
Figure 2-81: Sta. Cruz Annual Regular Revenue from 2009 to 20162-130Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 20162-130Figure 2-83: Type of Construction Materials (Outer Wall of the House)2-131Figure 2-84: Type of Roof Materials2-132Figure 2-85: Type of House/Building2-133Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-86: Source of Water Supply for Drinking2-134Figure 2-87: Kind of Fuel for Lighting2-133Figure 2-88: Source of Water Supply for Cooking2-134Figure 2-89: Source of Water Supply for Cooking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-140Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-95: a) Years of Residency and b) Status of Tenure2-141Figure 2-96: a) Type of School and b) Statisfaction on Education2-142Figure 2-97: Religion2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-143Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016	2-130
Figure 2-62. Sta. Chi2 Annual Regental Revenue from 2007 to 201022-130Figure 2-83: Type of Roof Materials.2-132Figure 2-84: Type of Roof Materials.2-132Figure 2-85: Type of House/Building.2-133Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-88: Source of Water Supply for Drinking2-134Figure 2-89: Source of Water Supply for Cooking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-95: a) Years of Residency and b) Status of Tenure2-141Figure 2-96: a) Type of School and b) Satisfaction on Education2-142Figure 2-97: Religion2-141Figure 2-98: Educational Attainment2-142Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-144Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-82: Sta Cruz Appual Regular Revenue from 2009 to 2016	2_130
Ingure 2-03.19 pe of Construction Materials (Outer Wall of the House)2-131Figure 2-84:Type of Roof Materials2-132Figure 2-85:Type of House/Building2-133Figure 2-86:Tenure Status of the Housing Unit and Lot2-133Figure 2-87:Kind of Fuel for Lighting2-134Figure 2-88:Source of Water Supply for Drinking2-134Figure 2-89:Source of Water Supply for Cooking2-134Figure 2-90:Population of 15 Impact Barangays2-136Figure 2-91:Aggregated Population of Candelaria and Sta.Cruz by Age Group2-139Figure 2-93:a)Civil Status and b) No. of Household Members2-93:a)Civil Status and b)No. of Household MembersFigure 2-96:a)Type of Building and b)Status of Tenure2-97:Religion2-141Figure 2-98:Educational Attainment2-142Figure 2-99:a)Type of School and b)StatusFigure 2-100:Scholarship2-143Figure 2-101:a)Employment Type and b)Status2-143Figure 2-102:Place of Work2-144Figure 2-103:Occupational Classification2-142Figure 2-104:Respondents Working in the Mining Industry2-143Figure 2-105:a)Breadwinner and b)Monthly Family Income2-144Figure 2-105:a)Breadwinner and b)Monthly Family Income2-145Figure 2-105:a)Breadwinner and b)<	Figure 2-82: Type of Construction Materials (Outer Wall of the House)	2-130 2_131
Figure 2-94. Type of House/Building.2-132Figure 2-85: Type of House/Building.2-133Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-87: Kind of Fuel for Lighting2-133Figure 2-88: Source of Water Supply for Drinking2-134Figure 2-89: Source of Water Supply for Cooking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group.2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members.2-139Figure 2-95: a) Years of Residency and b) Status of Tenure2-140Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-98: Educational Attainment2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2.84: Type of Construction Materials (Outer Wall of the House)	
Figure 2-63. Type of Flouse/Juniting2-132Figure 2-86: Tenure Status of the Housing Unit and Lot2-133Figure 2-87: Kind of Fuel for Lighting2-133Figure 2-88: Source of Water Supply for Drinking2-134Figure 2-89: Source of Water Supply for Cooking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-97: Religion2-141Figure 2-98: Educational Attainment2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2.85: Type of House/Building	2-132
Figure 2-80. Feature status of the Frousnik Ontraine Lot2-133Figure 2-87. Kind of Fuel for Lighting2-133Figure 2-87. Kind of Fuel for Lighting2-134Figure 2-88. Source of Water Supply for Drinking2-134Figure 2-90. Population of 15 Impact Barangays2-136Figure 2-91. Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92. a) Gender and b) Age of Respondents2-139Figure 2-93. a) Civil Status and b) No. of Household Members2-139Figure 2-94. a) Birthplace and b) Ethnic Origin2-140Figure 2-95. a) Years of Residency and b) Status of Tenure2-141Figure 2-96. a) Type of Building and b) Type of House2-141Figure 2-97. Religion2-141Figure 2-98. Educational Attainment2-142Figure 2-99. a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2.86: Topure Status of the Housing Unit and Let	2-132
Figure 2-87. Knut of Puer for Lighting2-135Figure 2-88: Source of Water Supply for Drinking2-134Figure 2-89: Source of Water Supply for Cooking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-95: a) Years of Residency and b) Status of Tenure2-141Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-97: Religion2-141Figure 2-98: Educational Attainment2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-86. Tenure Status of the Housing Offic and Lot	
Figure 2-88: Source of Water Supply for Drinking2-134Figure 2-89: Source of Water Supply for Cooking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-95: a) Years of Residency and b) Status of Tenure2-140Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-97: Religion2-141Figure 2-98: Educational Attainment2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-143Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-144Figure 2-102: Place of Work2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-87. Kind of Fuel for Lighting	2-133
Figure 2-99: Source of Water Supply for Cooking2-134Figure 2-90: Population of 15 Impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-95: a) Years of Residency and b) Status of Tenure2-140Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-97: Religion2-141Figure 2-98: Educational Attainment2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-88. Source of Water Supply for Diffiking	2-134
Figure 2-90: Fopulation of 15 impact Barangays2-136Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group.2-136Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-95: a) Years of Residency and b) Status of Tenure2-140Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-97: Religion2-141Figure 2-98: Educational Attainment2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-89: Source of Water Supply for Cooking	2 124
Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group	Figure 2-90: Fopulation of 15 impact barangays	2 120
Figure 2-92: a) Gender and b) Age of Respondents2-139Figure 2-93: a) Civil Status and b) No. of Household Members2-139Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-95: a) Years of Residency and b) Status of Tenure2-140Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-97: Religion2-141Figure 2-98: Educational Attainment2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-144Figure 2-102: Place of Work2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group	2 120
Figure 2-93: a) Civil Status and b) No. of Household Members.2-139Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-95: a) Years of Residency and b) Status of Tenure.2-140Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-97: Religion.2-141Figure 2-98: Educational Attainment2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship.2-143Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-92: a) Gender and b) Age of Respondents	2 120
Figure 2-94: a) Birthplace and b) Ethnic Origin2-140Figure 2-95: a) Years of Residency and b) Status of Tenure2-140Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-97: Religion2-141Figure 2-98: Educational Attainment2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-93: a) Civil Status and b) No. of Housenold Members	
Figure 2-95: a) Years of Residency and b) Status of Tenure	Figure 2-94: a) Birthplace and b) Ethnic Origin	
Figure 2-96: a) Type of Building and b) Type of House2-141Figure 2-97: Religion2-141Figure 2-98: Educational Attainment2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-95: a) Years of Residency and b) Status of Tenure	
Figure 2-97: Religion.2-141Figure 2-98: Educational Attainment.2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship.2-143Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-96: a) Type of Building and b) Type of House	
Figure 2-98: Educational Attainment.2-142Figure 2-99: a) Type of School and b) Satisfaction on Education2-142Figure 2-100: Scholarship2-143Figure 2-101: a) Employment Type and b) Status2-143Figure 2-102: Place of Work2-144Figure 2-103: Occupational Classification2-144Figure 2-104: Respondents Working in the Mining Industry2-145Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-97: Religion	
Figure 2-99: a) Type of School and b) Satisfaction on Education       2-142         Figure 2-100: Scholarship       2-143         Figure 2-101: a) Employment Type and b) Status       2-143         Figure 2-102: Place of Work       2-144         Figure 2-103: Occupational Classification       2-144         Figure 2-104: Respondents Working in the Mining Industry       2-145         Figure 2-105: a) Breadwinner and b) Monthly Family Income       2-145	Figure 2-98: Educational Attainment	
Figure 2-100: Scholarship       2-143         Figure 2-101: a) Employment Type and b) Status       2-143         Figure 2-102: Place of Work       2-144         Figure 2-103: Occupational Classification       2-144         Figure 2-104: Respondents Working in the Mining Industry       2-145         Figure 2-105: a) Breadwinner and b) Monthly Family Income       2-145	Figure 2-99: a) Type of School and b) Satisfaction on Education	
Figure 2-101: a) Employment Type and b) Status       2-143         Figure 2-102: Place of Work       2-144         Figure 2-103: Occupational Classification       2-144         Figure 2-104: Respondents Working in the Mining Industry       2-145         Figure 2-105: a) Breadwinner and b) Monthly Family Income       2-145	Figure 2-100: Scholarship	
Figure 2-102: Place of Work	Figure 2-101: a) Employment Type and b) Status	2-143
Figure 2-103: Occupational Classification	Figure 2-102: Place of Work	
Figure 2-104: Respondents Working in the Mining Industry2-145 Figure 2-105: a) Breadwinner and b) Monthly Family Income2-145	Figure 2-103: Occupational Classification	
Figure 2-105: a) Breadwinner and b) Monthly Family Income	Figure 2-104: Kespondents Working in the Mining Industry	
	rigure 2-105: a) breadwinner and b) Monthly Family Income	2-145

Figure 2-106: a) Mode of Transportation and b) Mode of Communication	2-146
Figure 2-107: a) Health Concerns and b) Treatment Facilities	2-146
Figure 2-108: Top Six (6) Diseases/Health Problems in the Family	2-147
Figure 2-109: Availed Barangay Health Services	2-147
Figure 2-110: Problems Encountered in Barangay Health Centers	2-148
Figure 2-111: a) Mortality and b) Cause of Death	2-148
Figure 2-112: Environmental Pollution and Disaster	2-149
Figure 2-113: a) Source of Drinking Water and b) Source of Water for Other Uses	2-150
Figure 2-114: Water Contamination	2-150
Figure 2-115: a) Type of Toilet and b) Garbage Collection	2-151
Figure 2-116: Waste Disposal	2-151
Figure 2-117: In-migration and Out-migration	2-152
Figure 2-118: a) Relationship of the Neighbourhood and b) Relationship with Barangay	2-152
Figure 2-119: a) VAWC and b) Crime	2-153
Figure 2-120: Improvement in the Community	2-153
Figure 2-121: Level of Satisfaction on Livelihood/Job Opportunities	2-154
Figure 2-122: Level of Satisfaction on Life and Health	2-154
Figure 2-123: Level of Satisfaction on Peace and Order	2-155
Figure 2-124: Level of Satisfaction on Cleanliness and Sanitation	2-155
Figure 2-125: Level of Satisfaction on Education	2-156
Figure 2-126Level of Satisfaction on Infrastructure	2-156
Figure 2-127: Level of Satisfaction on Utilities	2-157
Figure 2-128: Level of Satisfaction on Community Facilities and Amenities	2-157
Figure 2-129Level of Satisfaction on Commercial Services	2-158
Figure 2-130: Level of Satisfaction on Barangay Services	2-158
Figure 2-131Level of Satisfaction on Transportation	2-159
Figure 2-132: Level of Satisfaction on Disaster Management	2-159
Figure 2-133: Level of Satisfaction on LGU and other Government Support	2-160
Figure 2-134: Perception on the Quality of Air	2-160
Figure 2-135: Perception on the Quality of Noise	2-161
Figure 2-136: Perception on the Quality of Drinking Water	2-161
Figure 2-137: Perception on the Quality of River, Lakes and Creek	2-162
Figure 2-138: Perception on the Quality of Marine/Sea	2-162
Figure 2-139: Perception on the Quality of Soil/Land	2-163
Figure 2-140: Perception on the Quality of Flora	2-163
Figure 2-141: Perception on the Quality of Fauna	2-164
Figure 2-142: Number of Respondents with Knowledge of the Project	2-164
Figure 2-143: Number of Respondents with Understanding of the Project	2-165
Figure 2-144: Number of Respondents with Knowledge of the Expansion Plan	2-165
Figure 2-145: Respondents' Source of Information	2-166
Figure 2-146: Attended the IEC or Information Drive	2-166
Figure 2-147: Responses on whether the mining project is beneficial	2-167
Figure 2-148: Responses on how the mining project can help the Community	2-167
Figure 8-1. ZDMC Organizational	8-1

List of Plates

Plate 2-1: View of Transect 1	2-28
Plate 2-2: View of Transect 2	2-28
Plate 2-3: Live Capture of Avifauna using mistnets.	2-30
Plate 2-4: Roasting of coconut for Baits in Cage Traps for Non-volant Mammalian Fauna	2-30

Plate 2-5: Environmental structures at H3 Old Area showing the locations of settling po	nds (18 June
2019)	2-78
Plate 2-6: Overview of Environmental Structures at H3 North Area (18 June 2019)	2-78
Plate 2-9: Gecarcinuridae	2-86
Plate 2-10: Pisauridae	2-86
Plate 2-11: Tipulidae	2-86
Plate 2-12: Lycosidae	2-87
Plate 2-13: Lycosidae egg	2-87
Plate 2-14: Heptageniidae	2-88
Plate 2-15: Aphelocheiridae	2-88
Plate 2-16: Caredia	2-88
Plate 2-17: Gobiidae	2-89

List of Annexes

Annex A: MGB Region III Endorsement to MGB CO Annex B: Permits/ Clearance and Certifications Annex C: Proponent's Response to Issues and Concerns Annex D: Proof of Authority over the Project Site Annex E: Accountability Statement of Preparers & Proponent Annex F: PEMAPS Annex G: Environmental Compliance Certificate Annex H: Proof of Compliance in Submission of Monitoring Reports Annex I: CMRs and CMVRs Annex J: Public Scoping Report Annex K: Agreement

# **Executive Summary**

Zambales Diversified Metals Corporation (ZDMC) is the current mining operator and tenement holder of Mineral Production Sharing Agreement (MPSA) No. 191-2004-III issued by the Mines and Geosciences Bureau (MGB) to Crau Mineral Resources Corporation (CMRC). This is by virtue of the Option Agreement between CMRC and Rusina Mining NL (RMNL) wherein the latter transfer the rights over MPSA No. 191-2004-III to ZDMC.

ECC amendment covers the increase of the MPSA or project area from 3,765.39 hectares to 3,846.39 hectares relative to the inclusion of the 81 hectares of Lot 4; Remove the ECC conditions on Heap Leach Processing (HLP) plant and Sulfuric Acid Plant (SAP), respectively, under ECC 0910-003; and Consolidate the conditions of ECC 0910-003 and ECC 0708-020-215



Table ES- 1. Project Fact Sheet					
Name of Project:	Sta. Cruz-Candelaria Mining Project				
Project Type	Mining Project				
Project Location:	Municipalities of Sta. Cruz and Candelaria, Province of Zambales				
Project Capacity/ Size	Nickel Laterite Ore extraction = 2,000,000 DMT per year				
	Surface mining rate = 415,800 MT per year of Chromite Lode (lumpy and milling grade)				
	Underground mining rate = 315,000 MT per year of Chromite Laterite Ore				
Project Area	Existing Area = 3,765.39 hectares				
	Area for inclusion = 82.39 hectares				
	Proposed Expansion Area = 3,847.78 hectares				
Project Cost	Estimated cost of the project is at US\$ 27,000,000				
Project Proponent	Zambales Diversified Metals Corporation (ZDMC)				
Address:	Corporate: 3rd Floor, DMCI Homes Corporate Center, 1321 Apolinario street, Bangkal, Makati City, 1223				
Authorized	Ramon Manuel R. Briones				
Signatory/Representative:	Vice President for Operations				
Contact details:	Contact Number : 8823-7963; 8831-6241				
	E-mail Address : rrbriones@dmcimining.com				
Name of Preparer:	AXCELTECHS, INC.				
Address:	10C Lansbergh Place,170 Tomas Morato Ave., Sacred Heart,				
	Quezon City				
Contact Person:	Engr. Paulo Noni T. Tidalgo				
Contact details:	management@axceltechs.com				

# ES.1 PROJECT FACT SHEET

This application for ECC amendment covers the following, to wit:

1. Increase of the MPSA or project area from 3,765.39 hectares to 3,846.39 hectares relative to the inclusion of the 81 hectares of Lot 4.

2. Remove the ECC conditions on Heap Leach Processing (HLP) plant and Sulfuric Acid Plant (SAP), respectively, under ECC 0910-003;

3. Consolidate the conditions of ECC 0910-003 and ECC 0708-020-215 maintaining the extraction rate of Nickel Laterite Ore at 2,000,000 DMT per year and the surface and underground mining rate of 415,800 MT per year of Chromite Lode (lumpy and milling grade) and 315,000 MT per year of Chromite Laterite Ore respectively.

# ES.2 PROCESS DOCUMENTATION

# ES.2.1 EIA Team

The EIA Team is composed of multi-disciplinary specialists as seen in Table ES-2.

Team Member		Expertise / Module	IPCO
			No.
Mr. JAY SIASOCO		Project Management	
FOR. JAN PAOLO T. POLLISCO		Terrestrial Flora and Fauna;	276
		Overall Integrator; GIS	
AILEEN G. SIASOCO		Socio-economic / People Module	
MR. JESS M. ADDAWE		Water and Air Quality and Noise	056
FOR. JOSE PAULO	E.	EIA Process / Project Management	
DEVANADERA			

# Table ES- 2: EIA Team

# ES.2.2 EIA Study Schedule and Area

The project site is located in the Municipalities of Sta Cruz and Candelaria, Province of Zambales. The mine site is around 280 kilometers away from Manila via the North Luzon Expressway. The project's MPSA is between geographical coordinates Longitude 1200 03' 30" East, and Latitude 150 42' North. The mine site is around 27 km distance from the National Highway passing through Barangay Lucapon South via the old Acoje Mines access road.

# ES.2.3 EIA Methodology

The following paragraphs discuss the methodology used in each of the study module of the EIA.

Modules	Methodologies Used and Data Sources
LAND	
Land Use and	Gathering/Review of secondary data
Classification	
Geology and	Gathering/Review of secondary data (EIS 2007, PHIVOLCS)
Geomorphology	

Modulos	Methodologies Used and Data Sources				
Woulles	Methodologies Used and Data Sources				
Pedology	Gathering/Review of secondary data (EIS 2007)				
Terrestrial Ecology	- Gathering and validation of secondary data				
	- Monitoring data (2017 - 2021)				
	- Quadrat Sampling Method, Transect Walk Method, Mist Netting, Trapping				
WATER					
Hydrology and	Gathering/Review of secondary data (EIS 2007)				
Hydrogeology					
Water Quality	Review of monitoring data (SMRs, CMRs and CMVRs)				
AIR					
Climate	Gathering of secondary data from PAGASA				
Air Quality and Ambient	Review of ZDMC monitoring data (SMRs, CMRs, MPPCL Monitoring				
Noise	Reports)				
PEOPLE					
Socio-economic Profile	- Site visit/preliminary survey				
	- Secondary data gathering				
	- Public Scoping				
	- Perception Survey - Random Sample Interviews				

# ES.2.4 Scoping and Public Participation

The IEC activities were conducted from March 8-22, 2021 in the impact barangays of Municipality of Sta. Cruz, and Municipality of Candelaria.

Key Informant Interview (KII) with the barangay officials were also conducted from June 23-26,2021 to gather more in-depth discussions about the stakeholder's perceived positive and negative impacts about the project.

From June 23-25, 2021, a Focus Group Discussion (FGD) was conducted with representatives from Barangays Bayto, Biay, Bolitoc, Lucapon North, Lucapon South, Naulo, Uacon, Malimanga and Sinabacan and include barangay officials, SK Chairperson, barangay health workers, nurse, representatives from the business sector, agriculture, fishing, education and transportation. The FGD served as a venue for an interactive dialogue among these stakeholders wherein they detailed their needs, concerns, perceived issues, and perceived opportunities concerning the project.

A Public Hearing Activity will be conducted in compliance with DENR Administrative Order 2017-15: "Guidelines on Public Participation under the Philippine Environmental Impact Statement System (PEISS)" and DENR-EMB Memorandum Circular No. 2020-30: "Interim Guidelines on Public Participation in the Implementation of the PEISS (PD 1586) during the State of National Public Health Emergency". The public hearing activity will be conducted in combination of videoconferencing and gathering in actual venue but in small groups.

# ES.3 EIA Summary

ES.3.1 Summary of Alternatives

The Proponent is in discussion with a local Philippine partner to assess the potential of a pig iron smelter as a medium-term plan. This would be fed directly with iron-rich limonite and saprolite ore from the project. The resulting nickel-enriched iron products would be sold to overseas markets at a value-added price.

ES 3.1.1 Power Sources and its Alternatives

The expansion project will still tap the existing power source of the current operation operation which is the single-phase 13.2 kVA Zambales Electric Cooperative (ZAMECO) power line. Other alternative is the use of generators.

ES 3.1.2 Water Supply and Distribution System

The current water requirements of the project are for domestic use, vehicle maintenance, watering of hauling road and plants, and Assay laboratory operations. The annual water requirement of the project is 2,880,000 liters. Water source are from deep wells, pumps and springs from L1250, L 1000 portals and the AUFA Nursery Creek.

ES 3.1.3 Fuel Storage and Handling System

Fuel is sourced from suppliers in Sta. Cruz or Masinloc, Zambales and delivered to site by fuel tanker. Then, being stored at the moto pool yard consisting of three fuel tanks that are lines with an impervious bund to contain110% of the total volume capacity of each tank.

Resource	Identified Impacts	Duration		Magnitude	Geographical extent	Residual impact
Constructior	n Phase					
	Loss of vegetation cover of approximately 47.877 ha	Long-term	Unavoidable	Highly significant	Within the proposed mining areas and mining facilities (haul roads, accommodation for workers, motor pool and workshops,	Highly significant; irreversible
	Habitat disturbance causing loss of important plant species that are sources of seeds/regenerants and habitats for faunal species	Long term	Unavoidable	Highly significant	Within the proposed mining areas and mining facilities	Significant; Reversible
The Land	Physiological stress to flora and fauna from excessive dust generation and increased in noise levels	Short term	Unavoidable	Moderately significant Significant	Within the peripheries of the - proposed mining areas and haul and access roads	Moderate Significant; Reversible
	Change in community structure	Long term	Unavoidable	significant	Within the proposed mining areas and mining facilities	Moderately Significant, Reversible
	Species displacement	Long term	Unavoidable	significant	Within the proposed mining areas and mining facilities	Moderately Significant, Reversible
	Loss of topsoil	Long term	Unavoidable	Highly Significant	Within the proposed mining areas approximately 30 has	Highly significant; irreversible
	Soil erosion	Short term	Unavoidable	Significant	Within the proposed mining areas and mining facilities approximately 30 ha	Significant, reversible
	Soil contamination from Oil and Grease	Short term	Avoidable	Significant	Within the motor pool area, fuel storage areas, and access and haul roads	Significant; Irreversible
	Generation of solid wastes	Short term	Unavoidable	Moderately Significant ·	Within the accommodation - village, offices, housing for	Insignificant; Reversible

# Table ES- 3: Integrated Summary of impacts and residual effects

Resource	Identified Impacts	Duration		Magnitude	Geographical extent	Residual impact
				significant	workers	
	Increase in surface run-off	Long term	Unavoidable	Highly Significant	Within the tributary of Lauis River	Insignificant; Reversible
The Water	Siltation of surface water bodies	Short term		Significant	Within the tributary of Lauis River	reversible
	Deterioration of surface water quality from increasing suspended particulates, oil and grease, and from solid wastes	Short term	Unavoidable	Highly Significant	Within the tributary of Lauis River	Moderately Significant, reversible
	Increase in noise levels	Short term	Unavoidable	Moderately significant	Construction areas and access and haul roads	Insignificant
Air Quality	Increase in gaseous emissions	Short term	Unavoidable	Negligible	Construction areas and access and haul roads	Negligible
	Dust generation	Short term	Unavoidable	Highly Significant	Construction areas and access and haul roads	Insignificant; Reversible
	Increase in Population	Short term	Unavoidable	Moderately significant	Within the adjacent barangays	Insignificant
The People	Employment generation	Short term	Unavoidable	Highly significant	Within the adjacent barangays	Significant
	Generation of taxes	Short term	Unavoidable	Highly significant	Host municipalities	Highly significant
	Capital investments	Long term	Unavoidable	Highly significant	Within project site	Highly Significant
	Increased incidence of respiratory diseases	Short term	Unavoidable	Significant	Mine construction areas	Insignificant; reversible
	Occupational risks	Short term	Avoidable	Significant - Highly significant	-Mine construction areas	Insignificant; irreversible/reversible
Operations I	Phase		1			
	Loss of vegetation cover of 99.885 has for the mine pits and adjacent areas	Long-term	Unavoidable,	Highly significant	Mine pits and adjacent areas	Highly Significant Reversible

2021 EPRMP

Resource	Identified Impacts	Duration		Magnitude	Geographical extent	Residual impact
	Habitat disturbance	Long term	Unavoidable	Highly significant	Mine pits and adjacent areas including access and haul roads	Significant; Reversible
	Physiological stress to flora and fauna from excessive dust and increased in noise level	Long term	Unavoidable	Significant	Mine pits and adjacent areas including access and haul roads	Moderately Significant Reversible
	Change in community structure	Long term	Unavoidable	significant	Within the proposed mining areas and mining facilities	Moderately Significant, Reversible
The Land	Species displacement	Long term	Unavoidable	Significant	Within the proposed mining areas and mining facilities	Significant, Reversible
	Loss of topsoil	Long term	Avoidable	Highly significant	Within the proposed mining areas, and stockpiles	Highly significant, Irreversible
	Soil erosion	Long term	Unavoidable	Highly significant	Within the proposed mining areas, and stockpiles, haul and access roads	Moderately Significant; Reversible
	Change in landform	Long term	Unavoidable	Moderately Significant	Within the proposed mining areas and mining facilities including haul roads	Insignificant; Irreversible
	Soil contamination from Oil and Grease	Long term	Avoidable	Highly significant	Within the motor pool area, fuel storage areas, and access and haul roads	Highly Significant; Irreversible
	Generation of solid wastes	Long term	Unavoidable	Significant	Within the accommodation village, laboratories, offices, housing for workers	Insignificant; Reversible
	Generation of hazardous wastes such as used oil, busted lamps, empty containers of hazwaste materials.	Long term	Unavoidable	Highly significant	Within the mine site	Highly significant, Reversible
The Water	Increase in surface run off	Long term	Unavoidable	Significant	Cabaluan, Lauis and Malabon Rivers	Insignificant; Reversible
	Occurrence of flash floods	Long term	Avoidable	Significant	Downstream of MPSA areas along Cabaluan, Lauis and Malabon Rivers	Insignificant; Reversible

Resource	Identified Impacts	Duration		Magnitude	Geographical extent	Residual impact
The Water	Decrease in aquifer recharge and competition for water resources	Long term	Unavoidable	Insignificant	Within the MPSA areas	Insignificant
	Deterioration of water quality	Long term	Unavoidable	Highly significant	Cabaluan, Lauis and Malabon Rivers	Significant; Reversible
	Physiological stress to aquatic organisms	Long term	Unavoidable	Highly significant	Cabaluan, Lauis and Malabon Rivers, Uacon Lake and Dasol Bay	Significant; Reversible
	Species displacement and change in community structure	Long term	Unavoidable	Highly Significant	Cabaluan, Lauis and Malabon Rivers, Uacon Lake and Dasol Bay	Significant; Reversible
	Increase in noise levels	Long – term	Unavoidable	Significant	Mining areas and haul and access roads to the port facilities	Insignificant;
The Air	Increase in gaseous emissions	Long term	Unavoidable	Negligible	Mining areas and haul and access roads to the port facilities	Negligible
	Dust generation	Long term	Unavoidable	Highly significant	Mining areas and haul and access roads to the port facilities	Moderately significant; Reversible
	In-migration	Long term	Unavoidable	Moderately significant	Sitio Acoje	Moderately significant
	Employment generation and improvement of income	Long term	Unavoidable	Highly significant	Host municipalities	Highly significant
	Government revenues and fees	Long term	Unavoidable	Highly significant	Host municipalities and province	Highly significant
The People	Social Development and Management Plan (SDMP) and community relations efforts	Long term	Unavoidable	Highly significant	Host municipalities especially Sitio Acoje	Highly significant
	Relocation	-	-	Not significant	-	-
	Legacy issues			Not significant	-	-
	Social acceptability	Long term		Highly Significant	Host Municipalities	-
	Peace and order	Long term	Unavoidable	Not significant	Host community/Sitio Acoje	-
	Migration	Long term	Unavoidable	Not significant	Host community/Sitio Acoje	-
	History, culture and aesthetics	Long term	unavoidable	Not significant	Host community/Sitio Acoje	-

2021 EPRMP

Resource	Identified Impacts	Duration		Magnitude	Geographical extent	Residual impact
	Increased incidence of respiratory diseases	Long term	Avoidable	Significant -	Mining areas and haul and access	Insignificant, reversible
				Highly	roads to the port facilities	
				significant		
	Occupational risks	Long term	Avoidable	Significant -	Mining areas, assay laboratory, motor	Moderately significant;
				Highly	pool and haul and access roads to the	reversible/irreversible
				significant	port facilities	
	Increased incidence of vehicle-related accidents	Long term	Avoidable	Highly	haul and access roads to the port	Moderately significant;
				significant	facilities	reversible/irreversible
	Contamination of drinking water resources	Long term	Avoidable	Significant	Cabaluan, Malabon, and Lauis River	Insignificant/reversible
	Presence of health facilities	Long term	Positive	Significant	Sitio Acoje	-

# **1 PROJECT DESCRIPTION**

Project Information

Name of Project	:	Sta. Cruz-Candelaria Mining
Project Location	:	Municipalities of Sta. Cruz and Candelaria, Province of Zambales
Nature of Project	:	Mining Project
Project Size Surface mining rate = 4 mining rate = 315,000 M	: 15,800 M /IT per y	Nickel Laterite Ore extraction = 2,000,000 DMT per year IT per year of Chromite Lode (lumpy and milling grade) Underground ear of Chromite Laterite Ore
Proponent Profile		
Proponent Name Proponent's Address	:	Zambales Diversified Metals Corporation (ZDMC) 3rd Floor, DMCI Homes Corporate Center, 1321 Apolinario street, Bangkal Makati City, 1223
Plant Site	:	Dangkai, Makati City , 1220
Contact Persons Plant Site	:	Ramon Manuel R. Briones Vice President for Operations
Contact Number	:	8823-7963; 8831-6241
E-mail Address :		rrbriones@dmcimining.com
EPRMP Consultant	:	AXCELTECHS, INC.
Consultant's Address	:	10C Lansbergh Place, 170 Tomas Morato Ave., Sacred Heart, Quezon City
Contact Person	:	Engr. Paulo Noni T. Tidalgo
E-mail Address	:	management@axceltechs.com

Zambales Diversified Metals Corporation (ZDMC) is the current mining operator and tenement holder of Mineral Production Sharing Agreement (MPSA) No. 191-2004-III issued by the Mines and Geosciences Bureau (MGB) to Crau Mineral Resources Corporation (CMRC). This is by virtue of the Option Agreement between CMRC and Rusina Mining NL (RMNL) wherein the latter transfer the rights over MPSA No. 191-2004-III to ZDMC.

Presently, ZDMC has an ongoing application for MPSA amendment for the expansion of the current area relative to the inclusion of the 82.39-hectare referred to as Lot 4 was endorsed by MGB Region III to MGB Central Office through MGB3 Memorandum dated 06 October 201 as herein attached as Error! Reference source not found.. Likewise, included in the MPSA amendment is the transfer of ownership from CRAU to ZDMC by virtue of the MGB approved and registered Deed of Assignment (DOA) in favor of ZDMC.

ZDMC's mining operation is covered by two existing Environmental Compliance Certificate (ECC) namely ECC Nos. 0708-020-2150 and 0910-003 respectively (copy attached herein as **Error! Reference source not found.**), for the extraction and direct shipping operation of Nickel, Chromite and other associated metals in the Municipalities of Sta. Cruz and Cadelaria, Province of Zambales.

Consequently, this request for ECC amendment is a prerequisite approval for the MPSA amendment application of ZDMC with MGB. Specifically, the inclusion of the said 82.39-hectare will only have an impact in the extraction of Nickel laterite ore since the chromite extraction and processing component of the project is not yet operational.

# 1.1 Project Location and Area

The project site is located in the Municipalities of Sta Cruz and Candelaria, Province of Zambales. The mine site is around 280 kilometers away from Manila via the North Luzon Expressway. The project's MPSA is between geographical coordinates Longitude 1200 03' 30" East, and Latitude 150 42' North. The mine site is around 27 km distance from the National Highway passing through Barangay Lucapon South via the old Acoje Mines access road. Table 1-1 shows the geographical coordinates of the existing MPSA boundaries under MPSA No: 191-2004-III. On the other hand, Table 1-2 shows the geographical coordinates of the proposed expansion area. The general location map and site location map are herein presented as Figure 1-1 and Figure 1-3, respectively.

Doint	Coordinates					
Point	N	E				
Start 1	15°44'24.9792"	120°3'3.2364"				
2	15°44'24.7164"	120°3'18.2952"				
3	15°44'9.9564"	120°3'18.2952"				
4	15°44'9.4308"	120°3'48.9636"				
5	15°44'24.45"	120°3'48.1428"				
6	15°44'24.45"	120°4'3.7488"				
7	15°42'38.7648"	120°4'4.8432"				
8	15°42'39.0276"	120°4'19.0812"				
9	15°42'54.8424"	120°4'18.534"				
10	15°42'54.8424"	120°4'33.5928"				

Doint	Coordinates				
Point	N	E			
11	15°41'24.1692"	120°4'33.5928"			
12	15°41'25.1124"	120°4'3.432"			
13	15°38'24.7092"	120°4'4.7316"			
14	15°38'25.2204"	120°3'34.308"			
15	15°39'25.0704"	120°3'34.308"			
16	15°39'25.0704"	120°3'22.806"			
17	15°39'33.1884"	120°3'22.8636"			
18	15°39'33.1884"	120°3'13.0068"			
19	15°39'42.5232"	120°3'12.8412"			
20	15°39'42.6816"	120°3'34.1964"			

# Table 1-1: Geographical Coordinates of MPSA No: 191-2004-III.

2021 EPRMP

Point	Coordinates					
	N	E				
21	15°39'55.3356"	120°3'34.1964"				
22	15°39'55.0512"	120°3'4.7412"				
23	15°40'23.322"	120°3'4.5108"				
24	15°40'23.2284"	120°2'35.4336"				
25	15°39'54.8496"	120°2'35.1888"				
26	15°39'54.8604"	120°2'49.02"				
27	15°39'40.1508"	120°2'49.5132"				
28	15°39'39.9924"	120°3'4.464"				
29	15°39'33.03"	120°3'4.626"				
30	15°39'33.1884"	120°3'13.0068"				
31	15°39'2.9736"	120°3'12.8412"				
32	15°39'2.8152"	120°3'4.464"				
33	15°38'54.906"	120°3'4.2984"				
34	15°38'54.7476"	120°2'52.962"				
35	15°38'52.2168"	120°2'52.8"				
36	15°38'52.3752"	120°3'4.626"				
37	15°38'25.1916"	120°3'4.914"				
38	15°38'25.3032"	120°2'3.7716"				
39	15°38'36.186"	120°2'3.7716"				
40	15°38'36.186"	120°2'13.5672"				
41	15°38'55.3128"	120°2'13.29"				
42	15°38'55.1796"	120°2'3.4944"				
43	15°38'25.3032"	120°2'3.7716"				
44	15°38'25.3572"	120°1'34.32"				
45	45 15°40'50.8764" 120°					
46	15°40'50.8764"	120°2'10.1364"				
47	15°41'0.5604"	120°2'9.4128"				
48	15°41'1.0248"	120°2'30.1236"				
49	15°41'20.9184"	120°2'29.7456"				
50	15°41'20.5872"	120°2'40.1856"				
51	15°41'40.0272"	120°2'39.3288"				
52	15°41'39.8652"	120°2'49.7688"				
53	15°41'58.776"	120°2'49.29"				
54	15°41'59.3052"	120°3'1.062"				
55	15°42'54.7092"	120°3'0.7884"				
56	15°42'54.7092"	120°2'50.658"				
57	15°43'16.0572"	120°2'50.3844"				
58	15°43'15.5316"	120°3'3.8016"				
59	15°43'35.562"	120°3'3.528"				
60	15°43'34.9644"	120°2'59.7984"				
61	15°43'24.492"	120°3'0.2412"				

Deint	Coordinates					
Point	N	E				
62	15°43'24.7728"	120°2'33.9684"				
63	15°42'24.9264" 120°2'33.68					
64	15°42'25.1892"	120°2'3.0156"				
65	15°41'54.8772"	120°2'3.8364"				
66	15°41'54.7116"	120°2'8.8332"				
67	15°41'20.112"	120°2'9.1788"				
68	15°41'19.95"	120°1'58.7388"				
69	15°41'40.0488"	120°1'58.7172"				
70	15°41'39.5556"	120°1'49.1556"				
71	15°41'19.95"	120°1'49.3248"				
72	15°41'20.112"	120°1'38.5464"				
73	15°41'49.6032"	120°1'39.3996"				
74	15°41'49.4376"	120°1'49.3248"				
75	15°42'38.5308"	120°1'48.9828"				
76	15°42'37.872"	120°1'59.25"				
77	15°42'47.5884"	120°1'59.1204"				
78	15°42'47.7576"	120°2'9.348"				
79	15°43'7.6728"	120°2'8.1492"				
80	15°43'7.3452"	120°1'59.0808"				
81	15°43'25.1508"	120°1'58.62"				
82	15°43'54.9336"	120°3'4.0572"				
End 83	15°44'24.9792"	120°3'3.2364"				
Start 84	15°38'15.1476"	120°2'32.874"				
85	15°38'14.8632"	120°3'12.906"				
86	15°38'5.1972"	120°3'12.7584"				
87	15°38'5.37"	120°3'2.9484"				
88	15°37'55.2756"	120°3'2.2608"				
89	15°37'55.2756"	120°2'53.016"				
90	15°38'5.1252"	120°2'52.5084"				
End 91	15°38'5.4816"	120°2'33.0216"				
Start 92	15°37'16.392"	120°2'2.454"				
93	15°37'16.3632"	120°2'31.7796"				
94	15°37'7.2084"	120°2'31.8624"				
95	15°37'7.1256"	120°2'13.02"				
96	15°36'56.8044"	120°2'12.786"				
End 97	15°36'56.9052"	120°2'2.1588"				

Points	Coordinates				
	N	E			
Start 1	15°39'42.6816"	120°3'34.1964"			
2	15°39'55.3356"	120°3'34.1964"			
3	15°39'55.0512"	120°3'4.7412"			
End 4	15°40'23.322"	120°3'4.5108"			

Table 1-2: Geographical Coordinates of Expansion Area



Figure 1-1. General Location Map



Figure 1-2: ZDMC Vicinity Map



Figure 1-3. Site Location Map with Proposed Expansion Area

The Direct and Indirect Impact Areas were delineated based on the host barangays within the Active Mine Area and Expansion Area of ZDMC. Direct impact barangays include Barangay Uacon in the Municipality of Candelaria, and Barangay Lucapon South in the Municipality of Sta. Cruz. Indirect Impact Areas are those neighbouring barangays located downstream of the Direct Impact Areas. The nearest Protected Area, the Malimanga Fish and Bird Sanctuary, is approximately 10 km away from ZDMC MPSA and around 12 km away from the proposed expansion and active site

Municipality	Direct Impact Areas	Indirect Impact Areas		
Candelaria	Uacon	Lauis		
		Malabon		
		Malimanga		
		Pamibian		
		Pinagrealan		
		Sinabacan		
		Taposo		
		Yamot		
Sta. Cruz	Lucapon South	Bayto		
		Biay		
		Bolitoc		
		Lucapon North		
		Naulo		

Table 1-3: Direct and Indirect Impact Areas of the Expansion Project.

# 1.1.1 Proximity to Protected Area

Luzon is the largest island in the Philippines and lies in the western Pacific Ocean. It is a mixture of two (2) towering mountain ranges -- the Cordillera Central in the West and the Sierra Madre to the East, and volcanoes, lush farmlands and natural sea harbors. The Central Luzon is rich in timber and mineral resources. It has volcanoes, lush farmlands, rich marine resources and natural sea harbors. It has been a home to unique plant and animal species. Thus, Central Luzon has 24 sites included in the initial components of the National Integrated Protected Areas System (NIPAS) which includes Lake Malimanga and Masinloc and Oyoy Bay.

By virtue of Proclamation No. 1949, s. 1980, Lake Malimanga situated at Barangay Malimanga, Candelaria, Zambales was declared a Bird and Fish Sanctuary on 14 March 1980. The proclamation covers an area of 127,485 square meters. It is now known as Lake Malimanga Bird and Fish Sanctuary.

Eventually, an approximate area of 7,568 hectares in the coastal municipality of Masinloc in Zambales – the Masinloc and Oyon Bay, was declared as a protected seascape through Proclamation No. 231 on 18 August 1993. It covers the prosperous town of Masinloc and parts of the municipality of Palauig in the province of Zambales. It was known as Masinloc-Oyon Bay Marine Reserve. It is now known as Masinloc-Oyon Bay Protected Landscape and Seascape (MOBPLS).

On 21 March 2018, the Masinloc-Oyon Bay Marine Reserve was declared a protected area by virtue of Republic Act 11038 or the Expanded National Integrated Protected Area System Act of 2018 to ensure that the area will be protected to maintain its natural conditions and reduce the threat of degradation. It is now known as the Masinloc-Bay Protected Landscape and Seascape (MOBPLS).

The MOBPLS is an important source of food and livelihood to coastal communities in the towns of Masinloc and Palauig. Aside from being home to unique mesophotic coral species and large fishes,

including the threatened Blue-spotted rabbitfish (Siganus corallinus), this coastal area is also the first declared mangrove protected area in Zambales where the rare hybrid mangrove, Rhizopora x lamarckii [hybrid of Rhizopora apiculata (Bakawan lalaki) and R. stylosa (Bakawan bato)] can be found.



Figure 1-4: Direct and Indirect Impact Areas

# 1.2 Project Rationale

The country is rich in mineral resources. The mining industry in the country has significantly contributed to the national economy. On the project level, the same have open doors of opportunities to the Local Government Units where the project is operating through active involvement in ensuring environmental safeguards are established and implemented, to livelihood and educational support. Clearly, mining made significant contributions to the economy at different facets.

In order to facilitate investment, Executive Order (EO) No. 270 issued in January 2004 provides for a National Policy Agenda for the revitalization of mining activities in the Philippines. The policy recognizes the critical role of investments in the mineral industry for national development and poverty alleviation and that the government shall provide support mechanisms for a sustained mineral exploration program, responsive research and development, capability building for industry workforce while ensuring the environment is protected.

Recently, President Rodrigo Duterte signed into law Executive Order No. 130 on 14 April 2021, which lifted the ban in the processing of Mineral Production and Sharing Agreement (MPSA).

Clearly, mining is a project of national interest and the National government thrust is for sustainable development through responsible mining. With the Covid 19 pandemic more Filipinos are economically affected, any revenue that can be generated from mining operations is a welcome development. Also, there is a scarce supply of Nickel in the world market and this project will be able to contribute to meet the global demands.

# 1.3 **Project Alternatives**

Initially, the long-term plan of the company is to develop a value-added process for the production of nickel (nickel/cobalt hydroxide) from laterite ore using the heap leaching technology. However, based on the result of the Trial Heap leach, it is not commercially feasible. Hence, this alternative did not pursue. Consequently, the current maximum annual production of Nickel ore of 3,000,000 DMT production is not attainable based on the remaining ore reserves. Thus, with the additional 82.39 hectares and the continued exploration works of the company, it is feasible to attain the maximum annual production of 2,000,000 DMT.

Primarily, the company decided to expand its mining area in order to increase its reserves. Then, the location of Lot 4 is is the most appropriate since it is already inside the current mining area of ZDMC. Same method of operation will be implemented. The waste management system of the Company will be enhanced to effectively address the additional area of operation.

Now, the Company ventured into a partnership for the operation of the chromite processing plant with an estimated capacity of 2.000 tons per day. In this partnership, the chromite that will be mined in the project area will be feed into the chromite processing plant of its partner. This alternative option is still in the actual mobilization stage and the operating permits were already secured for the Chromite Mineral Processing Plant (MPL). Once, the MPL is established and operational, extraction of chromite within the project site will also commence.

# 1.3.1 Siting

The expansion project has no alternative locations in terms of area expansion since the proposed area is bounded by the original MPSA. As such, all existing structures and facilities will be used for the expansion and no additional structures will be constructed. The following considerations for the location of the expansion site served as guidelines which were mostly geological, geotechnical and environmental:

- minimal impacts from excavation/ground preparation to ecosystem, and land use.
- Minimal land use design requirements.
- Less impact from noise and truck traffic.
- Highly irregular shape of the saprolite layer;
- Erosion and sediment control;
- Dilution and ore losses; and
- Bench and slope stability.

Additional considerations were also made in terms of the site's susceptibility to the following:

- Liquefaction, Ground Shaking, Ground Rupture,
- Earthquake induced Landslides Volcanic eruptions, tsunami (PHIVOLCS)
- Rain-induced landslide and flooding (MGB)
- Storm surge, and flooding as well as extreme climatologic conditions (PAGASA)

# 1.3.2 Technology Selection/Operation Processes and design selection for storage

The existing mining system will be adopted and will involve several phases that include:

- Land Clearing which needs tree cutting permit;
- Overburden removal (waste stripping) and storage for rehabilitation;
- Ore Mining; and
- Rehabilitation.

# 1.3.3 Resources

The existing power and water sources will be used for the expansion and no alternative sources were considered since additional facilities and structures will no t be constructed.

# 1.3.4 Consequences of not Proceeding

The suggested project alternative if not materialized will delay the extraction of the chromite reserves. and the maximum annual production of nickel laterite will not be meet. The nickel laterite will remain untapped, and will continue to increase in volume through the very slow process of weathering. At this rate and over a period of 25 years, the volumetric increase in the laterite deposit is almost negligible. However, the rate of erosion may be higher, as the headwaters of the streams migrate upslope and as the stream banks slide down as hastened by the seasonal rains. Occasional landslides and patches of heightened erosion will remove a fraction of the laterite deposit, but the major portion will remain in situ. Likewise, the conversion of the laterite into wealth will not occur, depriving the country and the local community of the economic benefits brought by the extraction of the laterite.

# 1.4 **Project Components**

# 1.4.1 General Layout of Facilities

The operations for nickel direct shipping ore will be within MPSA areas. The map in **Figure 1-5** shows the target areas for mining for the next 4 years. Development activities at Areas 1 and 2 of Parcel 2 of the Airstrip (Parcel 15B of STCEP) are on-going. Areas 3 and 4 of Parcel 3 of the Airstrip (part of Parcel 15B and Parcel 14 of STCEP) will undergo tree-cutting and development early next year (2021). Lot 4 (previously referred as Lot 6/Parcel 7 of STCEP) will then follow once the inclusion of the area is approved.

# 1.4.2 Major Components

Proposed changes include expansion in land area and increase in production capacity. A total increase in area of 82.39 ha is being proposed while production capacity is proposed to be increased from 1,000,000 DMT/ yr up to 2,000,000 DMT/yr.

Parameters	Existing	Proposed Changes	Total	
Area	3,765.39 ha	82.39 ha	3,847.78 ha	
Production Capacity	1,000,000 DMT/ yr	2,000,000 DMT/ yr	2,000,000 DMT/ yr	

# 1.4.3 Mineral Extraction

The proposed project will only entail mineral extraction. Ores acquired shall be shipped and transported to designated mineral processing plants. The proposed expansion project only includes an increase in land area and increase in production capacity.

Indicated Resource estimates is presented in the following:

Resource	Limonite		Saprolite			Total			
Category	Tonnage	Ni	Fe	Tonnage	Ni	Fe	Tonnage	Ni	Fe
Indicated	461,040	1.10	31.95	660,721	1.14	17.33	1,121,761	1.12	24.64

# 1.4.4 Support Facilities and Infrastructure Requirements

The existing power and water sources will be used for the expansion and no alternative sources were considered since additional facilities and structures will not be constructed. For power sources, requirements of the operation are estimated to be greater than 270 KW. This includes ongoing supply requirements for all existing structures such as accommodations, health facilities, recreational facilities, motor pool, maintenance workshops, assay lab, water supply pumps and lighting. Water requirements on the other hand will be for domestic use, vehicle maintenance, assay lab and for dust suppression. Water will be sourced from the L1250, L1000 portals and the creeks. Flows from measuring points indicate low flow volume of 37 l/sec which more than satisfies the projected needs of the operation. Water required for dust suppression may be alternatively sourced from sediment control dams that have the capacity to store water.



Figure 1-5: Three-Year Mining Plan

2021 EPRMP

Page 1-22

# 1.4.5 Pollution Control Devices

# 1.4.5.1 Sediment Control Structures

The expansion project will make use of existing sediment control measures. Disturbed areas will have water flowing and directed to settling ponds or sumps. Clean runoff from higher elevation areas will be directed away from disturbed areas through diversion drains. Some of the silt control facilities to be constructed would include:

- Diversion drains;
- Sumps and dams; and
- Settling ponds.

The control measures are placed within the MPSA as required by the operation. As the mine will operate on a continuous rehabilitation cycle, these structures will be maintained until such time that sediment discharge from rehabilitated areas has returned to an acceptable level.

# 1.4.5.2 Waste Rock Stockpile

The mining process works on a continuous rehabilitation. This entails 3 phases being mining, backfilling and rehabilitation. As there will be a delay in the availability of backfilling areas at the start of the operation, a waste stockpile facility may be required. This facility could be temporary or could become a permanent structure. The waste stockpile footprint will be cleared and topsoil stripped for future use in rehabilitation practices.

**Figure 1-6** shows the additional areas to be applied for a special tree-cutting permit (STCP). These areas are the targeted development and production areas for the succeeding years. **Figure 1-7** shows the current structures in the mining area and **Figure 1-4** shows the Direct and Indirect Impact Areas.



Figure 1-6: Tree Cutting Sites


Figure 1-7: Site Development Map

2021 EPRMP

Page 1-25

# 1.5 Process Technology Options

# 1.5.1 Description of Operations and Maintenance

For the mining operation proper, existing methods include clearing and stripping will be done in discrete parcels to minimize ground disturbance. Overburden thickness over the mining areas vary from near zero to three meters. This will be extracted by contour benching at an average height of three meters using excavator-dump truck combination. Topsoil will be removed, collected and stockpiled in a dedicated stockpiling area that will be later use for rehabilitation.

After all overburden materials are removed, development of mining benches with optimum width of 5 meters and bench height of 3 meters will be undertaken. Bench slope of an angle of 60 degrees but will not exceed 90 degrees will be achieved with an overall pit slope angle around 30 degrees. Generally, the area mined will be established with an on-contour terrace or bench design.

After the mine benches have been developed, extraction of ore ensues. This is done by pre-piling, a process where ore extracted from production benches are pre-piled in a small conical stockpile. It constitutes around 30 to 50 buckets (typically 1 cubic meter bucket of PC-210 back hoes) of ore. The pre-pile is sampled following the established sampling pattern of Grade Control.

Samples are then sent to the Assay laboratory for grade determination. After the grades are released, each pre-pile will be classified according to the established Grade Control Ore Classification system.

After the pre-piles are classified, the ore are ready for hauling. The ore will be loaded by excavators to dump trucks. During loading, boulder segregation is done where the backhoe operators separate oversize boulders (> 200 mm).

The dump trucks will then haul the Nickel Laterite ore material to Bolitoc port for temporary stockpiling and waiting for shipment. ZDMC will utilize the existing mine haul roads that will be properly maintained during the whole project duration. Traffic management will be regularly monitored and improved for efficient flow. Moisture reduction through solar drying is also done in the Bolitoc stockyard.

For the expansion, the same technology and methodology will be used. No changes or modifications will be added in the process technology.

The schematic flow sheet of Nickel Laterite Mining is shown in Figure 1-8.



Figure 1-8: Schematic Flowsheet of Nickel Laterite Mining

1.5.2 Description of the Pollution Control Devices and Waste Management System

# 1.5.2.1 Pollution Control Devices

The expansion project will make use of existing sediment control measures. Disturbed areas will have water flowing and directed to settling ponds or sumps. Clean runoff from higher elevation areas will be directed away from disturbed areas through diversion drains. Some of the silt control facilities to be constructed would include:

- Diversion drains;
- Sumps and dams; and
- Settling ponds.

The control measures are placed within the MPSA as required by the operation. As the mine will operate on a continuous rehabilitation cycle, these structures will be maintained until such time that sediment discharge from rehabilitated areas has returned to an acceptable level.

#### 1.5.2.2 Mine wastes and Overburden

The mine wastes to be generated include the following:

- Rock waste generated during ground preparation or leveling; and
- Topsoil cover of the nickel ore which are scraped and stockpiled for future rehabilitation requirements.

Majority of the waste to be generated during the operations phase are overburden materials. The bulk of the overburden materials shall be used for backfilling into the excavated sites. Those not used for backfilling will be stored. Slopes of the dumpsite will be engineered to minimize erosion and drainage will be provided to prevent runoff from causing further erosion.

Top soil materials will be stored separately for use in the rehabilitation of mined out areas.

#### 1.5.2.3 Regulated Wastes

The wastes generated by the project include:

• Household waste consisting of bio-degradable waste materials from food, vegetable consumptions, and non-biodegradable materials such as plastics, wrappers, crates or boxes for food supply.

• Vegetation removed for construction clearing. Commercial sized timber may be offered to the DENR or the local community. All remaining vegetation will be used for mulch or composting purposes in the mine rehabilitation activities.

The solid waste management plan of the project will be the "3 Rs", reduce, reuse, and recycle. This is to extract the maximum benefits from waste products in order to generate the minimum amount of waste. This involves the following:

• Provision of compost pits for biodegradable waste and to be used to supply the residents with fertilizer for vegetable gardens.

• Recycling or recovery through the Materials Recovery Facility of solid waste materials such as papers, refuse from repair shops, tires, batteries, for other alternative uses to be sold to prospective buyers from the nearby towns.

• Provision of garbage disposal sites for wastes that cannot be recycled or can not be composted.

# **1.6 Description of Project Phases**

The implementation of the expansion of the MPSA area will only have an impact in the extraction of Nickel laterite ore, to cover the following:

# 1.6.1 Permitting and Pre-Construction Phase

The Permitting and Pre-Construction phase covers the active participation of the proponent in securing the necessary regulatory compliances and approvals in order to secure the amendment of MPSA No. 191-2004-III with MGB for the inclusion of Lot 4 (*formerly identified as Lot 6 during the conduct of the Information, Education and Communication (IEC) campaign).* Relevant pre-requisite approvals will be secured at this phase to include close coordination with the various stakeholders in the project area both in the identified Direct Impact Areas (DIA) and Secondary Impact Areas (SIA). Careful planning, documentation and coordination effort will be undertaken by the project proponent to secure all the required permits, clearances and the necessary engagements. Securing the amended ECC is one of the many approvals needs to be in placed prior to the project implementation.

Also, at this stage the survey, planning and design will be finalized to supplement the existing mining operation and structures of the project. At this point, utilities will be sourced from the existing operation and will be upgraded as deemed necessary.

Further, the manpower complement will also be determined during this phase. Local hire will be given preference so long they are qualified for the available position.

# 1.6.2 Construction/Operational phase

The Sta. Cruz and Candelaria mining project has been operational since 2007. However, mining and shipping operations for Nickel ore commenced last CY 2020 after its suspension was lifted on the latter part of 2019. The chromite project is still in the exploration stage for confirmation of the remaining chromite deposit and it will commence once the necessary permits are secured.

Relative to this ECC amendment, additional settling ponds or environmental control structure will be added to the existing structures of the mining facility.

Existing methods include clearing and stripping which will be done in discrete parcels to minimize ground disturbance. Overburden thickness over the areas vary from near zero to three meters. This will be extracted by contour benching at an average height of three meters using excavator-dump truck combination. Topsoil will be removed, collected and stockpiled in a dedicated stockpiling area that will be later used for rehabilitation.

# 1.6.3 Decommissioning and Mine Closure

ZDMC will submit to MGB for approval the Final Mine Rehabilitation and Decommissioning Plan (FMRDP). This will serve as the guiding document of ZDMC as it undertakes mine closure. The FMRDP will give due consideration on the Environmental Impact Statement (EIS) and the updated Environmental Management Plan (EMP).

The plan shall include the following information:

• Alternatives for future use of the land, consistent with long term zoning and land use of the municipality

- Dismantling and proper turn-over of facilities,
- Decontamination plan on affected areas, and
- Land restoration

# 1.7 Project Size

This application for ECC amendment covers the following, to wit:

1. Increase of the MPSA or project area from 3,765.39 hectares to 3,846.39 hectares relative to the inclusion of the 81 hectares of Lot 4.

2. Remove the ECC conditions on Heap Leach Processing (HLP) plant and Sulfuric Acid Plant (SAP), respectively, under ECC 0910-003;

3. Consolidate the conditions of ECC 0910-003 and ECC 0708-020-215 maintaining the extraction rate of Nickel Laterite Ore at 2,000,000 DMT per year and the surface and underground mining rate of 415,800 MT per year of Chromite Lode (lumpy and milling grade) and 315,000 MT per year of Chromite Laterite Ore respectively.

#### 1.8 Manpower

A total of 458 workforce are being employed as or July 2021. These are distributed to each of the affected barangays in the Municipalities of Candelaria and Sta. Cruz in the Province of Zambales.

**Table** 1-4 shows the distribution of workforce per barangay

Barangay	No. of workers
1. Bolitoc	137
2. Bial	63
3. Bayto	29
4. Naulo	9
5. Lucapon North	10
6. Lucapon South	196
7. Uacon	0
8. Sinabacan	3
9. Malimanga	1
10. Malabon	1
11. Pamibian	0
12. Taposo	0
13. Yamot	0
14. Pinagrealan	6
15. Lauis	3
TOTAL	458

 Table 1-4: Distribution of Workforce per barangay

## 1.9 Indicative Project Cost

The estimated production and costs per annum for the nickel ore mining is shown in Table 1-5.

Particulars	Annual
Ore (DMT)	1,000,000
Overburden (DMT)	2,200,000
Cost (US\$)	27,000,000

# Table 1-5: Estimated Cost per Annum of the Nickel Operations

Based on mine planning projection, nickel production is still good for a five-year operation and can be extended to 10 years if the market will continue to cater low grade nickel ore.

Total project costs is estimated at PhP595 million

#### 2 ASSESSMENT OF ENVIRONMENTAL IMPACTS

#### 2.1 The Land

- 2.1.1 Land Use and Classification
- 2.1.1.1 Municipality of Sta. Cruz

The Municipality of Sta. Cruz has a total land area of forty-one thousand, four hundred four hectares (41,404.00 ha). The total urban area of the municipality is two hundred twenty hectares (220 ha). The urban barangays are Barangay Poblacion North, Barangay Poblacion South, and Barangy Lipay. The rest of the 22 barangays identified as rural barangays.

Considering the natural topography of Sta. Cruz which is hilly and mountainous, the land-use classification and allocation in the area is relatively dependent on the topographic factor. Based on **Table 2-1**, majority of the land use is classified Forestlands.

Land Use	Land Area
Agricultural	4,292.00
Industrial	18.00
Commercial	50.00
Residential	2,750.00
Institutional	20
Open Space	5,402.69
Others	31,313.31
Total	41,404.00

#### Table 2-1: Land Use Allocation in Sta. Cruz, Zambales.

Land-use that is allotted for agriculture only constitutes 13.97 percent of the total land area. Most of these agricultural areas are located in the floodplains on the southwestern portion of Sta. Cruz extending north, northeast of the municipality. Currently, they are still in the process of preparing the CLUP. Figure 2-1 shows the Proposed Zoning Plan of the municipality of Sta. Cruz.

#### 2.1.1.2 Municipality of Candelaria

The municipality has a total land area of 33,359.19 has majority of which are forested. The table below indicates that forest is the major land use of the municipality. Built up spaces are classified as residential as well as for other purposes like industrial and commercial establishments (**Table 2-2**). Currently, the municipality is in the process of updating their CLUP.

Land Use	Land Area
Agricultural	2,523.67
Residential	4,742.83
Open Space	26,092.69
Total	33,359.19

#### Table 2-2: Land Use Allocation in Candelaria, Zambales.



Figure 2-1: Land Use Map of Sta. Cruz

2.1.1.3 Impact in terms of Compatibility with Existing Land Use

The proposed expansion of the project is already compatible with its existing land use for both Municipalities of Candelaria and Sta Cruz. But still, the updating of the Comprehensive Land Use Plan for both municipalities is still highly recommended as this will result to a more accurate and effective land use planning. It will also attract investors to invest in the municipality.

2.1.1.4 Impact on Compatibility with Classification as an Environmentally Critical Area

Environmentally Critical Areas (ECA) are areas delineated through Presidential Proclamation 2146 of 1981 as environmentally sensitive such that significant environmental impacts are expected if certain types of proposed projects or programs are located, developed, or implemented in it. Based on the 12 categories identified in the Environmental Management Bureau (EMB) Memorandum Circular No. 005, Series of 2014 (MC 2014-005), there will be no encroachments in Environmental Critical Areas (ECAs).

2.1.1.5 Impact in Existing Land Tenure Issue/s

There will be no land tenure issues in the proposed expansion since the Project is within the established property of the ZDMC.

2.1.1.6 Impairment of Visual Aesthetics

The Sta. Cruz – Candelaria Mining Project will greatly affect the slopes and natural topography of the area. The process of mining activities will remove vegetative cover to extract mineral ore. And after

the extraction of mineral ores, ZDMC will be implementing a progressive rehabilitation program to ensure the re-greening and brining it back to its pristine form. Aside from the progressive rehabilitation, ZDMC will also implement timely an environmental plan that will help restore the area.

2.1.1.7 Devaluation of Land Value due to Improper solid waste management and others

There will be no devaluation of land value.

# 2.1.2 Geology/Geomorphology

# 2.1.2.1 Change in Surface Landform/Topography/Terrain/Slope

Sta. Cruz Municipality has moderately flat topography at the northern portion, gradually becoming rolling to undulating towards the east. In the Municipality of Candelaria, on the other hand, topography is generally rugged and mountainous. With regards to the ZDMC MPSA, the lowest elevation is at 180 meters above sea-level (masl) and maximum reaches to 1110 masl. Lastly, the lowest elevation in the expansion area is 640 masl while the highest is at 910 masl. The topography of the Project areas is shown in Figure 2-2, while the elevation map is presented in Figure 2-3.

The MPSA is located south of Mt. Natalisbong, along a mountainous area west of Zambales Mountain Range. In terms of slope, around 37% of the land area is moderately steep having slope gradient from 30 % to 50%. Flat areas only constitute to around 3% of the whole area. The same is true for the expansion area, having 46% of the land area or 37.38 ha, being Moderately steep, while flat areas constitute to only 2% of the whole land area. Table 2-3 shows the summary of the distribution of slopes within the MPSA and Expansion Area, while Figure 2-4 shows the slopes presented on a map.

Slope	Description	MPSA	%	Expansion	%	Total
0-8%	Not Steep	106.76	3	1.82	2	108.58
8.01-15%	Slightly Steep	357.11	9	5.06	6	362.17
15.01-30%	Fairly Steep	1245.03	33	17.93	22	1262.96
30.01-50%	Moderately Steep	1388.40	37	37.38	46	1425.78
>50%	Very Steep	668.09	18	18.82	23	686.91
		3765.39	100	81.00	100	3846.39

#### Table 2-3: Summary of slopes within the MPSA,



Figure 2-2. Topographic Map



**Figure 2-3: Elevation Map** 



Figure 2-4. Slope Map



# 2.1.2.2.1 Regional Geologic Setting

The project areas are part of the Zambales range, which form part of the western orogenic belt and borders the Mobile Belt of the Philippines. It has a a NS-trending ridge that serves as a volcanic and frontal arc to the Manila Trench. This trench is, in turn, a segment of the subduction zone that thrusts

the South China Sea and its southern extensions under the landmass of Luzon and the VIsayan Islands. In some sections, this subduction is choked by crustal fragments that collide with the overriding arc, leading to massive orogeny and tectonism. As such, this mountain range and its adjoining Manila Trench host earthquakes and volcanism that accompanies the subduction process.

The Zambales range consists the Acoje Block and the Coto Block. These blocks were up-thrust to the west and appear to be separated by a regional fault having a large left hand strike slip component. The Acoje Block is considered as an Island arc and the Coto Block as a backarc by Evans and Hawkins (1983). Chromite mineralization in Acoje is located largely within an elongated tabular-shaped body of steeply dipping dunite. The eastern margin of the dunite is in contact with layered gabbro and norite (Chamberlain 1983). The western portion is underlain by harzburgite / peridotite. Almost everywhere, the ultramafic complex is covered by well-developed reddish brown lateritic soil with varying thickness of 10cm to about 10m from the surface. Fresh outcrops of dunite, harzburgite / peridotite and gabbro could be observed almost everywhere (**Figure 2-5**).

# 2.1.2.2.2 Geomorphology

The Zambales Range occupies the central western Luzon while the Central Valley occupies the central Luzon and extends to the south of Metro Manila. It is characterized by steep slopes and almost vertical rock cliffs with ravines, and deeply incised river valleys. The existing MPSA and the proposed expansion area sits on an ultramafic land form. Figure 2-6 shows the geomorphology of the project area.

# 2.1.2.2.3 Stratigraphy

**Figure 2-7** presents the geologic setting covering the Mine Area and vicinity. The dunite horizons host most of the known chromite (Cr), platinum group element (PGE) and nickel (Ni) mineralization, particularly within mostly the dunite horizons, although mineralization has also been reported within the harzburgite horizons. The mineralization takes the form of bands, or lenses. Pyroxenite intrusions and dikes are also present within the lower sequences. The layered cumulates and pyroxenites have undergone extensive serpentinization subsequent to emplacement.

In general, the whole Zambales Range is considered to be Eocene and older. This is older than the Manila Trench which comprises of the Oligocene to Miocene age. Table 2-4 shows the generalized stratigraphy of the Mine Area and vicinity.



Figure 2-5: Geologic Map



**Figure 2-6: Regional Geomorphic Features** 



Figure 2-7: Comprehensive Geologic Setting



# Table 2-4: Stratigraphy of the Project Site

The laterite deposits that are found in the MPSA area are a result of the physicochemical processes that accompany weathering of ultramafic rocks. Initially, as the peridotites are exposed on the Earth's surface, the minerals are hydrated, leading to the formation of serpentinites. Prolonged exposure to water and weathering agents form the lateritic soils, wherein the breakdown of the serpentinites and the leaching of various elements out of the decaying rocks produce layers of material enriched in iron and nickel oxides. Thus, the nickel laterites are found as soil layers blanketing the top of the peridotites. And the old age of the Zambales Mountain Range, coupled with the tropical climate and vegetative conditions conducive to weathering, and the hilly topography of the project site, led to a unique geological condition that produced that laterite deposits in the MPSA area.

# 2.1.2.2.4 Natural Hazards

# 2.1.2.2.4.1 Volcanic Activities

Pinatubo Volcano is located about 65 km away. The site is expected to receive only a thin shower of ash if another major eruption should occur. **Figure 2-8** shows the proximity of the project site to Mt. Pinatubo.



Figure 2-8: Proximity of the Project Site to Mt. Pinatubo

#### 2.1.2.2.4.2 Earthquakes

Due to the presence of active faults such as the East Zambales Fault, West Boundary Fault, and Philippine Fault Zone, the geologic hazard recognized most significant at the project site and immediate vicinity is the earthquake or seismic hazard. **Figure 2-9** shows the location of the mining project relative to major earthquake generators in the Philippines. The project site is 20km from the East Zambales Fault (EZF), 105km from Philippine Fault Zone (PFZ) approximately and approximately 10km from the West Boundary Fault (WBF). The engineering evaluation of earthquake hazards include the likely strength, location, effect of vibration to the proposed dwellings, and the response of the ground to such phenomena such as ground shaking, ground rupture, liquefaction, settlement, and landslides/mudflow. These potential hazards and their direct impact on the project site are further discussed below.





Figure 2-9: Major earthquake generators relative to Mine Site.

#### 2.1.2.2.4.3 Ground Acceleration

Earthquake events generate seismic waves, which pass across the earth surface causing ground vibration commonly called 'ground shaking'. The majority of the damage incurred during earthquakes results from ground vibration whose intensity in a given area is influenced by the magnitude of the earthquake, the distance of the site from the epicenter, and the modifying effects of the sub-soil conditions.

To provide a guide for estimating the peak ground acceleration (PGA) in the Philippines, zonation maps of g-values was produced in 1994 by a joint project between the PHIVOLCS and the US geological survey, taking into consideration the various geological factors in the country (Thenhaus, et. al 1994). Engineers may refer to these maps in seismic design of buildings and infrastructures. Using these probabilistic maps (**Figure 2-10** to **Figure 2-12**) the peak horizontal acceleration amplitude, g-values, for the project site is:

- 1. >>0.22g for bedrock,
- 2. >0.39g for medium soil,
- 3. >0.60g for soft soil.



Figure 2-10: Peak horizontal acceleration amplitudes (g) in soft soil. 10% probability of exceedance in 10 years



Figure 2-11: Peak horizontal acceleration amplitudes (g) in medium soil. 10% probability of exceedance in 10 years



Figure 2-12: Peak horizontal acceleration amplitudes (g) in rocks. 10% probability of exceedance in 10 years

To assess the worst-case scenario of ground shaking, the Deterministic Method is used employing the equation developed by Fukushima and Tanaka (1990). The equation is as follows:

 $Log10 A = 0.41M - log10 (R + 0.32 \times 10 (0.41M)) - 0.0034R + 1.30$ 

Where A = mean peak acceleration (cm/sec2) R = shortest distance between site and fault (km) M = surface-wave magnitude

This method presumes that the highest magnitude earthquake (or Maximum Credible Event - MCE) that has been recorded along the segments of the WBF or the Philippine Fault or the EZF and has the possibility to recur, and that the epicenter will be at the nearest distance of the fault from the project site. Hence for the computation of the highest peak ground acceleration (PGA), the MCE used is Ms=7.5 and R is 5 km to 15.0 km from the WBF, 20.0 km to 30.00 km from the EZF, and 105km to 115km from the Philippine Fault Zone. Moreover, amplification factors used for the different ground conditions are as follows:

- for medium soil is 1x,
- for hard soil or bedrock is 0.6x.

The g-values derived for the different earthquake magnitudes at various distances from the project site in relation to the WBF and within a radius of 20.0 kilometers are shown in the Table 3.1-2.

Earthquakes originating from the WBF, say with epicenter about 15 kilometers from the project site and a magnitude of Ms=7.0 will generate a g-value of 0.243437 for the rock. Thus, large earthquakes related to the Philippine Fault will have significant impact at the site. Earthquakes originating from the EZF, say with epicenter about 20 kilometers from the project site and a magnitude of Ms=7.5 will generate a g-value of 0.2139228 for the rock. Thus, distant large earthquakes related to the EZF will generate significant impact on the site. Earthquakes originating from the north segment of the Philippine Fault Zone, say with epicenter about 105 kilometers from the project site and a magnitude of Ms=7.5 will generate a g-value of 0.0446161 for the rock. Thus, earthquakes related to the Philippine Fault Zone will have a low impact on the site.

2.1.2.3 Inducement of subsidence, liquefaction, landslides, mud / debris flow, etc.

Ground acceleration or seismic load is a critical factor in slope or ground stability. Intense ground vibration may trigger mud, debris flow or slope failure particularly in Acoje where the slopes are generally steep to almost vertical.



Figure 2-13: Ground Shaking Hazard Map

# 2.1.2.3.1 Liquefaction

Liquefaction occurs in active seismic areas underlain by thick saturated deposits of thick, saturated deposits of unconsolidated sand and silt. When earthquakes occur and ground shaking occurs, sediments are rearranged and compacted and pore water is forced upwards. This results in the loss of shear strength and behaves like a liquid. This results in settlement of structures into the soil. The mine site however is located in a rock foundation with no threat of liquefaction or strong seismic acceleration.



Figure 2-14: Liquefaction Hazard Map

# 2.1.2.3.2 Slope Failure and Earthquake-Induced Landslide

Slopes fail due to various causes, depending on the angle of slope, the water content, the type of earth material involved, and local environmental conditions. Slope failure may be induced by the following:

- erosion or weathering, land subsidence or faulting which cause the removal of lateral support of the ground;
- rain and water impoundment, or accumulation of talus or debris which cause added weight on slopes;
- earthquakes, thunder, and nearby slope failures which cause vibrations;
- erosion or dissolution which cause decrease of underlying support;
- cutting of slopes (for roads and other structures, or by quarrying)
- shifting of weight of materials (through landfills, stockpiles of rock, waste piles, construction of heavy building and other structures, and water leaking from pipes and reservoirs); and
- slope alterations such as mining, excavation, fluid extraction from the ground.

The slope condition in the proposed mine range from steep to flat, with the steep slopes being confined to three types of sites. These is where slope failures are most likely to occur:

- 1. Areas adjacent to the river channels
- 2. Hillsides with steep natural gradients, and
- 3. Roadsides and other slopes with artificial steep slopes.



Figure 2-15: Earthquake-induced Landslide

# 2.1.3 Pedology

# 2.1.3.1 Soil Erosion/ Loss of Topsoil/ Overburden

The Municipalities of Sta. Cruz and Candelaria in Zambales have different soil types, being soil of the swamp and marshes (Hydrosol), soil of the plains (La Paz series) and soil of upland hills and mountains (Bani series, Alaminos series and miscellaneous soil) (Figure 2-16).

Majority of the project site is underlain by Alaminos Clay. The soil belongs to the lateritic soils or red soils which has strong brown color due to unhydrated oxides of iron present in the soil. Reddish color of the soils varies in shade depending on the amount of moisture, organic matter content and the extent of weathering of the parent material. Within deforested areas, Alaminos clay tends to become lighter in color, varying from orange to reddish brown, becomes columnar, porous and loose silt loam to clay loam. The soil type is sticky when wet but friable when dry. The Alaminos clay is insignificant in terms of agricultural importance, because the relief where the soil type occurs is generally rugged.

# 2.1.3.2 Change in Soil Quality/Fertility

#### 2.1.3.2.1 Soils of the Project Area

As seen in **Table 2-5**, the project site comprises of 2 soil types which include Alaminos clay and Undifferentiated Mountain soil. These soils have limited land capability as pasture or forest and both are characterized as having steep slopes and well drained shallow soil. Alaminos clay covers 86.94% of the existing, while Undifferentiated Mountain Soils only covers 13.06% of the whole MPSA Area. The Proposed expansion comprises of only Alaminos clay at 100% for the whole 81 hectares. **Figure 2-16** shows the distribution of soil type within the MPSA

Soil Type	Area (Ha	Percentage (%)	Dominant
			Features
Existing MPSA			
Alaminos Clay	3,273.73	86.94	Steep, Well-
Undifferentiated Mountian Soil	491.65	13.06	drained shallow
Total	3765.39	100	soil
Proposed Expansion			
Alaminos Clay	81	100	Steep, Well-
Undifferentiated Mountian Soil	-	-	drained shallow
Total	81	100	soil

# Table 2-5: Soil type of the Project area.

The study area is naturally mineralized and thus has higher concentration of some minerals such as the PGA group of minerals and certain heavy metals. **Table 2-6** shows the result of heavy metal analysis of soil samples. The values obtained indicate the presence of concentrations of zinc and copper in most of the sampling stations together with mercury, nickel and chromium.

The study area is naturally mineralized and thus has higher concentration of some minerals such as the PGA group of minerals and certain heavy metals.



Figure 2-16: Soil Map of the MPSA

**Table 2-6** shows the result of heavy metal analysis of soil samples. The values obtained indicate the presence of concentrations of zinc and copper in most of the sampling stations together with mercury, nickel and chromium.

Baramatar	Sampling Stations						
Farameter	S1	S2	S3	S4	<b>S</b> 5	<b>S</b> 6	
Arsenic (mg/kg)	1.77	3.56	2.35	1.78	2.68	4.83	
Cadmium (mg/kg)	6.45	5.90	6.37	6.00	5.95	6.24	
Chromium (%)	1.08	2.91	0.93	1.02	1.82	0.63	
Copper (mg/kg)	124.01	147.42	98.04	74.97	74.70	170.39	
Nickel (%)	0.39	0.41	0.67	0.47	1.18	0.10	
Lead (mg/kg)	6.24	7.87	6.86	9.50	9.42	13.71	
Zinc (mg/kg)	162.20	147.91	197.55	148.18	183.04	90.23	
Mercury (mg/kg)	0.094	0.137	0.079	0.097	0.098	0.119	

# Table 2-6: Heavy metal analysis in Municipalities of Sta. Cruz and Candelaria, Province ofZambales

Table 2-7: Sediment heavy metal analysis,	Cabaluan, Malabon and Lauis Rivers and Dasol Bay,
Municipalities of Sta. Cruz	and Candelaria, Province of Zambales

Stationa	Concentration, mg/kg							
Stations	As	Cd	Cu	Ni	Pb	Hg		
1	112.92	17.44	5548.04	645.45	69.65	0.149		
2	<0.01	1.65	65.03	1352.60	22.75	0.009		
3	< 0.01	1.84	183.37	1637.42	22.12	0.021		
4	<0.01	1.84	50.78	2706.64	24.64	0.019		
5	<0.01	1.65	291.01	1280.61	22.12	0.064		
6	<0.01	1.45	149.42	986.67	17.70	0.028		
7	0.55	2.47	37.08	733.02	<0.10	0.028		
8	0.76	2.23	15.74	2082.06	<0.10	0.035		
9	0.62	1.99	16.31	2048.76	<0.10	0.028		
10	0.28	2.74	60.24	169.95	<0.10	< 0.004		

Of all the stations sampled, the Station 10, located in the main Lauis River and considered a control station has the lowest concentration of Hg. As concentration in the stations sampled in October 2006 have very low concentrations while a similar trend was observed for Pb in the February 2007 sampling. Sediment heavy metals from the old Acoje Port shows the highest metal concentrations except Ni compared with the freshwater samples.

# 2.1.3.2.2 Change in Soil Quality/ Fertility

In general, the soils within the study area are not suited to intensive agricultural purposes due to the very low fertility. Further, utilization of the soils for agriculture is only feasible with the use of fertilizer. However, due to low NPK content, growing of crops is not commercially viable if high levels of fertilizer need to be used. In addition,, the soils also require other micronutrients to maintain fertility and provide nutrients to growing plant. The land in the area is not suitable for intensive agricultural purposes. Table 2-8 shows the result of soil fertility analysis.

Deremeter	Sampling Station						
Farameter	<b>S</b> 1	S2	S3	S4	S5	<b>S</b> 6	
pН	6.2	8.20	6.2	5.6	6.3	5.2	
OM (%)	1.87	0.21	1.91	2.80	2.17	1.10	
N (%)	0.10	0.10	0.11	0.13	0.12	0.08	
P (Bray) ppm	3.30*	3.30*	3.30*	1.70	2.00*	1.70	
K (cmol (+) kg soil)	0.07	0.01	0.05	0.06	0.08	0.19	

#### Table 2-8: Result of soil fertility analysis

Land clearing and earthmoving activities during construction phase of the proposed expansion will remove most of the organic matter content of the topsoil and the overburden materials underneath it. Topsoil and overburden will be stockpiled separately as much as possible. This change will be permanent and mostly irreversible. Topsoil materials from stockpiles if not properly stored will be leached and carried to the water bodies by surface run-off. This impact will be significant and irreversible.

Areas stripped of vegetation cover will be prone to erosion form exposure to wind and rain. Soil erosion however is dependent on climate, topography and soil type. In case the construction/development phase of the proposed expansion area starts during the rainy season, soil erosion is exacerbated in the absence of erosion control measures since finer soil materials are carried easily by surface run off. This impact will be short term, unavoidable, highly significant and irreversible since lost soil will not be recovered.

Leaks and oil spill from heavy equipment, vehicles and maintenance activities may contaminate soil with hydrocarbon substances. These are non-biodegradable substances that are toxic to animals and plants. Percolation to the aquifer may also contaminate ground water resources. Surface runoff may carry hydrocarbon residues to the rivers and eventually contaminate coastal waters. This impact however will be short term avoidable, significant but irreversible.

# 2.1.4 Terrestrial Ecology

2.1.4.1 Flora and Fauna Survey

# 2.1.4.1.1 Survey Plots and Transect Description

Ten sampling plots and two transect lines were established in June 2021 for the terrestrial flora and fauna biodiversity assessment of ZDMC. The geographical coordinates are shown in **Table 2-9**. The plots assessed are composed of open forests, closed forests and shrubland/grasslands. As seen in **Figure 2-17**, established plots and transects lines were focused mainly on the expansion area as well as characteristics within the ZDMC MPSA. **Figure 2-18** on the other hand, shows the land cover map of the project site. The nearest Protected Area, the Malimanga Fish and Bird Sanctuary, is approximately 10 km away from ZDMC MPSA and around 12 km away from the proposed expansion site (**Figure 2-19**).

Flora	Coord	inates	Fauna Transect	Habitat Description
Stations	Ν	Е	Line	
TFL 1	15°39'54.00''N	120° 2'52.80''E	Transect Line 1	Open Forest
TFL 2	15°40'9.33''N	120° 2'50.11"E		Closed Forest

# Table 2-9: Geographical Coordinates of Established Monitoring Plots and Transects.

Flora	Coordinates		Fauna Transect	Habitat Description
Stations	Ν	Ε	Line	
TFL 3	15°40'20.61"N	120° 2'50.57''E		Closed Forest
TFL 4	15°40'34.40"N	120° 2'55.51''E		Open Forest
TFL 5	15°40'33.52''N	120° 3'8.01"E		Shrubland/ Grassland
TFL 6	15°41'8.37''N	120° 3'26.99''E	Transect Line 2	Closed Forest
TFL 7	15°41'16.24"N	120° 3'12.88''E		Closed Forest
TFL 8	15°41'23.40"N	120° 2'59.86''E		Open Forest
TFL 9	15°41'21.21"N	120° 2'53.04''E		Shrubland/ Grassland
TFL 10	15°41'24.73"N	120° 2'45.29''E		Shrubland/ Grassland



Figure 2-17: Terrestrial Flora and Fauna Sampling Stations



Figure 2-18: Land Cover Map



Figure 2-19: Proximity of Project Area to Protected Area.

Transect 1 is located within the proposed expansion area where it starts in an open forest, and then trails into a closed forest, and ends on a shrubland/ grassland area. **Plate 2-1** shows the areas covered for Transect 1.





Plate 2-1: View of Transect 1

Transect 2 on the other hand, trails within the areas of ZDMC MPSA and starts on a closed forest, and ends with a shrubland/grassland area. **Plate 2-2** shows the integrity of the vegetation in the transect line.





Plate 2-2: View of Transect 2

#### 2.1.4.1.2 Terrestrial Flora Assessment

The Stratified Nested-Quadrat Method was used in the assessment of the vegetation on the THPAL site. This method makes use of  $10m \times 10m$  plots to assess the Canopy layer, listing those trees with diameter at breast height of greater than 10 cm. Inside the main plot, subplots were established to assess the iIntermediate and ground layers with dimensions of  $3m \times 3m$  and  $1m \times 1m$ , respectively. For the Intermediate layer, plants with dbh ranging from 6cm to 10cm were listed, and all plant species found in the ground layer within the  $1m \times 1m$  plot were also listed. Those species with less than 5cm diameter were also included in the ground layer.



Figure 2-20: Stratified Nested-Quadrat Method

Transect walk was also employed during the monitoring. This involves establishing a 2-km transect line and a walk through, listing all plant species not found within the nested quadrats. This ensures that majority of the species encountered will be included in the list of plant species.

# 2.1.4.1.3 Terrestrial Fauna Assessment

Mist nets and Cage traps were used to capture faunal specimens for identification and listing. Opportunistic sampling was used in the assessment making use of encounters in the transect line during transect walk. Auditory and visual cues were observed on-site to determine bird species, and look for signs such as tracks, droppings and actual passage of individuals during Transect Walk. This method involves walking through existing trails and pathways, listing the observed faunal assemblages encountered. Other indirect methods involve interviews from locals regarding the presence and absence of faunal species. The faunal assemblages that were monitored include: Birds, Mammals, and Herpetofauna (Reptiles and Amphibians).

#### 2.1.4.1.3.1 Birds

Assessment of birds were conducted early in the morning from 6:00 AM to 8:00 AM and late in the afternoon from 4:00 PM to 6:00 PM. These times are deemed the most active for birds, maximizing the encounters during the survey. Mist-nets were used for catching birds and done for 15 net days. A total of 5 mist-nets were established for all transect lines. These nets are made of fine nylon mesh fitted on thick string frame that divides the net into panels with pockets. Birds are caught and entangled as soon as they hit the nets. Nets were left in the sites for 24 hours to capture nocturnal birds like owls and nightjars, etc. and was checked regularly three or four times during the day for captured birds to minimize stress on the animals.


Plate 2-3: Live Capture of Avifauna using mistnets.

# 2.1.4.1.3.2 Mammals

Volant or flying mammals were also captured in Mist-nets during night-time for a total of 15 net nights. Small non-volant mammals on the other hand were sampled using live traps for 30 trap nights. The traps were baited with roasted coconut, laced with peanut butter to maximize mammalian encounters. The cage traps were randomly set in places where rodents would most likely pass near the established mist-nets. Checking of traps were made once in the morning and once in the afternoon while re-baiting was done every other day.



# Plate 2-4: Roasting of coconut for Baits in Cage Traps for Non-volant Mammalian Fauna

#### 2.1.4.1.3.3 Herpetofauna

Most of the listed species of the herpetofauna (amphibians and reptiles) were observed using the cruising (opportunistic) method in various habitats and microhabitats like leaf litter, fallen logs, exposed rocks and other ground debris. Sampling was carried out from late morning to early afternoon (9AM-2PM) and evening (6-8 PM) for amphibians and nocturnal reptiles

# 2.1.4.1.3.4 Processing and Identification of the Vertebrate Fauna

Live captured animals were processed for identification and photo-documentation. Taxonomic keys and published references were used in the identification of specimens. Large animals were recorded through direct observations or from information gathered through key informants. Unidentified species were documented through the preparation of voucher specimens. Distribution status was based on published references while conservation status was based on IUCN (2021).

#### 2.1.4.1.4 Biodiversity Indices

Reference used for interpretations and statistical analysis was the Ecosystems Diversity and Its Measurements by Magurran (1988). Level of significance was set at  $\alpha$  = 0.05. The checklist of species for flora and fauna in the terrestrial ecosystems was updated and enhanced. Information held therein contained the taxonomic family name, scientific name, common name, conservation status and geographical distribution.

Using the Paleontological Statistics (PaST v. 3.20) software, a software capable of generating several statistical analyses, biodiversity indices were generated by inputs of number of plots and abundance values.

Biodiversity Indices were used to determine the diversity and distribution of species found in the area. The indices used in the monitoring are as follows:

**Shannon-Weiner Index (H')** is a measure of the average degree of "uncertainty" in predicting to what species an individual chosen at random from a collection of S species and N individuals will belong (Magurran 1988).

$$\mathsf{H}' = \sum_{i=1}^{S} \left[ \left( \frac{n_i}{N} \right) \ln \left( \frac{n_i}{N} \right) \right]$$

**Pielou's Evenness Index (J')** expresses H' relative to the maximum value that H' can obtain when all of the species in the sample are perfectly even with one individual per species (Magurran 1988).

$$J' = \frac{H'}{\ln(S)}$$

The computed values are then compared to the Fernando Biodiversity Scale (1998) shown in Table 2-10

Relative Values	Shannon (H') Index	Pielou (J') Evenness Index
Very High	3.5 and above	0.75-1.00
High	3.0-3.49	0.50-0.74
Moderate	2.5-2.99	0.25-0.49
Low	2.0-2.49	0.15-0.24
Very Low	1.9 and below	0.05-0.14

Table 2-10: The Fernando Biodiversity Scale

# 2.1.4.1.5 Terrestrial Flora Biodiversity

#### 2.1.4.1.5.1 Biodiversity Parameters

*Shorea polysperma* (Tanguile) dominates the area and ranks 1<sup>st</sup> in terms of abundance, at 31 individuals, and then followed by *Syzygium nitidum* (Makaasim) at 24 individuals throughout the assessment. These species are mainly used for construction purposes and for furniture making. Next in rank is the *Dinochloa luconiae* (Bikal babui) which greatly dominated the understorey of the forest formations in the site. These are mainly used for basket making, and its roots are used for decoction for drinks. Other lesser ranked species are shown in **Figure 2-21**.



Figure 2-21: Abundance of Flora Species in the ZDMC site.

In terms of species richness, TFL 2 exhibited the highest number of species within a plot at 20 species. IT is then followed by plots TFL 5 and TFL 6 with 18 species each. TFL 5 is a mixture of trees, shrubs and grasses, while TFL 6 is mostly composed of several trees and undergrowth species, typical of closed forest ecosystems. The lowest number of species was found in TFL 10 with only 11 species typical of disturbed areas with less trees and shrubs. **Figure 2-22** shows the species richness of flora species in the assessed plots of THPAL.



Figure 2-22: Species Richness of Flora Species in the Assessed Plots of ZDMC.

# 2.1.4.1.5.2 Importance Value

Tanguile (*Shorea polysperma*) mostly influences the forest ecosystem in the area and ranks 1<sup>st</sup> in terms of Importance value. Second in rank is Makaasim (*Syzygium nitidum*) and then followed by Sasalit (*Teijsmaniodendron ahernianum*) which grow into large trees as indicated by the Relative dominance (RD), and contributes to 5 to 20% of the total basal area of trees assessed in the areas. Other flora species dominant are Bikal babui (*Dinochloa luconiae*), Lomboy (*Syzygium jambos*), and pangnan-bundok (*Lithocarpus philippinensis*). Other lesser ranked species are shown in Table 2-11.

FAMILY	SCIENTIFIC NAME	COMMON NAME	Abund	RA	Freq	RF	Dom	RD	IV
Dipterocarpaceae	Shorea polysperma	Tanguile	31	10.54	0.7	4.67	5.8E-04	35.99	17.07
Myrtaceae	Syzygium nitidum	Makaasim	24	8.16	0.7	4.67	3.3E-04	20.04	10.96
	Teijsmanniodendron								
Lamiaceae	ahernianum	Sasalit	12	4.08	0.6	4.00	9.2E-05	5.67	4.58
Poaceae	Dinochloa luconiae	Bikal babui	23	7.82	0.7	4.67	0.0E+00	0.00	4.16
Myrtaceae	Syzygium jambos	Lomboy/ Tampui	13	4.42	0.3	2.00	7.0E-05	4.31	3.58
	Lithocarpus								
Fagaceae	philippinensis	Pangnan-bundok	7	2.38	0.3	2.00	9.7E-05	5.95	3.44
Lauraceae	Litsea cordata	Malaabokado	9	3.06	0.3	2.00	5.2E-05	3.18	2.75
	Melastoma								
Melastomataceae	malabathricum	Malatungau	11	3.74	0.6	4.00	0.0E+00	0.00	2.58
	Pandanus								
Pandanaceae	luzonensis	Alas-as	10	3.40	0.6	4.00	0.0E+00	0.00	2.47
	Elaeocarpus								
Elaeocarpaceae	argenteus	Zambales hunggo	8	2.72	0.5	3.33	1.7E-05	1.07	2.37

#### 2.1.4.1.5.3 Flora Diversity and Evenness

Overall, the area has a Very High diversity value at H' = 3.631. In terms of per plot basis, plots exhibited diversity values ranging from a Low H' = 2.303 in TFL 9, up to a moderately diverse H' = 2.86 in TFL 2. The mixture of different ecosystems increase the diversity value of the whole area. The assessed plots exhibit the following trend from highest diversity to lowest diversity: TFL 2 > TFL 5 > TFL 4 > TFL 6 > TFL 1 > TFL 3 > TFL 7 > TFL 10 > TFL 8 > TFL 9. **Figure 2-23** shows the diversity values per plot in the assessed areas.



Figure 2-23: Diversity of Flora Species in the Assessed Plots in ZDMC

In terms of Evenness, Overall evenness is very high at J' = 0.88. TFL 7 exhibited the highest evenness value at a Very High J' = 0.97, since flora species have even distribution within the area. The lowest is seen in TFL 6 at J' = 0.88, due to the dominance of Lomboy (*Syzygium jambos*). All plots exhibited Very High evenness values according to the Fernando Biodiversity Scale. The Evenness of species per plot is presented in **Figure 2-24**.



Figure 2-24: Evenness of Flora Species in the Area.

Family Name	Scientific Name	Common Name
Anacardiaceae	Mangifera altissima	Pahutan
Anacardiaceae	Swintonia acuta	Apitong babui/ Lomarau
Apocynaceae	Alstonia macrophylla	Batino
Apocynaceae	Voacanga globosa	Bayag-usa
Araucariaceae	Agathis philippinensis	Almaciga
Cannabaceae	Celtis philippensis	Malaikmo
Cannabaceae	Trema orientalis	Anabiong
Chrysobalanaceae	Maranthes corymbosa	Liusin
Clusiaceae	Garcinia ituman	Ituman
Combretaceae	Terminalia nitens	Sakat
Dipterocarpaceae	Shorea astylosa	Yakal
Dipterocarpaceae	Shorea polysperma	Tanguile
Elaeocarpaceae	Elaeocarpus argenteus	Zambales hunggo
Euphorbiaceae	Macaranga cumingii	Anitap
Euphorbiaceae	Macaranga sp.	
Fagaceae	Lithocarpus philippinensis	Pangnan-bundok
Fagaceae	Lithocarpus sp.	Ulaian
Gleicheniaceae	Dicranopteris linearis	Kilob
Lamiaceae	Teijsmanniodendron ahernianum	Sasalit
Lauraceae	Actinodaphne intermedia	-
Lauraceae	Actinodaphne multiflora	Puso-puso
Lauraceae	Cinnamomum sp.	
Lauraceae	Litsea cordata	Malaabokado
Marattiaceae	Angiopteris evecta	Salaguisog
Melastomataceae	Melastoma malabathricum	Malatungau
Meliaceae	Aglaia pachyphylla	Tukang- kalau
Moraceae	Artocarpus heterophyllus	Nangka
Moraceae	Artocarpus ovatus	Anubing
Moraceae	Ficus nota	Tibig
Moraceae	Ficus septica	Hauili
Moraceae	Ficus ulmifolia	ls-is
Myristicaceae	Myristica philippensis	Duguan
Myrtaceae	Syzygium jambos	Lomboy/ Tampui
Myrtaceae	Syzygium nitidum	Makaasim
Myrtaceae	Syzygium philippinense	Bagohian
Pandanaceae	Pandanus luzonensis	Alas-as
Pentaphyllacaceae	Ternstroemia philippinensis	Arana
Phyllanthaceae	Antidesma ghaesembilla	Binayuyu
Phyllanthaceae	Glochidion merrillii	Pudpud
Phyllanthaceae	Glochidion sp.	-
Poaceae	Dinochloa luconiae	Bikal babui
Poaceae	Melinis repens	Galamas grass

# Table 2-12: Checklist of Flora Species

Poaceae	Schizostachyum lumampao	Buho
Rosaceae	Rubus luzoniensis	-
Rubiaceae	Ixora philippinensis	-
Rubiaceae	Mussaenda benguetensis	Mussaenda
Rubiaceae	Mussaenda multibracteata	Mussaenda
Rubiaceae	Mussaenda sp.	Mussaenda
Rubiaceae	Wendlandia luzoniensis	Daram
Sapindaceae	Dimocarpus cinereus	Alupag
Sapotaceae	Madhuca betis	Betis
Sapotaceae	Palaquium luzoniense	Nato/Red nato
Sapotaceae	Palaquium philippense	Malakmalak
Sapotaceae	Planchonella villamilii	White Nato
Unknown	Unknown	Yoson (Local name)
Unknown	Unknown tree1	-
Unknown	Unknown tree2	-
Violaceae	Rinorea bengalensis	Tuak
Violaceae	Rinorea niccolifera	Rinorea

### 2.1.4.1.6 Terrestrial Fauna Biodiversity

#### 2.1.4.1.6.1 Birds

#### 2.1.4.1.6.1.1 <u>Abundance</u>

In total, birds exhibited a total of 173 individuals for the assessment. Majority of the individuals were observed with Mountain Leaf-Warbler (*Phylloscopus trivigatus*). These birds usually fly singly, in pairs or in groups. Next in rank is the Citrine Flycatcher (*Culicicapa helianthea*) which mainly feeds on insects. It is usually seen alone or in mixed flocks. Next in rank are the common Olive-backed Sundbir (*Cinnyris jugularis*), and the Cream-bellied fruit dove (*Ramphiculus merrily*). Abundance of birds are shown in **Figure 2-25**.





#### 2.1.4.1.6.1.2 Species Richness

Out of the 2 transect lines established, a total of 43 bird species were identified on the assessed sites. The highest number of species was observed in Transect 1 located in the proposed expansion area with 32 species listed. Transect 2 on the other hand exhibited 27 species in total. **Figure 2-26** shows the species richness of birds in all transects.



Figure 2-26: Species Richness and Families of Birds in All Transect Lines.

# 2.1.4.1.6.1.3 Diversity and Evenness Indices

Overall, diversity and evenness values for birds exhibited a Very High value at H' = 3.484 in Transect 2 with evenness of 0.93. This indicates that the areas assessed have very high diversity, with its numbers very highly similar to each other. **Figure 2-27 and Figure 2-28** shows the diversity and evenness of Birds in the assessed Transects, respectively.



### Figure 2-27: Diversity Indices in all Transects Assessed



Figure 2-28: Evenness values of birds in the assessed transects.

#### 2.1.4.1.6.2 Mammals

A total of 5 mammalian species within 4 families were listed in the assessed areas. Out of the 25 individuals listed, the highest number of individuals listed was seen in the volant mammal *Cynopterus* brachyotis with 11 individuals. It is then followed by *Ptenochirus jagori*. There were no rodents captured during the survey. However, fecal signs were observed on-site for *Paradoxurs hermaphroditus*. **Table 2-13** shows the list of mammals found on the sites monitored.

Family	Scientific Name	Common Name		Abundance
Pteropodidae	Cynopterus brachyotis	Short-nosed Fruit Bat		11
Pteropodidae	Ptenochirus jagori	Musky Fruit Bat		10
		Common Long-tailed		
Cercopithecidae	Macaca fascicularis	Macaque		1
Suidae	Sus philippensis	Philippine Warty Pig		1
	Paradoxurus			
Viverridae	hermaphroditus	Philippine Palm Civet		2
		Т	otal	25

Table 2-13: Mammals observed in the Monitoring S
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#### 2.1.4.1.6.3 Herps

A total of 4 species of herps were found in the monitored areas, 1 species is an amphibian, and 3 species are reptiles. The highest number of individuals was seen under *Limnonectes macrocephalus* at 3 individuals. **Table 2-14** shows the list of herps found in the monitored sites.

Family	Scientific Name	Common Name	Abundance
Gekkonidae	Gekko gecko	Tokay Gecko	1
	Limnonectes		
Dicroglossidae	macrocephalus	Luzon Fanged Frog	3
Pythonidae	Malayopython reticulatus	Reticulated Python	1
Varanidae	Varanus sp.	Monitor Lizard	1
			6

#### Table 2-14: Herps found in the Monitored sites

#### 2.1.4.1.7 Distribution and Endemicity

#### 2.1.4.1.7.1 Flora Distribution

In total, there were 50 species identified on-site. Fifty percent were found to be indigenous to the site and 6% were found to be exotic. Around 44% of the species found were endemic species. Figure 2-29 shows the distribution of species found in the monitored sites.

Distribution	# of Species	Percent Distribution
Indigenous	25	50
Exotic	3	6
Endemic	22	44
Total	50	100



# Figure 2-29: Geographic Distribution of Flora Species Found in the Monitoring Sites

A total of 22 species were listed as endemic and include Pahutan (*Mangifera altissima*), Bayag-usa (*Voacanga globose*), Ituman (*Garcinia ituman*), Yakal (*Shorea astylosa*), Tanguile (*Shorea polysperma*), and Pangnan-bundok (*Lithocarpus philippinensis*) to name a few. Other species are listed in Table 2-15. These species are the recommended species for forest restoration and rehabilitation since these species are originally found in the area.

#### Table 2-15: List of Endemic Flora Species

Family Name	Common Name	Scientific Name
Anacardiaceae	Pahutan	Mangifera altissima
Apocynaceae	Bayag-usa	Voacanga globosa
Clusiaceae	Ituman	Garcinia ituman
Dipterocarpaceae	Yakal	Shorea astylosa
Dipterocarpaceae	Tanguile	Shorea polysperma
		Lithocarpus
Fagaceae	Pangnan-bundok	philippinensis
		Actinodaphne
Lauraceae	-	intermedia
		Actinodaphne
Lauraceae	Puso-puso	multiflora
Moraceae	Anubing	Artocarpus ovatus
Moraceae	ls-is	Ficus ulmifolia
		Myristica
Myristicaceae	Duguan	philippensis
		Syzygium
Myrtaceae	Bagohian	philippinense
		Pandanus
Pandanaceae	Alas-as	luzonensis
		Ternstroemia
Pentaphyllacaceae	Arana	philippinensis
Phyllanthaceae	Pudpud	Glochidion merrillii
		Schizostachyum
Poaceae	Buho	lumampao
Rosaceae	-	Rubus luzoniensis
		Mussaenda
Rubiaceae	Mussaenda	benguetensis
		Mussaenda
Rubiaceae	Mussaenda	multibracteata
		Palaquium
Sapotaceae	Malakmalak	philippense
		Planchonella
Sapotaceae	White Nato	villamilii
Violaceae	Rinorea	Rinorea niccolifera

#### 2.1.4.1.7.2 Faunal Distribution

Out of the total 51 faunal species classified, 57% are residents. Endemic species on the other hand constitute to about 41% of all the species found on-site. Migrants are only 2% of the whole population. The distribution of all groups are shown in **Figure 2-30** while the list of endemic fauna species are shown in **Table 2-16**. which include 18 birds, 2 mammals and 1 amphibian.

Distribution	# of Species	Percent Distribution
Endemic	21	41
Migrant	1	2
Resident	29	57
Total	51	100.00



#### Figure 2-30: Geographic Distribution of Fauna Groups presently observed in the Monitored Areas

Group	FAMILY	SCIENTIFIC NAME	COMMON NAME
Birds	Apodidae	Aerodramus mearnsi	Philippine Swiftlet
Birds	Apodidae	Collocalia troglodytes	Pygmy swiftlet
Birds	Bucerotidae	Penelopides manillae	Tarictic Hornbill
Birds	Columbidae	Phapitreron amethystinus	Amethyst Brown-dove
Birds	Columbidae	Phapitreron leucotis	White-eared Brown Dove
Birds	Columbidae	Ptilinopus occipitalis	Yellow Breasted Fruit-Dove
Birds	Columbidae	Ramphiculus merrilli	Cream-bellied Fruit Dove
Birds	Cuculidae	Centropus viridis	Philippine Coucal
Birds	Dicruridae	Dicrurus balicassius	Balicassiao
Birds	Falconidae	Microhierax erythrogenys	Philippine Falconet
Birds	Pachycephalidae	Pachycephala albiventris	Green-backed Whistler
Birds	Paridae	Parus elegans	Elegant Tit
Birds	Pycnonotidae	Hypsipetes philippinus	Philippine Bulbul
Birds	Rhipiduridae	Rhipidura cyaniceps	Blue-headed Fantail
Birds	Rhipiduridae	Rhipidura javanica	Pied Fantail
Birds	Strigidae	Otus longicornis	Luzon Scops-Owl
Birds	Sturnidae	Sarcops calvus	Coleto
Birds	Trogonidae	Harpactes ardens	Philippine Trogon
Herps	Dicroglossidae	Limnonectes macrocephalus	Luzon Fanged Frog
Mammal	Pteropodidae	Ptenochirus jagori	Musky Fruit Bat
Mammal	Suidae	Sus philippensis	Philippine Warty Pig

#### **Table 2-16: List of Endemic Fauna Species**

# 2.1.4.1.8 Conservation Status

In total, 19 flora species and 11 fauna species were identified as globally and locally threatened. Based on IUCN 2021-1, 11 species are classified as Vulnerable, 1 is endangered which is the Yakal (*Shorea astylosa*). However in DAO 2017-11, the species is classified as Critically Endangered. These species are generally threatened by over-extraction and habitat loss through land-conversion. For terrestrial fauna, the Amethyst brown Dove is considered as Critically Endangered by DAO 2019-09. Other threatened species of flora and fauna are shown in **Table 2-17**.

Group	Family Name	Scientific Name	Common Name	IUCN, 2021-1	DAO 2017-11/ DAO 2004-15
Flora	Anacardiaceae	Mangifera altissima	Pahutan	Data Deficient	Vulnerable
Flora	Anacardiaceae	Swintonia acuta	Apitong babui/ Lomarau	Least Concern	Vulnerable
Flora	Araucariaceae	Agathis philippinensis	Almaciga	Vulnerable	Vulnerable
Flora	Combretaceae	Terminalia nitens	Sakat	Vulnerable	Not Listed
Flora	Dipterocarpaceae	Shorea astylosa	Yakal	Endangered	Critically Endangered
Flora	Dipterocarpaceae	Shorea polysperma	Tanguile	Least Concern	Vulnerable
Flora	Fabaceae	Adenanthera intermedia	Tanglin	Vulnerable	Other threatened Species
Flora	Fabaceae	Pterocarpus indicus	Prickly Narra	Vulnerable	Vulnerable
Flora	Marattiaceae	Angiopteris evecta	Salaguisog	Not Assessed	Other Threatened Species
Flora	Meliaceae	Aglaia pachyphylla	Tukang- kalau	Near Threatened	Not Listed
Flora	Moraceae	Ficus ulmifolia	ls-is	Vulnerable	Not Listed
Flora	Myristicaceae	Myristica philippensis	Duguan	Least Concern	Other Threatened Species
Flora	Myrtaceae	Syzygium nitidum	Makaasim	Least Concern	Vulnerable
Flora	Sapindaceae	Dimocarpus cinereus	Alupag	Near Threatened	Not Listed
Flora	Sapotaceae	Madhuca betis	Betis	Vulnerable	Endangered
Flora	Sapotaceae	Palaquium luzoniense	Nato/Red nato	Vulnerable	Vulnerable
Flora	Sapotaceae	Palaquium philippense	Malakmalak	Vulnerable	Vulnerable
Flora	Sapotaceae	Planchonella villamilii	White Nato	Vulnerable	Vulnerable
Flora	Violaceae	Rinorea niccolifera	Rinorea	Not Assessed	Endangered
Birds	Bucerotidae	Penelopides manillae	Tarictic Hornbill	Least Concern	Vulnerable
Birds	Bucerotidae	Penelopides manillae	Tarictic Hornbill	Least Concern	Vulnerable
Birds	Columbidae	Phapitreron amethystinus	Amethyst Brown-dove	Least Concern	Critically Endangered
Birds	Columbidae	Ramphiculus merrilli	Cream-bellied Fruit Dove	Near Threatened	Vulnerable
Birds	Strigidae	Otus longicornis	Luzon Scops- Owl	Near Threatened	Vulnerable
Herps	Dicroglossidae	Limnonectes macrocephalus	Luzon Fanged Frog	Near Threatened	Other Threatened Species
Herps	Gekkonidae	Gekko gecko	Tokay Gecko	Least Concern	Other Threatened

#### Table 2-17: List of Threatened Flora and Fauna Species observed in the Monitored Sites.

Group	Family Name	Scientific Name	Common Name	IUCN, 2021-1	DAO 2017-11/ DAO 2004-15	
Horps	Bythonidae	Malayopython	Reticulated	Loast Concorn	Other Threatened	
пегря	Fythomuae	reticulatus	Python		Species	
Mammal	Corconithogidaa	thecidae Macaca fascicularis	Common Long-	Vulnorablo	Not Listed	
Warnina	Cercopitriecidae		tailed Macaque	vumerable		
Mammal	Suidae	Sus philippensis	Philippine	Vulnorablo	Vulnerable	
			Warty Pig	vuillerable		

# 2.1.4.2 Vegetation Removal and Habitat Loss

During vegetation clearing, vegetated land areas will be subjected to removal of plants. This change in land cover will entail habitat loss both for terrestrial flora and fauna. As such, it is essential that clearing be done in areas specified in the development plan. Unnecessary clearing of vegetation will mitigate habitat loss and possible displacement of terrestrial fauna. Also, necessary permits from DENR should be secured before removal of trees. If trees are to be cut, designated areas for reforestation should be conducted following the 1 tree to be cut : 100 seedlings to be planted policy. Trees recommended for reforestation are threatened indigenous and/or endemic trees such as Yakal (Shorea astylosa), Tanglin (*Adenanthera intermedia*), Prickly Narra (*Pterocarpus indicus*) and Is-is (*Ficus ulmifolia*). This will ensure that displaced populations of terrestrial fauna will return to the site and decrease competition for territories and resources.

#### 2.1.4.3 Threat to existence and/or loss of important local species

Activities such as vegetation clearing and tree cutting poses a threat to the existence of important local species. Food sources will become unavailable for fauna species, leading to mortalities. To minimize the effects of this threat, reforestation of neighboring degraded lands should be conducted. This ensures that populations will still be present even if removal of vegetation will be done. Mother trees should be identified for easy access to planting materials and seasonal flowering, seeding and germination should be recorded so as to determine the proper timing for gathering planting materials for each species.

The removal of vegetation cover in the expansion areas will also result in changes with the community structure. Vegetative areas will be converted to mining areas. Species diversity, dominance, frequency will be changed from the loss of cover. This will be further affected by loss of mature trees that could be a source for seeds and regenerants which promotes natural succession. This impact will be long term, unavoidable, and significant. **Figure 2-31** shows the location of Flora and Fauna Stations in relation to the Project Site.



# Figure 2-31: Location of Sampling Stations in relation to Project Site

2.1.4.4 Threat to Abundance, Frequency and Distribution of Important Species

Endangered species identified is the Yakal (Shorea astylosa). The species is threatened by resource extraction and habitat degradation. As such, this species is recommended as choice species for revegetation of bare and disturbed areas. Other species found to be Vulnerable, as cited by IUCN are

the Tanglin (*Adenanthera intermedia*), Prickly Narra (*Pterocarpus indicus*) and Is-is (*Ficus ulmifolia*). These are the species found in the Project site which may be affected by the expansion. As such, the policy of 1 tree to be cut: 100 seedlings to be planted should be followed accordingly in the clearing for the construction phase.

# 2.1.4.5 Hindrance to Wildlife Access

The lands of the proposed expansion will be affected and would entail the removal of trees. Fauna species will be displaced from the forest with birds being able to migrate to areas with more suitable living conditions. Mammals and herps on the other hand shall become displaced near the remaining vegetation cover. There will be competition for food and territory where affected animals will have to compete with each other for food, resources and territory.

To minimize food competition of non-volant fauna, such as mammals and herps, enrichment planting with the surrounding forest cover to increase the food supply. Indigenous fruiting trees may be planted. Other fruit trees that may be used are Manga (*Mangifera indica*) and Atis (*Annona squamosa*).

# 2.2 The Water

# 2.2.1 Hydrology/Hydrogeology

# 2.2.1.1 Catchment Area

The project area is drained by three river systems namely, the Cabaluan River system, Baling Buaya - Uacon River system, and the North Lauis River system (**Figure 2-32**). All three rivers flow westward into Dasol Bay and West Philippine Sea.

As described in the 2007 EIS (GAIA South, Inc.), the headwaters and tributaries of the rivers draining the project area display a dendritic pattern. Narrow channels, rocky streambeds and steep gradients, usually around 30 degrees characterize the tributaries in the area. The stream profiles are less steep at the base of the mountain range. In the lowlands, the rivers exhibit wide floodplains and braided stream patterns particularly near the coastline.

The northern portion of the project area (23% of total project area) drained by Cabaluan River, the southeastern portion (53% of total project area) by North Lauis Catchment, and the southwestern (24% of total project area) by Baling Buaya – Uacon River. In terms of catchment areas, the project area comprises 6% of Cabaluan Catchment (drainage area (DA) = 14,680.6 ha), 10% of North Lauis Catchment (DA = 21,112.9 ha), and 8% of Baling Buaya – Uacon Catchment (DA = 12,283.5 ha). As of October 2020, about 4 % (148 ha) of the total project area is disturbed comprised of active mine areas, mined-out areas, infrastructure and environmental control areas. The direction if water runoff within the Project Area is illustrated in **Figure 2-33**.

The proposed 81-ha additional project area is located within Baling Buaya – Uacon and North Lauis catchment.



Figure 2-32: Mine Catchment Area



Figure 2-33: Direction of Water Runoff within the ZDMC Project Area

# 2.2.1.2 Hydrogeologic Units<sup>1</sup>

The regional hydrogeologic map in **Figure 2-34**, the region may be divided into two hydrogeologic units. These are: 1) areas underlain by ultramafic rocks with little or no groundwater and; 2) areas underlain by sedimentary rocks and thin alluvial deposit with local, disconnected aquifers.

# 2.2.1.2.1 Ultramafic Rocks

The zone where the project area is located is underlain by ultramafic rocks of the Zambales Ophiolite. These rocks are dense and generally permeable. When fractured and weathered, they become slightly permeable, having hydraulic conductivities ranging from 10<sup>-3</sup> to 10<sup>-1</sup> m/d (Brassington, 1988). Although shallow unconfined aquifers may form in the weathered and fractured zones, ultramafic rocks are generally without exploitable water. The absence of water wells in the Study site and in most areas underlain by the ultramafic rocks substantiates this.

#### 2.2.1.2.2 Sedimentary Rocks and Thin Alluvial Deposits

Sedimentary rocks consisting of tuffaceous sandstone and shale, conglomerate and limestone of the Zambales Formation underlie the lowlands to the west of the Zambales Mountain Range. Thin alluvial deposits drape these rocks along the floodplains and coastline. The confined and unconfined aquifers that develop in these areas are generally of limited extent and thickness due to the occurrence of clayey deposits. Available well records in a publication of the former National Water Resources Council (now National Water Resources Board) show that wells in the area rarely extend beyond 50 meters depth and attain specific capacities of up to 2.6 L/s per meter of drawdown in the more permeable zones (NWRC, 1982).

<sup>&</sup>lt;sup>1</sup> Discussion lifted from Sta. Cruz – Candelaria Mining Project EIS (GAIA South, Inc., 2007)



Source: Sta. Cruz – Candelaria Mining Project EIS (GAIA South, Inc., 2007)

Figure 2-34: Regional Hydrogeologic Map

# 2.2.1.3 Water Source and Water Use

From year 2015 -2018, water use consists of domestic waste water, wash water for equipment and wash water for floors with average annual water use of 68,084.45 m<sup>3</sup> per year. Majority of water use is attributed to wash water for equipment at 58,427.38 m<sup>3</sup>/ year and then followed by domestic waste water use at 7,831.53 m<sup>3</sup>/ year. Water used for floors was the least at 1,825.55 m<sup>3</sup>/year. From 2019-2020, there were no reported water use. **Table 2-18** shows the summary of water use in the project areas.

	2015	2016	2017	2018	2019	2020	Average
Water Use	(m <sup>3</sup> /year)						
Domestic waste water	11,689.13	7,300.00	7,300.00	5 <i>,</i> 037.00	0	0	7,831.53
Wash water,							
equipment	109.50	87,600.00	87,600.00	58,400.00	0	0	58,427.38
Washwater, floor	2.19	2,920.00	2,920.00	1,460.00	0	0	1,825.55
Total	11,800.82	97,820.00	97,820.00	64,897.00	0	0	68,084.45

#### Table 2-18: Summary of water use in the Project Areas

According to ZDMC's 2020 First Quarter 3-year Development/Utilization Work Program Status Report, 2020-2022, the project has no water requirements for its nickel mining operation. Water for domestic consumption is sourced from within the mining tenement and outside of the area or from deep well, pumps and springs.

ZDMC has been granted two water permits by the National Water Resources Board (NWRB), one for Cabaluan River and one for a spring located inside the project area. Summary record of groundwater/surface water withdrawal submitted to NWRB on a quarterly basis from 2014 to 2020 is presented in **Figure 2-35**. No water withdrawal was recorded for Cabaluan River for the entire monitoring period. From July 2016 to 2020, no water was withdrawn from both water sources. Locations of these water sources are shown in **Figure 2-36**.



Figure 2-35: Record of Groundwater/Surface Water Withdrawal



Figure 2-36: Location of Water Sources with NWRB Water Permits

# 2.2.1.4 Impacts and Mitigation Measure – Hydrology/Hydrogeology

# 2.2.1.4.1 Change in Drainage Morphology

Nickel laterite ores are being mined using surface mining methods which inevitably modify the drainage patterns in the area. The change in drainage morphology may cause inundation of low-lying areas and erosion of newly excavated areas if there are no control measures in place to manage surface runoff. Thus, part of the mine development of ZDMC is the construction of drainage system, structures for erosion and sediment control such as ditches/canals, silt traps and settling ponds. Waste dumps and topsoil stockpiling areas are also strategically located to prevent erosion. Immediate rehabilitation of backfilled mined out areas is also being implemented.

The same mitigation measures shall be implemented for the proposed expansion area.

#### 2.2.1.4.2 Inducement of Flooding

The project area is located in an area that is not susceptible to flooding. However, the increase in surface run off that may contribute to flooding downstream is an unavoidable impact.

This can be mitigated by a good storm water management system to route the excess water safely through the catchment without scouring the open areas, slopes, and banks.

All active mining areas of ZDMC have an extensive network of environmental structures such as canals, silt traps, settling ponds, geotextile covers, gabions, and cocomatting to divert surface runoff away from the active mine areas and disturbed areas and to collect silted runoff from the disturbed areas. In addition to the engineering measures mentioned, ZDMC also conducts progressive rehabilitation through immediate reforestation of mined out areas and buffer zones. Revegetation and reforestation of mined out areas lessens surface runoff through increased infiltration rates and slows down runoff velocities. Silt traps and settling ponds installed in series also decrease runoff velocities and mitigates flashfloods downstream or sudden increase in streamflow.

The proposed expansion area shall adopt the existing mitigation measures being implemented at the existing mining sites for erosion and flooding.

# 2.2.1.4.3 Competition in Water Use

The proposed expansion will not entail an increase in water demand and is not expected to cause water resource competition. The current mine operations' water demand is very minimal and is limited to domestic water use. Water from settling ponds is also being reused for dust suppression.

# 2.2.1.4.4 Climate Change Projections

The projected seasonal temperature increase and seasonal rainfall change in 2020 (2006-2035) and 2050 (2036-2065) under medium-range emission scenario for the Province of Zambales are presented in **Figure 2-37** and **Figure 2-38**. Projected seasonal temperature increases in 2020 (2006-2035) range from 0.9 °C in JJA to 1.1 °C in MAM. In 2050, projected temperature increase is higher from 1.7 °C in JJA to 2.1 °C in DJF and MAM. The projected increase in temperature will put pressure on the availability of water in the project area. This could make rehabilitation efforts more challenging since higher temperature means higher evapotranspiration rates for plants/vegetation.

Zambales Province climate is classified under the Type I based on the Modified Coronas Climate Classification. It is characterized by two pronounced seasons, dry from November to April and wet during the rest of the year. As depicted in the **Figure 2-38**, dry season months DJF and MAM are projected to change by +32.2 % and -4.5 % in 2020 and -2.2 % and -21.6 % in rainfall in 2050, respectively. Wet season months JJA and SON are projected to change by +13.3 % increase and -1.6 % in 2020 and +31.5 % and +5.6 % change in rainfall in 2050, respectively. In general, dry season is projected to be drier and wet season is projected to be wetter. With this, there is a possibility of water shortage during the dry months in the future in terms of low streamflow and drying of springs. On the other hand, risk of flooding, erosion, and other associated hazards due to increased rainfall would be higher for the wet season.

ZDMC shall continue to implement and improve its existing progressive rehabilitation strategy which involves planting of grasses interspersed with fast-growing native and non-native species, culminating in the planting of forest and fruit trees. The company shall continue the implementation of all environmental structures and periodic de-silting and slope stabilization of multi-stage settling ponds in its active mine areas.

Additional medium for erosion control, drainage and filtration applications like Geotextile filter fabric, Coco-matting and Gabion are integrated with the environmental structures to stabilize its soil structure and to augment prevention of sedimentation into the hydrological system. ZDMC has an existing 52 settling ponds, 15 oversize siltation ponds and 82 silt traps.



Figure 2-37: Climate Change Projections (2020 & 2050) - Seasonal Temperature Increase in Zambales Province



Figure 2-38: Climate Change Projections (2020 & 2050) – Seasonal Rainfall Change

# 2.2.2 Water Quality

### 2.2.2.1 Environmental Structures for Water Quality

Settling ponds, silt traps, and drainage canals are ZDMC's existing environmental structures to reduce total suspended solids (TSS) and mitigate sedimentation in creeks and rivers that receive mine-derived sediment. Additional medium for erosion control, drainage and filtration applications like Geotextile filter fabric, Coco-matting and Gabion are integrated with the environmental structures to stabilize its soil structure and to augment prevention of sedimentation into the hydrological system. ZDMC has an existing 52 settling ponds (**Table 2-19**), 15 oversize siltation ponds and 82 silt traps.

Maps of ZDMC's environmental structures are shown in Figure 2-39 to Figure 2-42.

SP Code	Location	Land Area	Capacity	Water Body
		(m <sup>2</sup> )	(m <sup>3</sup> )	
	MALIMLIM AREA			
SP-01	A 1	1,617	8,085	Lawis River
SP-02	A 1	1,224	6,120	Lawis River
SP-03	A 2.1	1,062	5,310	Lawis River
SP-04	A 2	1,174	5,870	Lawis River
SP-05	A 3	1,617	8,085	Lawis River
SP-06	A 4	2,039	8,156	Lawis River
SP-07	A 4	4,040	20,200	Lawis River
SP-08	AREA 4B	1,000	5,000	Lawis River
SP-09	AREA 4B	805	3,220	Lawis River
SP-10	LOWER A 077	852	3,408	Lawis River
SP-11	LOWER A 077	2,624	10,496	Lawis River
SP-12	LOWER A 077	865	4,323	Lawis River
SP-13	A 077	1,038	5,190	Lawis River
SP-14	A 2	1,469	7,345	Lawis River
SP-15	A 2	676	2,000	Lawis River
SP-16	A 2.1	1,737	15,633	Lawis River
SP-17	UPPER A 2.1	2,240	13,437	Uacon River
SP-18	UPPER A 2.1	2,010	12,061	Uacon River
SP-19	UPPER A 2.1	3,877	23,265	Uacon River
SP-20	UPPER A 2.1	993	5,957	Uacon River
SP-21	UPPER A 2.1	1,309	7,852	Uacon River
SP-22	UPPER A 2.1	2,212	17,700	Uacon River
SP-23	GAP	901	2,703	Lawis River
SP-24	AREA 4B	900	4,500	Lawis River
SP-25	GAP	1,000	5,000	Lawis River
SP-26	A 3	770	3,850	Lawis River
SP-27	GAP	3,098	13,864	Uacon River
SP-28	A 77	993	5,957	Lawis River
SP-29	GAP	993	5,957	Lawis River
SP-30	GAP	3,000	15,000	Lawis River
SP-31	GAP	772	2,316	Lawis River
SP-32	AREA 4B	1,500	7,500	Lawis River

Table 2-19: ZDMC Settling Pond Location, Area and Capacity

SP Code	Location	Land Area	Capacity (m <sup>3</sup> )	Water Body
SP-33	GOPHER	1,148	5,740	Lawis River
SP-34	GOPHER	4,350	21,750	Lawis River
SP-35	GOPHER	3,282	16,410	Lawis River
SP-36	AREA 4B	390	1,950	Lawis River
	H3 AREA			
SP-37	H3 Old (previously SP-01)	7,595	37,975	Cardones Creek
SP-38	H3 Old (previously SP-02)	1,646	8,230	Cardones Creek
SP-39	H3 Old (previously SP-03)	4,572	22,860	Lawis River
SP-40	H3 North (previously SP-04)	10,000	70,000	Lawis River
SP-41	H3 North (previously SP-05)	909	1,928	Lawis River
SP-42	H3 North (previously SP-06)	812	1,467	Lawis River
SP-43	H3 North (previously SP-07)	6,275	106,675	Lawis River
SP-44	H3 North (previously SP-08)	2,196	10,980	Lawis River
SP-45	H3 Old (previously SP-09)	1,586	7,930	Lawis River
SP-46	H3 Old (previously SP-10)	650	3,250	Cardones Creek
SP-47	H3 Old (previously SP-11)	2,370	11,850	Cardones Creek
SP-48	H3 Old (previously SP-12)	2,816	14,080	Cardones Creek
SP-49	H3 North	730	2,026	
	AIRSTRIP AREA			
SP-50	Airstrip / ERF (previously SP-	5,106	10,212	Lawis River
	01)			
SP-51	Airstrip / ERF (previously SP-	3,422	6,843	Lawis River
	02)			
SP-52	Airstrip / ERF (previously SP-	794	1,588	Lawis River
	03)			



Figure 2-39: ZDMC Environmental Structures and Rehabilitation Status as of September 2017





Figure 2-40: Malimlim Environmental Stuctures as of February 2019



Figure 2-41: H3 Environmental Structures as of May 2019



Figure 2-42: Airstrip Environmental Structures

# 2.2.2.2 Effluent Quality Monitoring

Settling ponds and silt traps of the project are interconnected and are arranged in series (multi-stage) as shown in the previous maps. **Figure 2-43** presents a simplified flow diagram of ZDMC's drainage system. ZDMC previously monitors five (5) settling ponds for monitoring of effluent water quality (**Figure 2-44**). In 2020, ZDMC started monitoring three (3) more settling ponds totaling to eight (8) effluent quality monitoring stations at present.

As mentioned in the Hydrology Section, the project area is drained by three rivers namely Cabaluan River, Balin Buwaya-Uacon River and Lawis River. Lawis River has been classified by the DENR as Class B in 1977<sup>2</sup>. Cabaluan River and Balin Buwaya-Uacon River is not yet classified by DENR. Results of water quality monitoring in these two rivers were compared to Class C General Effluent Standards based on their existing beneficial use which is mainly for agriculture and irrigation. Cabaluan River Watershed is listed as one of the priority watersheds of the National Irrigation Administration (NIA) in 2013 primarily because of the Bayto River Irrigation System (RIS).

Station ID		Receiving Water Body	Geographic Coordinates	
EFWQ1	H3 North Old SP8	Cabaluan River tributary	15°43'10.58"N 120° 3'28.51"E	
EFWQ2	Gopher SP35	Lawis River	15°40'41.34"N 120° 3'29.08"E	
EFWQ3	Malimlim SP22	Balin-Buwaya River	15°41'24.75"N 120° 2'44.46"E	
EFWQ4	H3 North SP7	Cabaluan River tributary	15°43'20.14"N 120° 3'4.34"E	
EFWQ5	Malimlim Area Grace	Balin-Buwaya River	15°40'37.04"N 120° 2'25.89"E	
EFWQ6	Malimlim SP7	Lawis River tributary	15°40'43.23"N 120° 3'8.22"E	
EFWQ7	Malimlim SP2	Lawis River tributary	15°41'9.91"N 120° 2'56.46"E	
EFWQ8	Malimlim SP8	Lawis River tributary	15°40'30.28"N 120° 3'15.79"E	

Table 2-20: ZDMC Effluent Monitoring Stations

As per DAO 2016-08, significant effluent quality parameters for Nickel ore mining are pH, total suspended solids (TSS), manganese (Mn), arsenic (As), cadmium (Cd), lead (Pb) and nickel (Ni). For chromite ore mining, significant effluent quality parameters are pH, TSS, nitrate, chromium, arsenic, cadmium and lead.

Trend graphs of effluent monitoring from 2014 to 2020 are shown in **Figure 2-45** to **Figure 2-53**.

Effluent pH data in all stations were compliant with DAO 35 & DAO 2016-08 effluent standards with values ranging from 6.8 to 8.6. Exceedances were observed in the effluent for the parameter total suspended solids (TSS) in stations EFWQ1 (3Q 2014 TSS = 71 mg/l > 70 mg/l DAO Class C general effluent standard (GES)), EFWQ3 (4Q 2020 TSS = 293 mg/l > 100 mg/l DAO 2016 Class C GES) and EFWQ7 (3Q 2020 TSS = 145 mg/l and 4Q 2020 TSS = 249 mg/l, both exceedibg the 85 mg/l DAO 2016 Class B GES (Lawis River)). Oil and grease effluent data were all below the GES (5 mg/l) with concentrations ranging from below method detection limit (MDL) to 2 mg/l.

Traces of manganese (Mn) below the GES (Mn = 2 mg/l) were found in stations EFWQ1 (4Q 2019 Mn = 0.028 mg/l), EFWQ2 (4Q 2019 Mn = 0.442 mg/l) and EFWQ3 (3Q 2018 Mn = 0.122 mg/l). All effluent data for parameters arsenic (As), cadmium (Cd) and lead (Pb) were below their respective method detection limits (MDL). About 93% of monitoring data for nickel (Ni) were below MDL. Traces of Ni ranging from 0.04 mg/l to 0.14 mg/l were found in effluent samples from Station EFWQ3. Hexavalent Chromium

<sup>&</sup>lt;sup>2</sup> EMB DENR. (n.d.). *WATER BODIES IN THE PHILIPPINES: Classification according to beneficial use*. Retrieved April 11, 2021, from Region 3, List of Waterbodies: http://water.emb.gov.ph/?page\_id=757

found in effluent samples ranged from below MDL to 0.5 mg/l. Four (4) out of nine Cr <sup>6+</sup> effluent data of Station EFWQ1 exceeded the GES.



Figure 2-43: Simplified Settling Ponds Flow Diagram


Figure 2-44: Effluent Water Quality Sampling Stations of ZDMC



Figure 2-45: Trend chart of pH monitoring data of effluent from settling ponds



Figure 2-46: Trend chart of total suspended solids (TSS) monitoring data of effluent from settling ponds



Figure 2-47: Trend chart of oil & grease (O&G) monitoring data of effluent from settling ponds



Figure 2-48: Trend chart of manganese (Mn) monitoring data of effluent from settling ponds



Figure 2-49: Trend chart of arsenic (As) monitoring data of effluent from settling ponds



Figure 2-50: Trend chart of cadmium (Cd) monitoring data of effluent from settling ponds



Figure 2-51: Trend chart of lead (Pb) monitoring data of effluent from settling ponds



Figure 2-52: Trend chart of nickel (Ni) monitoring data of effluent from settling ponds



Figure 2-53: Trend chart of hexavalent chromium (Cr(VI)) monitoring data of effluent from settling ponds

#### 2.2.2.3 Ambient Water Quality Monitoring

ZDMC currently has 20 monitoring stations for ambient water quality described in **Table 2-21** and **Figure 2-54**.

Paremeters tested for ambient water quality are dissolved oxygen (DO), pH, TSS, 5-day BOD, oil & grease, fecal coliform, temperature, color, phosphate, nitrate, and metals arsenic, cadmium, lead, hexavalent chromium, nickel, manganese. Water quality monitoring is conducted quarterly. Trend charts are shown in **Figure 2-55** to **Figure 2-59**.

DO values were above the minimum guideline value except in station FWQ18 Kinabuang Kabayo station in 1Q 2018 with DO level at 2.36 mg/l. Exceedance in WQG for pH was observed in station FWQ17 Area 1250 in 2Q 2016 with pH = 9.3. The rest of pH monitoring values were within the WQG. TSS values were within WQG values with highest recorded value at 34 mg/l observed in station FWQ10 Mouth of Cabatuan River in 4Q 2020. BOD monitoring BOD monitoring data were within WQG with 76% of monitoring data below MDL. Traces of Ni within WQG were observed in stations FWQ9 Cabatuan NIA Irrigation (Ni = 0.03 mg/l), FWQ10 Mouth of Cabatuan River (Ni = 0.03 mg/l) and FWQ13 Downstream Lauis River (Ni = 0.04 mg/l). Monitoring data for parameters O&G, As, Cd, Pb, and Mn were all below MDL.

Station ID	Location/Description	Geographic	Coordinates		
ZDMC-FWQ1	Cabaluan River	N 15° 43′ 52.8″	E 120° 02′ 01.6″		
ZDMC-FWQ2	Cabaluan River Tributary	N 15° 43′ 33.0″	E 120° 01' 56.3"		
ZDMC-FWQ3	Downstream Cabaluan River	N 15°43′35.4″	E 120° 01' 50.4"		
ZDMC-FWQ4	Libed River upstream	N 15°41′51.8″	E 120° 04' 27.3"		
ZDMC-FWQ5	Libed River downstream	N 15°41′32.0″	E 120° 04' 35.1"		
ZDMC-FWQ6	Confluence of 2 creeks Acoje	N 15°41′59.6″	E 120° 04' 00.5"		
ZDMC-FWQ7	Confluence of 2 creeks Acoje	N 15°39′37.3″	E 120° 03' 30.4"		
ZDMC-FWQ8	Upper Libed River	N 15°42′37.5″	E 120° 04' 32.4"		
ZDMC-FWQ9	Cabatuan NIA Irrigation	N 15°42′53.8″	E 120° 58' 03.3"		
ZDMC-FWQ10	Mouth of Cabatuan River	N 15°42′14.7″	E 119° 53′ 22.2″		
ZDMC-FWQ11	Lauis River	N 15°35′56.3″	E 119° 54' 35.1"		
ZDMC-FWQ13	Downstream Lauis River	N 15°36′13.8″	E 120° 01' 09.8"		
ZDMC-FWQ14	Malabon river upstream	N 15°38′27.1″	E 119° 57' 01.5"		
ZDMC-FWQ15	Balin-buwaya creek	N 15°40′22.8″	E 120° 05' 04.2"		
ZDMC-FWQ16	Upper main Lauis River	N 15°40′22.6″	E 120° 05' 02.2"		
ZDMC-FWQ17	Area 1250				
ZDMC-FWQ18	Kinabuang kabayo				
ZDMC-FWQ19	Rim Project				
ZDMC-FWQ19	Cabaluan River				
Marine Water					
Quality					
ZDMC-MWQ1	Old Acoje Port	N 15°45′1.4″	E 119° 53′ 30.9″		

Table 2-21: Ambient water quality monitoring stations of ZDMC



Figure 2-54: Ambient Water Quality Monitoring Map



Figure 2-55: Trend chart of DO monitoring data of ZDMC freshwater stations



Figure 2-56: Trend chart of pH monitoring data of ZDMC freshwater stations



Figure 2-57: Trend chart of TSS monitoring data of ZDMC freshwater stations



Figure 2-58: Trend chart of BOD5 monitoring data of ZDMC freshwater stations



Figure 2-59: Trend chart of Nickel monitoring data of ZDMC freshwater stations

#### 2.2.2.4 Impacts and Mitigation Measure – Water Quality

Surface water quality will continue to be degraded due to anthropogenic activities outside the MPSA such as kaingin farming and small scale mining. This contributes to the sediment load of surface water resources. Farmlands are still being affected by siltation of lateritic materials.

Water quality will remain to be affected by the natural geological materials such as contamination of Cr6+ of some of the surface water resources. It was observed in the past that low level heavy metal contamination is attributed to chromite sorting for the surface water resources and natural contamination. With the continued small-scale mining activities, Cr6+ contamination will persist.

The company shall continue the implementation of all environmental structures and periodic desilting and slope stabilization of multi-stage settling ponds within the project area. Provision of environmental structures and mitigating measures are undertaken to prevent and minimize the impacts. Environmental structures are strategically situated primarily on the disturbed areas, waste dump areas and where there is great volume of runoff water loaded with suspended solids.

Environmental structure put forth by ZDMC to reduce TSS and sedimentation in creeks and rivers that receive mine-derived sediment are Settling Ponds, Silt Traps and Drainage Canals.

Additional medium for erosion control, drainage and filtration applications like Geotextile filter fabric, Coco-matting and Gabion are integrated with the environmental structures to stabilize its soil structure and to augment prevention of sedimentation into the hydrological system. ZDMC has an existing 52 settling ponds, 15 oversize siltation ponds and 82 silt traps.

ZDMC shall implement these mitigation measures in the proposed expansion area. Additional sampling stations shall be identified as new areas are opened and new settling ponds are constructed.



Plate 2-5: Environmental structures at H3 Old Area showing the locations of settling ponds (18 June 2019)



Plate 2-6: Overview of Environmental Structures at H3 North Area (18 June 2019)

## 2.2.3 Freshwater Ecology

This section discusses the results of the freshwater ecology survey conducted for the proposed project to provide information on general conditions of the freshwater environment and determine how the proposed project would affect the general use and ecology of the rivers. The survey includes aquatic communities assessment, such as phytoplankton, zooplankton, macrobenthos, and fish. This study is an essential component as it serves as an essential basis for the effective management and evaluation of impacts on freshwater ecosystems.

A total of four stations were established along the perimeter of the ZDMC MPSA. However, two (2) of the four stations were Intermittent rivers, only having water flow during rainfall events. The freshwater ecology along the alignment of the proposed project was assessed by collecting biological samples on two sampling sites (**Table 2-22**). Stations are presented in **Figure 2-60** and **Figure 2-61** 

Sampling	Description	Coordinates			
Point					
	Lebbed Creek in Sitio Acoje, Barangay	15º41'22 64''NI	100º 1'29 10"E		
FVVE I	Locapon South, Sta. Cruz; Perennial	15 41 52.04 IN	120 4 30.19 E		
EWE 2	Old SP8 H3. Sitio Acoje, Barangay	15942'10 64"NI	120° 3'28.60''E		
FVVE Z	Locapon South, Sta. Cruz; Perrenial	13 43 10.04 IN			
	Nagiliran Creek (Upstream);				
FEW 3	Intermittent/ No flowing water on time	15°41'33.62''N	120° 2'7.81''E		
	of Sampling				
	Nagiliran Creek (Downstream);				
FEW 4	Intermittent/ No Flowing Water on time	15°40'35.37''N	120° 2'2.06"E		
	of sampling				

#### Table 2-22: Freshwater ecology sample sampling sites inside the proposed expansion area.



Figure 2-60: Freshwater Ecology Stations in Google Map.



Figure 2-61: Freshwater Ecology Sampling Stations

## 2.2.3.1 Phytoplankton

The term "plankton" refers to those microscopic aquatic forms having little or no resistance to currents and living free-floating and suspended in natural waters. Planktonic plants, phytoplankton, and planktonic animals, zooplankton, are covered in this report. The phytoplankton (microscopic algae) occurs in unicellular, colonial, or filamentous forms. Plankton, particularly phytoplankton, have long been used as indicators of water quality. Some species flourish in highly eutrophic waters, while others are susceptible to organic and chemical wastes. Some species develop toxic blooms, sometimes creating offensive tastes and odors or anoxic or toxic conditions resulting in animal deaths or human illness. The species assemblage of phytoplankton and zooplankton also may help assess water quality. Because of their short life cycles, plankters respond quickly to environmental changes, and hence their standing crop and species composition are more likely to indicate the quality of the water mass in which they are found.

Generally, phytoplankters are used as bioindicators because they are more reactive to environmental changes than other organisms. The use of microalgae as bioindicators was pioneered by Patrick (1954) and has concentrated mainly on benthic organisms since the rapid transit of phytoplankton with water flow means that these algae have little time to adapt to environmental changes at any point in the river system. Furthermore, they are better than fishes and macroinvertebrates as bioindicators in their presence before and after environmental changes. The state of the phytoplankton community is resultant of the nutrient load of the water. Their abundance and diversity reflected water quality and were used to derive assessment protocols. These features make them the best bioindicators in aquatic ecosystems (Pourafrasyabi & Ramezanpour, 2014). Additionally, they are used because they are

straightforward, quantitatively describe water quality, are applicable in a wide area, and provide background conditions and natural variability (Onyema & Popoola, 2013).

For this study, plankton samples were collected on xxx. Three replicate samples of zooplankton and phytoplankton were obtained by passing 100 mL of water through a plankton net, with a mesh size of 64  $\mu$  and a mouth diameter of 0.3 m. The collected samples were placed in properly labeled 1 L plastic bottles, immediately fixed in alcohol, and brought to the laboratory for processing and further analysis. Plankton enumeration was done using a counting chamber observed under a compound microscope and identified to the lowest possible taxa using taxonomic keys of van Vuuren et al. (2005), Segers (2007), and Bellinger and Sigee (2010).

According to Bellinger and Sigee (2010), the phytoplankton biomass in rivers is typically lower than standing waters since the transport of suspended algae by water current (potentially short residence time) limits the development of established populations. The phytoplankton community of rivers is also dominated by a smaller number of taxa compared to lakes, with fast-growing algae such as centric diatoms being significant. In shallow rivers, light penetration to the sediments means that sampling of benthic algae may also be critical in assessing the total algal population. Their entry of phytoplankton into rivers can occur from standing waters or stream inlets, and assessment of river phytoplankton dynamics needs to take into account both irregularities of entry and displacement by the current.

A total of eight phytoplankton taxa representing four divisions were recorded in Table 2. Bacillariophyta was the most abundant division with 49.6% of the total count, followed by Cyanophyta (38.1%). Chlorophyta and Dinoflagellata have 16.7% and 6.3% relative abundances, respectively (**Figure 2-62**). The results were relatively similar to the data collected in 2007.



Figure 2-62: The comparison of phytoplankton density on the two sampling sites based on phyla.

The Bacillariophyta or diatoms have been a beneficial contemporary biomonitoring aspect of river water quality because of their predictable tolerances to environmental variables, widespread occurrence within lotic systems, ease of counting, and species diversity detailed. These advantages allow a detailed evaluation of environmental parameters. Among the observed species, *Navicula* sp. is one of the most tolerant diatom species. However, some Navicula species are less tolerant of nutrient pollution. Other less tolerant species observed were *Gomphonema* sp. and *Fragilaria* sp.

## Table 2-23: Phytoplankton composition and abundance in the two sampling stations along the alignment of the proposed project's site.

	Si	te		Relative		
Таха	FWE1 (cells/L)	FWE2 (cells/L)	Mean	Mean Density (%)		
Bacillariophyta	30	15	22.5	28.1%		
Navicula sp.	14	7	10.5	13.1%		
Gomphonema sp.	5	3	4	5.0%		
<i>Flagillaria</i> sp.	8	5	6.5	8.1%		
Arthospira sp.	3	0	1.5	1.9%		
Cyanophyta	7	6	6.5	8.1%		
Oscillatoria sp.	7	6	6.5	8.1%		
Dinoflagellata	2	4	3	3.8%		
Ceratium sp.	2	4	3	3.8%		
Chlorophyta	14	2	8	10.0%		
Cosmarium sp.	5	2	3.5	4.4%		
Spyrogyra sp.	9	0	4.5	5.6%		
Mean Density	53	27		80		
Number of Taxa	8	6				

As seen in **Figure 2-62** and **Table 2-23**, FWE2 has a lower number of taxa. This result is possibly related to its hydrology being an intermittent river or river section. Flow intermittence is a selective force on algal community composition, usually resulting in the decrease of alpha diversity. For example, diatom communities in IRES have fewer species and a lower proportion of specialist taxa than perennial streams (Tornés and Ruhí, 2013). A long drying phase can eliminate most sensitive species and reduce diversity because few species can resist drying, and few pioneer species can recolonize when flow resumes.

Based on the species observed, phytoplankton is not the dominant community of the stream ecosystem. Despite this, they perform a particular ecological function like photosynthesis and nitrogen fixation, which contributes to the productivity of the streams in a limited manner. However, the constant water movement continually carries them downstream and inhibits their reproduction.

## 2.2.3.2 Zooplankton

Zooplankters are microscopic organisms that are also crucial in aquatic food webs. As primary consumers, they respond strongly to environmental changes. Certain species are susceptible to changes in nutrient cycling, temperature, pH, and variable environmental conditions. Due to their unique responses to certain environmental dynamics, zooplankters are effective bioindicators; thus, they are widely used to measure the impact of disturbance in aquatic ecosystems.

Zooplankton is one of the most important biotic components influencing an aquatic ecosystem's functional aspects, such as food chains, food webs, energy flow, and cycling of matter (Pal & Chakraborty, 2015). Zooplankton inhabiting freshwater responds quickly to environmental changes, and hence their species indices fluctuate (Gholap, 2014). Zooplankters are initially the sole prey item for almost all fish larvae as they use up their yolk sacs and switch to external feeding for nutrition. Fish species rely on the density and distribution of zooplankton to coincide with first-feeding larvae for good survival of larvae, which can otherwise starve. Natural factors (e.g., variations in currents) and anthropogenic factors (e.g., dams on rivers) can strongly affect zooplankton density and distribution, which can strongly affect the larval survival and breeding success, and stock strength of fish species.

**Table 2-24** shows the two sampling stations' zooplankton composition and has only one taxon, Rotifera. The absence of large numbers of zooplankton in the sample indicates energy relations because phytoplankters are the primary producers in an aquatic environment driving other organisms' energy flow and productivity, the low population of phytoplankton limits available energy sources for secondary producers zooplankters, which also limits their probability of being included in the sample.

	Si			
Таха	FWE1 (cells/L)	FWE2 (cells/L)	Relative Mean Density (%)	
Rotifera	18	4	100	
Brachionus sp.	18	4	100	

# Table 2-24: The zooplankton composition of the two sampling stations along the alignment of theproposed project's site.

Rotifers or wheel animalcules are usually found in many freshwater environments and in moist soil, where they inhabit the thin films of water formed around soil particles. In this survey, Rotifera was generally observed attributable to their high fecundity, parthenogenic reproduction, and high growth rates (Melo & Medeiros, 2013). Rotifers play an essential role in connecting the microbial loop to the classic food web, whereby the dissolved organic carbon is taken up by the bacteria consumed by the rotifers, which are consumed by higher trophic levels. Ecologically, these dominant groups serve as important links in marine food webs, serving as major grazers of phytoplankton, as components of the microbial loop, and prey for ichthyoplankton and other larger pelagic carnivores (Turner, 2004).

#### 2.2.3.3 Benthic Macroinvertebrates

Benthic macroinvertebrates, similar to plankton, are useful biological indicators of changes in the aquatic systems. The main advantages of using macroinvertebrates are their relatively short life span of up to two years, sedentary characteristics, varying sensitivities to water quality changes, and easy collection and identification. Benthic fauna (also known as "benthos") are small animals living among stones, logs, sediments, and aquatic plants on the bottom of streams, rivers, and lakes. They are large enough to see with the naked eye (macro) and have no backbone (invertebrate). These organisms contribute immensely to the functioning of the aquatic ecosystem. Communities of macrobenthos provide many ecosystem services that help to maintain good water and sediment quality. Filter feeders remove particles from the water column, which may result in enhanced water clarity. Given the importance of light in shallow aquatic ecosystems, filter-feeding may improve shallow water habitat for submerged aquatic plants and benthic microalgae. Accordingly, the changes in benthic species composition and abundances could aid as an alarm system and even allow the quantification of environmental alterations (Hutchinson & Edmondson, 1993).

For macroinvertebrates, rocks and debris were disturbed and washed to dislodge clinging organisms. The dislodged samples and the rocks were placed in secured polyethylene plastic, preserved with ethyl alcohol, and identified using a microscope (Motoh, 1980; Wolfe et al., 2019). The identified species are cross-checked with the IUCN Red List to determine their conservation status and distribution.

## Table 2-25: The macroinvertebrates composition of the two sampling stations along the alignment of the proposed project's site.

	Site		
Taxa	FWE1	FWE2	
	(indi/m <sup>2</sup> )	(indi/m <sup>2</sup> )	

Crustacean	94	0
Malacostraca		
Decapoda		
F. Gecarcinuridae	3	0
F. Caredia	85	0
F. Penaeidae	6	0
Chelirecata	0	6
Arachnida		
Araneae		
F. Pisauridae	0	2
F. Lycosidae	0	2
Lycosidae egg	0	2
Hexapoda	2	1
Insecta		
Diptera		
F. Tipulidae	0	1
Hemiptera		
F. Aphelocheiridae	1	0
Ephemeroptera		
F. Heptageniida	1	0

As shown in **Table 2-25**, Phylum Arthropoda dominates the macroinvertebrate species on both sites, with representatives from Crustacea, Chelicerata, and Hexapoda. In FWE1, most samples collected are under Caredia (94 individuals/m<sup>2</sup>), followed by Penaeidae (6 indi/m<sup>2</sup>), and Gecarcinuridae (3 indi/m<sup>2</sup>). Members of Ephemenoptera and Hemiptera were observed as well. Compared to FWE1, FWE2 is dominated by Arachnids, and an individual under Tipulidae was observed too.

Examination of the trophic position of crustacean groups indicates that most crustaceans have relatively generalized feeding habits, and most are subject to intense predation. Their abundance, moderate size, and generalized carnivory likely exert top-down control in some communities. In addition, as evidenced by almost universal morphological and behavioral adaptations against predation and their importance in the diets of many different predators, the availability of crustaceans as prey for other trophic levels is probably essential for the structure, function, and diversity of many aquatic communities. They are a vital food web link between primary producers (algae and aquatic weeds) and higher trophic levels. Crustaceans obtain food as detritivores, herbivores, omnivores, and carnivores, and they range in size from minute zooplankton only 0.1 mm long up to giant crayfish at 400 mm (Thorp & Rogers, 2011).

As for Heptageniid mayflies, various species have been used as indicators of anthropogenic disturbance because they are relatively intolerant of pollution change and sensitive indicators of organic pollution and metal pollution. Furthermore, individuals of this family were test subjects of toxicity and drift behavior studies (Boonsoong & Braasch, 2013).



Plate 2-7: Gecarcinuridae



Plate 2-8: Pisauridae



Plate 2-9: Tipulidae





Plate 2-11: Lycosidae egg



Plate 2-12: Heptageniidae



Plate 2-13: Aphelocheiridae



Plate 2-14: Caredia

#### 2.2.3.4 Fish

Fish samples were collected through electric fishing. Each site was fished for 30 minutes, and all collected species were taken to the laboratory for identification (Herre, 1953; Conlu, 1986; Vidthayanon, 2007) and were validated using the fishbase.de. The identified species are cross-checked with the IUCN Red List to determine their conservation status and distribution.

Fishes are the major vertebrate group within freshwater ecosystems. Therefore, it follows that appropriate environmental management and understanding of a catchment require that fish fauna within that ecosystem be well understood before any undertaking, be it conservation or development, occurs.

Table 2-26: The ichthyofauna composition of the two sampling stations along the alignment of the
proposed project's site.

Така	Site			
Taxa	FWE1	FWE2		
Gobiidae	16	0		

Based on Table 5, limited fish species were observed to be present in the surface water as members of Gobiidae are the only ones collected. According to Islam (2004), gobies have a widespread distribution and are present in the clear to turbid streams with rock, gravel, or sand bottoms. The juvenile gobies mostly feed on crustaceans, while adult gobies prefer other smaller fishes.



Plate 2-15: Gobiidae

#### 2.2.3.5 Loss of Important species and habitat

Preconstruction activities would entail clear-cutting of hardwood timber and other development in the watershed and can impact biotic macroinvertebrates and fish communities in the study area. Cutting bottomland hardwoods eliminates leaves and woody debris, which are an important primary food source. Loss of canopy cover allows solar radiation to raise the water temperature, especially in summer. Erosion and siltation resulting from the cutting of trees can also have detrimental effects on water quality. These effects can be mitigated if the vegetative cover is maintained, most especially along

and proximal to embankments of water systems in the area. In addition, appropriate drainage designs should be constructed to decrease rates of erosion.

Construction activities, such as earthmoving and vegetation removal within the development area, will proportionately increase runoff. Most of the water will be directed to the downstream zones and outfall areas adjacent to the river mouth. Sediment runoff will have a potential impact on river organisms and flora and may be a potential source of threat to the existence of locally important species.

Potential contamination of the water bodies may arise during construction activities. Maintenance of heavy equipment/vehicles generates oil and oily wastewater, which can cause leaks at the project site. Accidental but substantial oil spills from the used oil storage facility could cause a thin film of oil on the water surface. This film could inhibit gaseous exchange between lifeforms in the water and the atmosphere.

In addition, oil ingestion may also have short and long-term effects on certain freshwater species of fish and benthic macrofauna. Oil can clog gills and suffocate fish, and oil-coated phytoplankton and macrophytes may not be able to obtain energy from the sun for photosynthesis. Oil can kill plankton/ larva. Some oil can be consumed by plankton and larva and can be transferred through the food chain to kill juvenile fish. The presence of oils in the river water could create adverse effects on alga, microproducers, and freshwater benthic fauna, depending on the extent, frequency, and duration of contamination. Thus, to minimize these impacts (if not preventable), used oil to be generated from the heavy equipment or vehicles will be collected and stored in drums. Furthermore, the project shall be equipped with oil-water separators to remove oil from effluents before discharge to the water bodies. Another impact during the construction phase is the potential increase in turbidity of water bodies due to unmanaged spoils or earthworks that can harm the freshwater fauna. The contractor will be required to comply with the Civil Works Guidelines to ensure proper management of spoils and will prevent or minimize sedimentation and water pollution around the construction site. In addition, sediment or settling ponds construction and related structures would mitigate massive siltation or sedimentation of the water bodies. In the sampling areas, no macroinvertebrates or fish species of any significant value were identified in the study carried out to date. The scarcity of sampled organisms (zooplankton and benthic fauna) could be due to the swift flow of water current, making it challenging to conduct benthic sampling and the water quality of the rivers and creeks sampled. In addition, FWE2 is an intermittent river, limiting the probability of observing significant species.

The project site and its immediate surroundings do not currently support diverse or abundant aquatic ecological values, with very limited significant macroinvertebrate or fish species identified in studies conducted. Studies worldwide show an overwhelmingly negative response of invertebrate communities to low pH, with taxa such as mayflies, crustaceans, and mollusks (Suren & McKerchar, 2001). Activities that may cause potential environmental impacts on freshwater ecology during construction include site preparation (e.g., clearing and grading), facility construction, and vehicular and pedestrian traffic. Impacts would be similar but more extensive than those addressed for the exploration and drilling phase. However, many of these impacts would be reduced by implementing good industry practices and restoring disturbed areas once construction activities have been completed.

Most impacts to ecological resources (aquatic biota) would be low and localized during the construction phase. Activities such as site clearing and grading, road construction, and vehicle traffic can affect ecological resources by disturbing habitat, increasing erosion and runoff, and creating noise at the project site.

Phytoplankton and zooplankton would be generally subjected to short-term impacts during the construction. Threats to the plankton community would come from the increased load of suspended solids during the project's construction, resulting in reducing the depth of photosynthetic activity of the phytoplankton. Similarly, highly turbid waters would affect the grazing success of zooplankton.

This would temporarily result in lower rates of photosynthesis and primary production. However, plankton population recovery after construction would be rapid due to quick reproduction periods, including recruitment and advection from the adjacent unaffected area. However, generally, studies have not significantly impacted the levels experienced from activities, such as dredging and related activities (Clarke et al., 2000). In addition, many larval stages are only in the plankton for short periods, and other groups have short life cycles, which means recovery can be relatively quick depending on the time of year and source of larvae. Given the temporary and limited extent of the effect of highly turbid waters relative to the overall area, the impact on the plankton community is predicted to be low in the long term.

With the increase in water elevation, some of these organisms may perish since light penetration would decrease their photosynthetic capacity. Plankton can also be negatively affected by the material overflow released during construction activities—the overflow material released during construction increase the turbidity of the freshwater ecosystem. The increased load of suspended solids would reduce light penetration, reducing the depth of photosynthetic activity by the phytoplankton. Some studies show that high sediment loads reduce the grazing success of zooplankton. However, these adverse effects are generally short-term. Therefore, it is recommended to prevent or minimize obstruction of sediments and debris during the construction into the river that could promote stagnation of water flow, potentially resulting in algal blooms.

In sum, activities such as earthmoving and removal of vegetation within the development area will proportionately increase runoff. Most of the water will be directed to the downstream zones and outfall areas adjacent to the river mouth. Sediment runoff will potentially impact river organisms and flora and may be a potential source of threat to locally essential species. However, this may be adequately mitigated by the measures identified.

On the other hand, minimal impacts are expected in terms of potential loss of freshwater habitats since the project will be located in upland areas. However, and to ensure that this is the case, regular monitoring of freshwater quality should form part of the overall project monitoring program.

In its many forms, pollution profoundly affects the ecosystem because it influences the physiological and habits of fauna species like breeding and foraging or hunting habits. Air and water pollution affect the flora in both negative and positive effects. Increased carbon exhausts from motorized vehicles and equipment may affect air quality for humans but may be trapped or sequestered by an adequately stocked forest canopy. Heavy metals that may leach on aquifers can affect those consuming water, be it man flora or fauna. However, studies indicate that some plants can assimilate heavy metals into their system without detrimental effects on their physiology.

#### 2.2.3.6 Threat to Abundance, Frequency and Distribution of Species

The minerals or heavy metals are natural components of the environment, and their presence affects life forms. The mineral elements are essential for the proper functioning of body processes. Some mineral elements are classified as macroelements because they are required in large quantities, whereas mineral elements required in minimal quantities are called micronutrients. Some elements, however, have no known physiological function yet and are considered hazardous to health.

The classification of these elements as macro and micronutrients stresses the amount of mineral intake, indicating that a minimum amount is required for growth and development and that low levels in the diet may cause deficiencies, whereas excess intake may just be excreted. However, a thin borderline separates the dose that may cause a deficiency for some of the elements or may cause toxicity. It is such elements, when available in excess that causes concern.

In general, nickel (Ni) and other heavy metals are considered essential in humans, presenting health problems whenever deficient. For most of these elements, evidence has shown the occurrence of nutritional problems in humans with abnormally low or high dietary intakes. In addition, Ni is moderately toxic to freshwater organisms, with acute LC50 values ranging from 510  $\mu$ g/L for a cladoceran to 43,000  $\mu$ g/L for fish at low hardness.

The interactions of trace elements with phytoplankton are governed by a complex mixture of physical, chemical, and biological constraints. Many elements are extremely particle reactive and sorb readily to both living (phytoplankton) and non-living (sediment) particles. Phytoplankters are efficient scavengers of trace elements, accumulating high concentrations from the surrounding medium with concentration factors ranging from 103 to 106 (Sanders & Riedel, 1998). Both active and passive mechanisms can be involved in trace element sorption; the relative importance of different sorption pathways varies with the element of interest.

For phytoplankton, the community structure (community composition and plankton group abundances) will be affected by Ni concentration. In the study conducted by Nys et al. (2019), a decrease in *Oscillatoria* sp. abundance is seen in communities with Ni, and this will create the opportunity for diatoms, especially the single-cell diatoms, to dominate the area. In addition, Ni affects three chemical parameters ( $O_2$ , pH, and dissolved organic carbon (DOC)), wherein all of these parameters significantly decreased during Ni exposure. The change in  $O_2$  and pH possibly caused the decreased in *Oscillatoria* sp. production, while the decrease in DOC generated lower input of DOC to the microbial loop, causing a decreased phytoplankton abundance. Senescent algae are an important carbon source for the microbial loop, and especially at the end of algae blooms, high levels of carbon are released (Brönmark & Hansson, 2005). In addition, five species of freshwater green algae showed significantly decreased growth at 100 µg Ni/L at pH 7.2. Reduced growth was noted in several freshwater algae at concentrations as low as 50 µg/L. In general, blue-green algae were more tolerant to Ni at pH 7, possibly due to extracellular organic compounds that bind nickel outside the cell.

Regarding zooplankton, when Ni concentration is high, it usually enters into the individual cells through the metabolic pathways. It replaces the metals of the metalloenzymes and disrupts metabolism in certain cases. The nickel acts as an important metal for many organisms and occurs in aquatic systems as soluble salts adsorbed on clay particles or organic matter (detritus, algae, bacteria) or associated with organic ligands viz. humic acids, fluvic acids, and proteins. Concentration Ni in the zooplankton followed the dissolved form in water, indicating bioaccumulation or adsorption of the metals (Achary et al., 2020).

The Australian Government Initiative's Guidelines for Freshwater and Marine Water Quality reported that Ni's lowest acute toxicity to fish was 2480 µg/L. According to Binet et al. (2018), bacteria, amphibians, and fish were less sensitive to Ni than other taxa (acute and chronic EC50 values  $\geq$  6000 mg Ni/L). Crustaceans, insects, and worms varied from moderate sensitivity to extreme tolerance (acute EC50 values ranged from 460 to 155000 mg Ni/L). For crustaceans, the early life stages of cladocerans and copepods were the most sensitive to Ni (a chronic EC50 of 410 mg Ni/L and NOEC of 250 mg Ni/L; acute EC50 values of 1190–6500 mg Ni/L), compared with ostracods (adult) and prawns (intermoult), which were relatively tolerant to Ni (acute EC50s of 8000–419000 mg/L).

#### 2.2.3.7 Threat to Existence or Loss of Species

In terms of biological organisms, continued contamination of the rivers with silt from small-scale mining and kaingin farming will affect aquatic organisms. Although fishing in rivers is not a major source of livelihood for resident, with continued degradation of surface water resources, those who fish in rivers will have to find alternative sources of food.

### 2.3 The Air

#### 2.3.1 Meteorology

#### 2.3.1.1 Methodology

Meteorological data from the weather station of Philippine Atmospheric Geophysical Service Administration (PAGASA) in Iba, Zambales, which is 39 kilometers south of the project site were used to characterize the climatological normal and extremes of rainfall, air temperature, wind speeds, and wind directions, including projected change of climate of the said climatic factors.

	RAIN	FALL			TEMP	ERATU	RE (°C)		ar)					WIN	ID		NO	. OF
MONTH	AMOUNT (mm)	NO. OF RAINY DAYS	MAX	NIM	MEAN	DRY BULB	Wet Bulb	DEW PT.	VAPOR PRESSURE (mb	%RH	MLSP (mbar)	DIRECTION (16pt)	SPEED (m/s)	CLOUD AMT. (okta)	TSTM	PLING		
JAN	4.1	2	30.8	20.8	25.8	25.8	22.6	21.3	25.2	76	1012.4	NW	3	4	0	0		
FEB	9.3	2	31.3	21.2	26.2	26.2	23	21.8	25.9	76	1012.3	NW	3	3	0	1		
MAR	19.8	2	31.9	22.1	27	27.1	23.8	22.6	27.2	76	1011.5	NW	3	3	1	2		
APR	38.1	4	33.2	23.6	28.4	28.7	25	23.7	29.1	74	1010.2	NW	3	3	5	8		
MAY	254.7	13	32.7	23.7	28.2	28.5	25.3	24.2	30	77	1008.6	Е	3	5	14	20		
JUN	519.9	18	31.5	23.4	27.4	27.6	25.2	24.4	30.4	82	1007.9	S	3	6	16	18		
JUL	838.1	23	30.4	23	26.7	26.8	24.8	24.1	29.9	85	1007.6	S	3	6	16	18		
AUG	897.7	25	29.9	22.9	26.4	26.5	24.7	24	29.9	86	1007.3	S	3	7	14	15		
SEP	559.5	21	30.4	23.1	26.7	26.8	24.8	24.1	29.9	85	1008.2	Е	3	6	14	17		
OCT	234.2	14	31.3	23.2	27.3	27.3	24.8	23.9	29.6	82	1008.9	Е	3	5	10	16		
NOV	62.3	6	31.5	22.8	27.1	27.1	24.3	23.3	28.4	79	1010.1	Е	2	4	3	8		
DEC	13.2	3	31.1	21.7	26.4	26.4	23.2	22	26.2	76	1011.6	Е	3	4	0	2		
ANNUAL	3450.7	133	31.3	22.6	27	27.1	24.3	23.3	28.5	80	1009.7	Е	3	5	93	125		

Table 2-27:	Climatological	Normals for	Zambales	(1981 - 2010)
1 abic 2-27.	Chimatological	Normans 101	Lambarcs	(1)01-2010)

Source: Climate and Agrometeorology Division, PAGASA Notes:

1) RH – relative humidity

2) MSLP – mean sea level pressure

3) TSTM – thunderstorm

4) LTNG - lightning

MONTH	]	TEMPERA	TURE (	°C)	GREATEST DAILY HIG RAINFALL (mm)		HIGHEST WIND (m/s)		SEA LEVEL PRESSURE (mb)				
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date	High	Date	Lowe	Date
JAN	37.2	1/30/71	13	1/18/92	29.7	1/24/35	18	NW	1/19/74	1020.9	1/14/55	1002.1	1/5/99
FEB	37.2	2/20/72	13	2/2/93	47.6	2/23/01	16	Е	2/11/74	1020	2/4/64	1003.4	2/8/2011
MAR	38.5	3/27/73	11	3/8/93	87.1	3/17/49	16	SE	3/27/94	1019.6	3/3/68	1001.3	3/6/99
APR	38.8	4/22/73	16	4/5/93	72.2	4/18/98	24	SW	4/20/78	1018.2	4/8/65	1001.5	4/21/56
MAY	38	5/11/93	15	5/31/92	543.4	5/23/76	41	SW	5/22/78	1015.3	5/7/57	989.6	5/17/89
JUN	38.2	6/29/95	13	6/4/95	356.4	6/27/60	47	SW	6/23/76	1015.6	6/6/66	980.9	6/29/64
JUL	38.6	7/2/95	14	7/21/92	406.1	7/28/52	36	W	7/25/80	1014.5	7/7/53	992.1	7/4/2001
AUG	35.7	8/27/69	14	8/26/92	437.7	8/31/70	29	S	8/25/78	1014.6	8/22/53	980	8/29/59
SEPT	35.6	9/24/72	12.3	9/10/78	623.7	9/21/35	30	SW	9/16/77	1015.1	9/1/71	990	9/27/78
OCT	37	10/23/7	17.8	10/21/60	325.9	10/13/6	40	SE	10/27/78	1017.4	10/30/61	983.8	10/11/89
NOV	38.3	11/7/72	15	11/30/92	291.4	11/14/7	31	NN	11/4/80	1018.4	11/24/57	981.2	11/4/67
DEC	38.1	12/20/7	15	12/7/92	138.5	12/4/36	18	Е	12/25/80	1019.7	12/10/67	996.6	12/14/64
ANNUAL	38.8	4/22/73	11	3/8/93	623.7	9/21/35	47	SW	6/23/76	1020.9	1/14/55	980	8/29/59
PERIOD OF RECORD		1910-	-2012		1903-2	2012	1	1966-20	)12		1949	-2012	

Table 2-28: Climatological Extremes for Iba, Zambales (as of 2012)

Source: Climate and Agrometeorology Division, PAGASA

- 2.3.1.2 `Change in Local Climate
- 2.3.1.2.1 Baseline Meteorological Data
- 2.3.1.2.1.1 Climate

The climate in the Project site belongs to the Type I of the Modified Coronas Classification (Figure XXX). It has two pronounced seasons, dry from November to April and wet from May to October.



Figure 2-63: Climate Map of Luzon

## 2.3.1.2.1.2 Rainfall

Base on the rainfall data record in the PAGASA Station in Iba, Zambales, low amount of rainfall was recorded during the months of November to April ranging from 4.1 mm to 62.3 mm. The months of May to October experience high amount of rainfall ranging from 234.2 mm to 897.7 mm with August having the highest amount of rain with 897.7 mm. **Figure 2-64** shows the monthly average rainfall and number of rainy days from 1981 to 2010.



Figure 2-64: Monthly average rainfall and number of rainy days from 1981 to 2010.

## 2.3.1.2.1.2.1 Extreme Recorded Rainfall Events

Based on the rainfall data from PAGASA-Iba Station from 1903 to 2012, the highest recorded rainfall was 623.7 mm on September 21, 1935. The second highest recorded daily rainfall occurred on May 23, 1976 with 543.4 mm. This is due to typhoon Olga which also enhance southwest monsoon.

#### 2.3.1.2.1.3 Ambient Air Temperature

The average minimum and maximum temperatures recorded in PAGASA-Iba Station are 22.66 °C and 31.33 °C, respectively. The annual average mean temperature of 26.97 °C which is also close to the annual dry bulb temperature of 27.07 °C. **Figure 2-65** shows the monthly air temperature and relative humidity for PAGASA-Iba Station.



Figure 2-65: Plot of mean monthly air temperature and relative humidity for PAGASA-Iba Station.

## 2.3.1.2.1.3.1 Extreme Temperature Events

Based on the record of PAGASA-Iba Station from 1910 to 2012, the highest recorded air temperature was 38.8 °C on April 22, 1973. Followed by a temperature of 38.6 °C and 38.5 °C recorded on July 2, 1995 and March 27, 1973, respectively. Figure xxx shows the extreme temperatures recorded at PAGASA-Iba Station.



## Figure 2-66: Highest recorded daily temperature and mean maximum monthly temperature for PASASA-Iba Station.

#### 2.3.1.2.1.4 Wind Speed and Direction

Climatological normal of wind speeds and wind directions for PAGASA-Iba Station is shown in **Table 2-29**. The table shows that the prevailing winds from the East (E) starts from September to December and northwest wind (NW) starts from January to April. Southernly winds also starts from June to July.

Table 2-29: Climatological monthly average wind speed and directions as PAGASA-Iba Station(1981-2010)

MONTH	WIND DIRECTION (16pt)	WIND SPEED (m/s)
January	NW	3
February	NW	3
March	NW	3
April	NW	3
May	E	3
June	S	3
July	S	3
August	S	3
September	E	3
October	E	3
November	E	2
December	E	3
Annual	E	3

Source: PAGASA Climatological Normals

#### 2.3.1.2.1.5 Frequency of Tropical Storms

An annual average of 20 tropical cyclones occurs in the Philippine annually. The province of Zambales experience at least five (5) cyclones in three years as shown in Figure 2-67. During the months of May to September, the province of Zambales is usually traversed by tropical cyclones as shown in Figure 2-68.



Figure 2-67: Frequency Map of Cyclones in the Philippines



Figure 2-68: Monthly Climatology of Tropical Cyclone Tracks (1948 – 2016)

#### 2.3.2.1 ENVIRONMENTAL PERFORMANCE/BACKGROUND AIR QUALITY MONITORING

Data used for the assessment of the environmental performance of air quality are based from the monitoring data of ZDMC from 2014 to 2019. Figure 2-69 to Figure 2-72 and Table 2-30 to Table 2-33 show the monitoring data of TSP, NO2, SO2 and PM10.



Figure 2-69: TSP Monitoring Data (2014 to 2019)





Figure 2-71: Monitoring Data of SO2 (2015 to 2018)



Figure 2-72: Monitoring Data of PM10 (2017 to 2020)

Sampling	2014	2014	2015	2015	2015	2015	2016	2016	2016	2016	2017	2017	2017	2017	2018	2018	2018	2018	2019	2019
point	Q3- 2014	Q4- 2014	Q1- 2015	Q2- 2015	Q3- 2015	Q4- 2015	Q1- 2016	Q2- 2016	Q3- 2016	Q4- 2016	Q1- 2017	Q2- 2017	Q3- 2017	Q4- 2017	Q1- 2018	Q2- 2018	Q3- 2018	Q4- 2018	Q3- 2019	Q4- 2019
DMCI/ZDMC Cause way (Bolitoc Pier)							44.22	57.34	5.8	24.9	60.1		50.54	29.56	43.8	20.44	9	24.9		
Bolitoc Stockpile (Sampaloc 1)							3.2	14.1	9.6	72.3	63.3	15.1	16.78	45.19	28.93	26.43	7	72.3		
Acoje Community	97.09	129.03	126.64	110.50	7.80	99.50	47.74	57.10	18.40	11.70		46.80	19.40	21.24	26.08	16.51	18.00	18.40	20.0	20.0
H3 Old (Downwind)	89.93	104.61	516.05	52.14	5.60	205.00	139.56	14.70	6.20	25.30			10.30	15.81	30.36	27.38	12.00	6.20		
H3 Old (Upwind)	47.22	255.43	118.00	58.74	6.80	840.00	116.31	9.80	3.10	4.70		48.60	3.40	3.35	8.46	13.72	15.00	3.10		
Malimlim Area 4 (Upwind)	101.06	101.12															4.70	4.70		
Malimlim Area 4 (Downwind)	130.71	153.51															4.70	4.70		
Malimlim Area 3/77 (Upwind)	150.36		83.43	87.38	6.80	82.80	69.14	10.90	4.70	1.50		56.90	1.40	1.63	15.36	10.01	18.00	17.00		
Malimlim Area 3/77 (Downwind)	166.98		116.44	101.74	5.70	34.80	6.31	6.70	4.70	7.80		127.90	133.90	1.63						
Sitio Banlag	159.45	143.01	226.15	94.41	14.80	320.00	92.21	24.30	17.00	23.00		63.80	29.70	1.66	15.08	4.90	13.00		13.0	13.0
Bolitoc Ricefield							3.18	29.70	8.20	89.20	295.60		12.12	53.59	65.26	45.52	27.00	89.20		
Dumpsite														78.80	11.04	6.16	12.00			

## Table 2-30: Monitoring Data of Total Suspended Particulate (TSP)

DENR Standard =  $300 \mu g/Ncm$
Sampling point	2015	2015	2015	2016	2016	2016	2016	2017	2017	2017	2017	2018	2018
Sampling point	Q2-2015	Q3-2015	Q4-2015	Q1-2016	Q2-2016	Q3-2016	Q4-2016	Q1-2017	Q2-2017	Q3-2017	Q4-2017	Q1-2018	Q2-2018
DMCI/ZDMC Cause way (Bolitoc Pier)										0.15	5.83	1.72	0.86
Bolitoc Stockpile (Sampaloc 1)										0.17	1.69	0.16	1.28
Acoje Community	26.15						21.6			1.06	0.76	2.69	0.91
H3 Old (Downwind)	23.28									1.2	0.16	0.16	0.47
H3 Old (Upwind)	22.11						14.3			0.8	0.97	0.93	0.47
Malimlim Area 3/77 (Upwind)	27.65									0.5	0.16	0.94	0.92
Malimlim Area 3/77 (Downwind)	19.26									0.8	0.16		
Sitio Banlag	12.26									0.2	2.65	0.92	0.45
Bolitoc Ricefield								11.1		0.15	0.16	2.19	1.29
Dumpsite											0.19	0.16	0.42

# Table 2-31: Monitoring Data of NO2 (2015 to 2018)

DENR Standard =  $260 \mu g/Ncm$ 

Compling point	2015	2016	2016	2016	2016	2017	2017	2017	2017	2018	2018
Sampling point	Q4-2015	Q1-2016	Q2-2016	Q3-2016	Q4-2016	Q1-2017	Q2-2017	Q3-2017	Q4-2017	Q1-2018	Q2-2018
Infront of DMCI											
DMCI/ZDMC Cause way				15.4	10.7			126.4	27	27	
(Bolitoc Pier)				10.4	10.7			120.4	2.7	2.7	
Bolitoc Stockpile (Sampaloc 1)						25.1		108.0	2.7	2.7	3.6
Acoje Community	36.3		29.2					126.5	2.7	2.7	
H3 Old (Downwind)	41.2							136.5	2.7	2.7	
H3 Old (Upwind)	37.4						31.8	147.7	6.6	2.7	
Malimlim Area 3/77 (Upwind)	31.0		29.8					111.7	2.7	2.7	
Malimlim Area 3/77 (Downwind)	40.9						29.2	127.6	2.7		
Sitio Banlag	65.5		27.7				33.2	127.3	2.7	2.7	
Bolitoc Ricefield				15.4				116.8	2.7	2.7	10.8
Dumpsite									2.7	2.7	

Table 2-32: Monitoring Data of SO2 (2015 to 2018)

DENR Standard =  $340 \mu g/Ncm$ 

				0					
Sampling point	2017	2017	2018	2018	2018	2019	2019	2020	2020
Samping point	Q3-2017	Q4-2017	Q1-2018	Q2-2018	Q3-2018	Q3-2019	Q4-2019	Q1-2020	Q4-2020
DMCI/ZDMC Cause way (Bolitoc Pier)	0.44	0.428	19.359	46.474	5				
Bolitoc Stockpile (Sampaloc 1)	0.36	0.493	23.206	5.344	5				
Acoje Community		0.48	29.132	12.48	6	13	13		
H3 Old (Downwind)		0.38	37.101	36.474	5				
H3 Old (Upwind)		0.49	18.612	3.537	5				
Malimlim Area 3/77 (Upwind)		0.415	25.808	17.201	5				
Malimlim Area 3/77 (Downwind)		0.51							
Sitio Banlag		0.515	18.433	11.36	5	7	7		
Bolitoc Ricefield	0.29	0.531	6.566	30.214	11				
Dumpsite			4.338	14.44	5				
Mapalad Elementary School						8	10		
Lucapon South Washbay Area						8	12		
H3 Acoje Road						8	10		
Shangpil Area									12
Sampaloc 1									8
Lucapon Wash Bay									11
Acoje Community									5
H3 Old									5
Banlag area									14
Mapalad Elementary School									6

Table 2-33: Monitoring Data of PM10 (2017 to 2020)

DENR Standard =  $200 \mu g/Ncm$ 

Data from the air quality monitoring of the Sta. Cruz – Candelaria Mining Project shows that there has no significant source of air emission that will have an impact to the community. Since 2014, the air quality over the project site have passed the DENR Standards except for the TSP were it failed only 3 times in 2015.

# 2.3.1.2.2 Projected Change in Climate

#### 2.3.1.2.2.1 Projected Change of Rainfall in 2036 to 2065

PAGASA (2018) noted that the increasing trends in annual and seasonal rainfall were observed in may parts of the country. Such trends were found to be associated with extreme rainfall events. Multi-model projections suggest a range of increase and decrease seasonal-mean rainfall exceeding 40% of its historical values. Nevertheless, the multi-model central rainfall variations, except for the projected rainfall reduction over central sections of Mindanao that are beyond the observed rainfall variations in the past.

From 1951 to 2010, the annual total rainfall over northern sections of Luzon, Palawan, western sections of Visayas, and central and western sections of Mindanao have declined while increasing trends have been observed in other areas, notably in the central parts of Luzon, eastern section of Visayas, and the northeastern and southwestern sections of Mindanao in March-April-May season at a rate ranging from 10mm/decade to as much as rate exceeding 40mm/decade. Such trends in annual total rainfall are associated with extreme rainfall events.

The projected change in seasonal total rainfall in the Philippines for the mid-21<sup>st</sup> century (2036-2065) relative to the baseline period of 1971-2000 suggests that the wettest possible change and could exceed a 40% increase in rainfall, particularly over Luzon, western sections of Visayas and some parts of Mindanao in Dec-Jan-Feb. Zambales was observed to have an increasing rainfall trend from Dec to June from 1971-2010 and it is projected to increase from 2036 to 2065 (**Figure 2-73**).



Figure 2-73: Project change in rainfall for the province of Zambales (Data Source: PAGASA, 2018)

### 2.3.1.2.2.2 Projected Change in Temperature in 2036 to 2065

Observed temperature in the Philippines is warming at an average rate of 0.1 °C/decade. Climate projections suggest continuous warming in the future. It is projected that the country-averaged mean temperature could increase by as much as 0.9 °C – 19 °C (assuming the moderate emission scenario, RCP4.5) and 1.2 °C – 2.3°C (considering the high emission scenario, RCP8.5) in the mid-21st century (2036-2065). Warmer conditions are further expected by the end of the 21st century (2070-2099), which could range from 1.3 °C – 2.5°C (based on the RCP4.5) to 2.5 °C – 4.1 °C (based on the RCP8.5) increase in mean temperature relative to the baseline climate.

Over the past 65 years (1951-2015), the annual mean temperature in the Philippines has risen by 0.68°C, which translates to an average rate of increase by about 0.1°C/decade. On the other hand, the country's annual maximum temperature has increased at a slower rate of approximately 0.05°C/decade while the minimum temperature has increased more rapidly at 0.15°C/decade.

The annual mean surface air temperature in the Philippines is expected to increase from 0.9°C to 1.9°C for the moderate emission scenario (RCP4.5) and from 1.2°C to 2.3°C for the high emission scenario (RCP8.5) in the mid-21<sup>st</sup> century (2036-2065), and from 1.3°C to 2.5°C (RCP4.5) to as warm as 2.5°C to 4.1°C (RCP8.5) by the end of the 21<sup>st</sup> century (2070-2099)

PAGASA (2018) noted that air temperature is projected to increase uniformly and minimally across the Philippines under moderate and high emission scenarios. In Zambales, air temperature is projected to increase in all periods (lower to upper bounds; **Figure 2-74**). The projected increase in temperature are as follows:

- Moderate emission scenario 1.3 to 3.2 °C (median) and 1.7 to 3.8 (upper bound)
- High emission scenario 1.6 to 3.7 °C (median) 2.1 to 4.3 °C (upper bound)



Figure 2-74: Projected change in temperature for the province of Zambales (Data Source: PAGASA, 2018)

### 2.4 The People

To ensure transparency and to enable stakeholders to make proactive participation about the project, different public consultation/dialogue/hearing were conducted to the 15 impact barangays. A perception survey, key informant interviews and focus group discussions were also administered to the host and neighboring barangays to establish baseline of the community, assess their needs, and identify gaps for future interventions of the proponent.

# 2.4.1 Methodology

To help the team assess the project's impact to the people, primary and secondary data were utilized, together with barangay ocular visits and information gathering from the barangays' respective officials and stakeholders. The table below shows the activities done by the team to encourage public participation and attain data gathering:

METHODOLOGY	DATE	VENUE/LOCATION	
Information, Education	8 March 2021	Brgy. Uacon Session Hall	
and Communication	9 March 2021	Sitio Mapalad, Pine Tree and Banla	
Campaign		Brgy. Taposo	
	10 March 2021	Brgy. Lauis Session Hall	
	11 March 2021	Brgy. Malabon	
	11 March 2021	Brgy. Pinagrealan Session Hall	
	12 March 2021	Brgy. Sinabacan Session Hall	
	12 March 2021	Brgy. Malimanga Session Hall	
	13 March 2021	Brgy. Tapos Session Hall	
	13 March 2021	Brgy. Yamot Session Hall	
	15 March 2021	Brgy. Biay Session Hall	
	16 March 2021	Brgy. Pamibian Session Hall	
	16 March 2021	Brgy. Bolitoc Session Hall	
	18 March 2021	Brgy. Lucapon North Session Hall	
	18 March 2021	Brgy. Naulo Session Hall	
	19 March 2021	Brgy. Bayto Session Hall	
	22 March 2021	Brgy. Lucapon South Session Hall	
	22 March 2021		
Public Scoping	26 March 2021	Public Scoping	
Perception Survey	24-29 June 2021	Barangays Bayto, Biay, Bolitoc,	
		Lucapon North, Lucapon South,	
		Naulo, and Uacon.	
Key Informant Interview (KII)	23-26 June 2021	Key Informant Interview	
		Barangays Bayto, Biay, Bolitoc,	
		Lucapon North, Lucapon South,	
		Naulo, and Uacon, Malimanga and	
		Sinabacan	

### Table 2-34. Methodologies used for gathering socio-economic and demographic data

Focus Group Discussion (FGD)	23-25 June 2021	Focus Group Discussion (FGD) Barangays Bayto, Biay, Bolitoc, Lucapon North, Lucapon South, Naulo, and Uacon.
Ocular Inspection	23-25 June 2021	Ocular visit in the areas of Barangays Bayto, Biay, Bolitoc, Lucapon North, Lucapon South, Naulo, and Uacon.
Secondary Data Gathering	23-25 June 2021	Data gathering in Barangays Bayto, Biay, Bolitoc, Lucapon North, Lucapon South, Naulo, and Uacon, and in the Municipality of Sta. Cruz and Candelaria
Public Hearing	TBA	ТВА

### 2.4.1.1 Ocular Inspection

The team conducted an ocular visit to the nine (9) impact barangays. This is to assess the physical condition of the affected areas and to see the living condition of the community within the area of host barangays and hauling area.

### 2.4.1.2 Secondary Data Gathering

The secondary data and information were sourced from the documents released by barangay offices to the team. The socio-economic data from the municipality of Sta. Cruz was not released to the team due to the unavailability of updated data and the absence of the Municipal Planning and Development Coordinator (MPDC) who was just recovering from COVID-19. The team was advised to wait for the MPDC for the copy. However, the CLUP available covers only the commercial/industrial offices along the highway. Moreover, the municipality of Candelaria was closed during the team's data gathering activities.

Other secondary information and materials were obtained from published documents of the Philippine Statistics Authority, the Social Development Management Plan of ZDMC, Environmental Impact Statement of CRAU Mineral Resources Corporation, Department of Trade and Industry, Department of Interior and Local Government, and other relevant data on the internet.

On the socio-demographics, the consultants used more of the 2015 Census as the 2020 Census only covers the total population of Zambales Province, and Sta. Cruz and Candelaria. The PSA mentioned that the more in-depth data that was included in the 2020 Census is not yet available.

### 2.4.1.3 Information, Education, and Communication (IEC) Activities

To encourage participation and cooperation of affected communities, the execution of the IEC activities is necessary. This will keep the community and the stakeholders become aware of the proponents' initiatives, progress of the project and accomplishment. The IEC activities provide an avenue to people to raise concerns over the phases of the project's implementation. The table below shows the summary of IEC activities for the expansion plan of Sta. Cruz – Candelaria Mining Project:

	Table 2-35: Im	plementation	of IEC Activ	vities for the	<b>Expansion</b> Plan
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Details	Summary of Issues and Concerns
08 March 2021 Brgy. Uacon Session Hall	1. Emphasized the ordinance of the Sangguniang Bayan of Candelaria that prohibits open-pit mining and other destructive activity. The ordinance was validated by the Department of Interior and Local Government (DILG).
	2. Inquired on the non-inclusion of the 81-hectare in the current MPSA.
	3. The Barangay Captain acknowledged that ZDMC is a responsible mining operator. Shared that the constituents of the barangay still think that all mining companies do illegal activities.
	4. The incumbent Barangay Captain manifested that he is an anti-mining advocate but he will listen to the voice of his constituents.
09 March 2021 ASCRAI and AKDA members	<ol> <li>Made clarification on the LGU having jurisdiction over the additional 81 hectares</li> </ol>
	2. Confirmation on the hauling route via Malimlim.
	3. Suggested for the hauling road backfilling every three months.
	4. Raised concern on food source access at the additional 81-hectares.
09 March 2021 Sitio Mapalad, Pine Tree and	1. Confirmation if IEC was already undertaken in nearby barangays.
Banlag	2. Occurrence of excessive dust generation due to insufficient watering of the hauling road since only one water truck is operating. However, it was further identified that the main problem is the water source. It was also stressed that due to dust generation, respiratory related diseases are significantly rising.
	3. Confirmation on the LGU having jurisdiction of the additional 81- hectare.
	4. Suggested to increase the number of water trucks for the current hauling operation since dust pollution affects the safety and health of their families.

	5. Requested for additional traffic marshal to reduce the speed of the hauling trucks.
10 March 2021 Vice Governor Jay Khonghun	<ol> <li>Maintain a good working relationship with the community.</li> <li>Practice responsible mining.</li> </ol>
10 March 2021 Farmers Association (Brgy. Taposo)	<ol> <li>Inquired if the operation of the 81-hectare will affect the river systems in the Municipality of Candelaria.</li> <li>Inquired if the Company is operating.</li> <li>Reiterated to the Company the need to secure the settling ponds to minimize siltation that will affect the irrigation system at the end of Pinagrealan River that connects to the farmlands of Barangays. Taposo, Yamot, Pamibian, Dampay and Binabalian.</li> </ol>
11 March 2021 Brgy. Lauis Session Hall	<ol> <li>Confirmation in the location of the additional 81 hectares.</li> <li>Clarification on Lot 6 in reference to Mount Lanat.</li> <li>Inquired if the host communities already received their percentage of excise tax paid by the company.</li> <li>Suggested to include Barangay Lauis as a host community since the upstream portion of the Lauis river is near the mine site.</li> <li>Inquiry if the ECC amendment will proceed even without the endorsement from the Host Barangay and SB of Candelaria.</li> </ol>
11 March 2021 Brgy. Malabon Council	<ol> <li>Confirmation if ZDMC mining activity covers Barangay Malabon which is negative.</li> <li>Impact of the Municipality of Candelaria Ordinance banning new mining operations on the expansion area.</li> <li>Inquiry on the mine life of the current MPSA.</li> </ol>

	4. Asked to provide a more accurate map showing the barangay boundaries within the Municipality of Candelaria.
	5. Requested for site visit.
12 March 2021	
Brgy. Pinagrealan	1. Confirmed the location of the additional 81-hectare
Session Hall	2. Barangay Officials expressed support over the project.
12 March 2021 Barangay	1. Intensify the IEC campaign for the marked anti -mining groups in the
Sinadacan Session Hall	Darangay.
13 March 2021 Barangay	1. Confirmation as to the operator of Lot 6.
Malimanga Session Hall	2. Barangay boundaries dispute being determined.
13 March 2021 Barangay Taposo	1. Clarification if the project area is newly acquired by ZDMC.
Session Hall	2. Raised the concern on the ordinance of the Province of Zambales prohibiting new applications for destructive mining.
15 March 2021 Barangay Yamot Session Hall	1. Clarification on why the project area is not included in the current MPSA.
	2. The rationale on the additional mining area when the current mining area is just 8%-9% of the total MPSA area.
	3. Barangay Officials expressed their view that the ordinance of the Municipality of Candelaria should be repealed.
	4. The upcoming election will have an impact on the approval of the ECC amendment.
	5. The Barangay Officials agreed for the amendment of Lot 6 inclusion since it was acquired by ZDMC legally.
16 March 2021 Barangay Biay Session Hall	<ol> <li>Clarification in the ECC amendment process if the same process applies to that of the original ECC.</li> </ol>
	<ol> <li>Confirmation in the location of the project and on why it was not included in the original ECC.</li> </ol>
	3. Conveyed a message to the IEC team that the Barangay Officials asked for continuous and harmonious communication relative to the hauling operations.

16 March 2021 Barangay	1. Requirement on Barangay endorsement for the ECC amendment.
Hall	2. Clarification if Lot 6 is near Balin Buwaya Area of Candelaria due to its proximity to Barangay Pamibian.
	3. Assurance from the Company that they will not neglect and abandon their rehabilitation endeavors once the area is already mined out.
	4. Relay to the Barangay the finalization of the Barangay boundaries dispute.
18 March 2021	
Barangay Bolitoc Session Hall	1. No opposition to the ECC amendment
	2. Asking for additional SDMP or other source of funds since their Barangay is the most affected by the Hauling and Shipment operation due to dust and noise generation. It is also the location of the since it is where the port is located. Neighboring mining companies are also providing the same assistance.
18 March 2021	
Barangay Lucapon North	1. Inquiry on why their barangay was involved in the ECC amendment process.
Session Hall	2. Intensify the IEC in the farmers of Barangay Uacon who are most affected by the mining operations.
	3. Inquiry on the years of mining operations in Sta. Cruz and Candelaria.
	4. Provide information on local employment hired by the company that resides in the Municipality of Sta. Cruz and the per barangay data.
	5. Appreciate the efforts of the company in providing information in the implementation of the SDMP.
	6. Inquiry if the Company is not affected by the ordinance of the municipality of Candelaria prohibiting destructive mining operations in Candelaria.
19 March 2021 Brgy. Naulo	1. Inquiry on the possible site inspection in the project area.
Session Hall	2. Intensify the IEC to eliminate the negative impression on Mining operations since during the rainy season some Barangays are submerged in water coming from the Cabaluan River.
	3. Inquire on the remaining mine life of the Company.
22 March 2021 Brgy. Bayto Session Hall	1. Inquiry on the rationale in adding the additional 81-hectare

	<ol> <li>Raised the flooding incident during heavy downpour that happened during Typhoon Lando.</li> </ol>
	3. The Barangay supports responsible mining.
22 March 2021	
	1. Inquired on the location of the additional area for inclusion which is
Brgy. Lucapon	1. Inquired on the location of the additional area for inclusion which is
South Session	within the jurisdiction of the barangay.
Hall	
11411	2. Suggested to verify the accuracy of the maps to confirm the correct jurisdictions of the Municipality and Barangays within the MPSA.

# 2.4.1.4 Public Scoping

The Public Scoping for ZDMC's ECC amendment was conducted on 26 May 2021. It was attended by Vice Mayor Byron Jones E. Edquilang of Candelaria, barangay officials from Candelaria and Sta. Cruz, and ZDMC representatives at the Dawal Beach Resort.

Other participants who attended via Zoom meeting were representatives from BMB, Provincial Government of Zambales, DENR-PENRO Zambales, DENR-CENRO Masinloc, EMB, Tanggol Kalikasan and Save Candelaria Movement, MGB RO3, Concerned Citizens of Candelaria, Argotek, Inc., Sta. Cruz LGU and ZDMC.

The activity was aimed towards opening the proposed expansion plan to the public so the proponent can provide the background and plans of the project, as well as give concerned communities and stakeholders the opportunity to ask questions, provide inputs and recommend alternatives.

The common issues raised during the public scoping were: 1) the rehabilitation activities be complied with by ZDMC, 2) assurance that mining will not result to flooding or other form of disaster, 3) that the people will be part of the continuous employment, 4) that the people will be made aware/consulted of the activities of the project, and 5) that ZDMC shall comply with barangay agreements and other pertinent government laws and regulations.

The issues and responses during the Public Scoping are provided in **Error! Reference source not found.**: Public Scoping Report.

### 2.4.1.5 Perception Survey

The perception survey produces information on the respondents as representatives of the community where they belong and to provide evidence to the proponent and stakeholders for future policies and programs that will be beneficial to the impact barangays. The perception survey that was conducted on 24 June to 04 July 2021 measures the respondents' 1) Experiences, 2) Beliefs and Values, 3) Attitudes and Opinions, 4) Knowledge, and 5) Expectations.

There were seven (7) impact barangays covered in this survey – the two (2) host barangays and five (5) barangays that are being used as hauling roads. The two (2) host barangays are Uacon, Candelaria and Lucapon South, Sta. Cruz. The other five (5) neighboring barangays in Sta. Cruz are Bayto, Biay, Bolitoc, Lucapon North and Naulo.

### Table 2-36: Perception Survey Activity

Activity	Timeframe	Location	
	24-26 June 2021	Barangay Uacon - Candelaria	
Perception Survey		Barangay Bayto - Sta.Cruz	
		Barangay Biay - Sta.Cruz	
		Barangay Bolitoc - Sta.Cruz	
		Barangay Lucapon North - Sta.Cruz	
		Barangay Naulo - Sta.Cruz	
	2-4 July 2021	Barangay Lucapon South – Sta. Cruz.	

Where the number of households in the seven (7) impact barangays is either not available or updated, the researchers referred to the average household size based on the 2015 COP, which was 4.4 members per family. Hence, the table below:

Table 2-37: Population and Household Count	t
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Municipality	No. of Barangays	Population	Estimate No. of Households
Sta. Cruz	6	18,162	3,632
Candelaria	1	3,471	694
Total	7	21,633	4,326

To practically understand and obtain a feasible representation from the existing large population, the researcher used a probability sampling method by systematic sampling. The households were selected at regular intervals from the sampling frame. The intervals were chosen to ensure adequate sample size.

There are 4,326 households as the target population (N). The survey sample size is **159** households (n) based on the following formula:

Sample size (n) =		$\frac{[z^2 * p(1-p)]}{e^2}$
	1+	$\frac{[z^2 * p(1-p)]}{e^2 * N}$

Where:

e: N = target population of n = households of 159 z = z-score of 1.28 (or 80% confidence level) e = 0.05 (+/-5% margin of error) p = 0.5 standard of deviation

The allocation of number of respondents by barangay shall be based on two (2) strata: host barangays and neighboring barangays. Since the host barangays are Uacon and Lucapon South, in which the actual mining area is located, we are allotting 60 percent of the household respondents to them. The remaining 40 percent shall be allocated to the five (5) neighboring barangays. The number of household respondents is allocated based on ratio and proportion, first by separating the two (2) strata where they receive 60:40 ratio, and second, by distributing the number of household respondents according to the proportioned percentage. The table below shows the sampling distribution per barangay as respondents:

2021 EPRMP

Municipality	Barangay	No. of Population	Estimated No. of Household	% of Total	Allocated Number of Household Respondents
	Hosts:				
Candelaria	Uacon	3,471	694	46.8%	44
Sta. Cruz	Lucapon South	3,941	788	53.2%	51
			1,482	100%	95 (60%)
	Neighboring				
Sta. Cruz	Bayto	3,925	785	27.6%	18
Sta. Cruz	Biay	2,379	476	16.7%	11
Sta. Cruz	Bolitoc	3,375	675	23.7%	15
Sta. Cruz	Lucapon North	2,521	505	17.7%	11
Sta. Cruz	Naulo	2,021	404	14.2%	9
			2,844	100.0%	64 (40%)
Total		21,633	4,326		159

# Table 2-38: Sampling Distribution

# 2.4.1.6 Key Informant Interview (KII)

To get qualitative and in-depth first-hand knowledge of the community's present condition, pressing issues and concerns, and perceived impacts of the project, the KII was conducted through one-on-one interview with barangay captains of the seven (7) impact barangays. Two (2) other barangays nearest to the host community, Barangay Uacon, were also included for consideration of their opinions on the expansion plan. These are Barangays Malimanga and Sinabacan. The table below shows the KII activities conducted from 23-26 June 2021:

ACTIVITY	SCHEDULE	VENUE	PARTICIPANTS
KII	23 June 2021	Uacon Barangay Hall	Brgy. Captain Daniel Esteron
	24 June 2021	Bayto Barangay Hall	Brgy. Captain Raul Ecleo
	24 June 2021	Brgy. Captain Samuel Marila	
	24 June 2021	Lucapon North Barangay Hall	Brgy. Captain Remedios Misa
	24 June 2021	Malimanga Barangay Hall	Brgy. Captain Danilo Pulusan
	24 June 2021	Bolitoc Barangay Hall	Brgy. Captain Melecio Medes
	24 June 2021	Sinabacan Barangay Hall	Brgy. Captain Marcos Villanueva
	24 June 2021	021 Naulo Barangay Hall Brgy. Captain Esmae	
	26 June 2021	Residence	Brgy. Captain Gloria Barnillo

Table 2-39: Key Informant Interview Activity	Table 2-39: Key	Informant	Interview	Activity
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# 2.4.1.7 Focus Group Discussion (FGD)

To get more candid information about current problems in the community, discuss their preconceived notions about the project and gather feedback/recommendations, the stakeholders were invited for a dialogue.

Due to limitations on space and quarantine restrictions, the team opted to conduct the FGD per barangay and not gather all of them at the same time. The table below shows the FGD activities conducted on 23-25 June 2021:

ACTIVITY	SCHEDULE	VENUE	PARTICIPANTS
Focus Group Discussion	24 June 2021	Bolitoc Barangay Hall	BHWs, SK Chairperson, Brgy. Staff, Farmer
	24 June 2021	Naulo Barangay Hall	SK Chairperson, Farmer, Fisherman, Brgy. Officials
	25 June 2021	Lucapon North Barangay Hall	Farmer Fisherman
	25 June 2021	Uacon Barangay Hall	Business owner and SK Chairperson
	25 June 2021	Bayto Barangay Hall	Irrigators Association Chair, Business owner
	25 June 2021	Biay Barangay Hall	Barangay Health Workers (BHWs), DepEd, TODA representative
	25 June 2021	Uacon Barangay Hall	Business owner and SK Chairperson
	25 June 2021	Bayto Barangay Hall	Irrigators Association Chair, Business owner
	25 June 2021	Biay Barangay Hall	Barangay Health Workers (BHWs), DepEd, TODA representative
	25 June 2021	Malimanga Barangay Hall	Brgy. Officials, Tanod, Nurse, BHW
		Sinabacan Barangay Hall	Brgy. Officials, BHWs, VAWC officer

#### Table 2-40: Focus Group Discussion Activity

### 2.4.1.8 Public Hearing

No schedule of Public Hearing as of yet.

#### 2.4.2 Results

2.4.2.1 Secondary Data

2.4.2.1.1 Historical Profile of Zambales

The province of Zambales started to unfold in 1572 during the exploration of Don Juan de Salcedo from Spain. Thereafter, the earliest towns were organized - Masinloc, Iba and Sta. Cruz, which were established in 1607, 1611 and 1612, respectively. Masinloc was the first capital of the province. During the early parts of the American occupation of the Philippines, Iba became the capital of the province in 1901 because of its strategic location.

The name Zambales was derived from Hispanized term Zambal or in Malay word Samba. It refers to the native Malay language, meaning to worship, as the early Malay inhabitants were found to be superstitious and like to worship the spirits of their departed ancestors.

It is believed that the earliest inhabitants of Zambales were the kinky-haired Negritos or Aetas until they were pushed away by Zambals from Celebes Sea. The Zambals have established the nuclei of municipalities in Zambales. At various points in history, seven of the province's original northern towns, which included Bolinao, Infanta, San Isidro, now Burgos, Anda, Bani, Agno and Alaminos were later transferred under the jurisdiction of Pangasinan.

### 2.4.2.1.2 Demographic Profile of Zambales

The province of Zambales is situated in the Central Luzon region. Based on the 2020 Census of Population (COP), Central Luzon has 12,422,172 population as of 01 May 2020. It has a 2.17 percent growth rate compared to the 2015 population of 11,218,177. Central Luzon covers the seven (7) provinces of Aurora, Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, and Zambales, as well as two (2) highly urbanized cities: Angeles City and Olongapo City.

The province of Zambales (excluding Olongapo City) posted a total population of 649,615 in 2020. The population of the province was 590,848 in 2015. The province's population represented 5.23% of the total population of the Central Luzon region. In reference to the 2015 Census, the number of households is computed at 142,218.

The province recorded an increase of 58,767 persons than its population in 2015. The increase in its population translated into an average annual population growth rate (PGR) of 1.97 percent. Based on the computation made by PSA, the total population of Zambales would double in approximately 36 years if this average annual PGR continues.



Figure 2-75: Comparative Population in 2015 and 2020

Zambales has a land area of 3,630.35 square kilometers. Based on these figures, the population density is computed at 163 inhabitants per square kilometer. The age group with the highest population is 15 to 64 years old with 371,866 individuals. The age group with the lowest population (excluding under 1 year old) is 65 years old and over, with 32,456 individuals. Those aged 15 to over 65 years old, the economically active population or potential members of the work force accounted at 37.4 percent (220,953) of the province's total population. In the province's sex ratio, males accounted for 51.3 percent of the total population or a sex ratio of 105 males for every 100 females. The male population had 302,296 individuals, while the female population had 287,922.

Population	Male	Female	No. of Households	Highest Population	Lowest Population	Economically Active
				by Age Group (15-64)	(65 and over)	Population
590,848	302,296	287,296	142,218	371,866	32,456	220,953

The province of Zambales has 13 municipalities and one (1) highly urbanized city. The total number of barangays in the province is 230. It shares common boundaries with Pangasinan in the North, Tarlac and Pampanga in the East, Bataan in the South and the South China Sea in the West.

The 13 municipalities are Sta. Cruz, Candelaria, Masinloc, Palauig, Iba, Botolan, Cabangan, San Felipe, San Narciso, San Antonio, San Marcelino, Castillejos and Subic. Olongapo was the 14<sup>th</sup> until it became a chartered City.



**Figure 2-76: Map of Zambales Province** 

Among the 13 municipalities in Zambales, Subic is the most populous at 111,912 individuals in 2020. This is followed by Castillejos at 67,889 individuals and Botolan at 66,739 individuals.

MUNICIPALITY	INCOME CLASS	2015 POP	2020 POP
Botolan	1 <sup>st</sup>	57,707	66,739
Cabangan	$4^{th}$	25,163	28,118
Candelaria	3 <sup>rd</sup>	27,174	30,263
Castillejos	3 <sup>rd</sup>	64,841	67,889
Iba	2nd	50,506	55,581
Masinloc	1st	47,719	54,529
Palauig	3rd	34,947	39,784
San Antonio	2nd	34,661	37,450
San Felipe	4th	23,183	25,033
San Marcelino	1st	33,665	37,719
San Narciso	4th	28,360	30,759
Sta. Cruz	1st	58,151	63,839
Subic	1st	104,771	111,912
TOTAL		590,848	649,615

Table 2-	42: Population	of m	unicipalities	of Zambal	es in 2015	and 2020

### 2.4.2.1.3 Education and Literacy

In 2015, a literacy rate of 98.9 percent was noted among the 460,092 household population aged 10 years old and over. This covers those individuals who can read and write a simple message in any language or dialect. The male and female group had an equal literacy rate.

Of the 227,793 population aged 5 to 24 years old, 68.5 percent was attending school in school year 2015-2016. The female population attending school was higher (69.4 percent) than the males (67.7 percent).

# 2.4.2.1.4 Agriculture

Based on the 2016 PSA survey result, the top five (5) agricultural crops in Zambales are palay, corn, coconut, mango and banana.

Crops	Harvested/Hectares	Production	
Palay	32,466	112,222	
Corn	443	1,698	
Coconut	353	683	
Mango	8,851	18,114	
Banana	540.24	8,838	

# Table 2-43: Top Five (5) Crops in 2016

The municipality of Sta. Cruz has about 11.59% of its total land area or 5,082.85 hectares of land devoted to agriculture. At about 3,503.85 hectares are planted with palay as the major crop of the municipality. This was followed by Mango, which is sold as a major commercial product.

The other 90 hectares of land are dedicated to Corn. The produce was a total of 379 and 7 metric tons of yellow and white corn, respectively. Other part of the agricultural land is devoted to vegetables and root crops which is about 496 hectares. The vegetables produce are tomatoes, ampalaya, squash, eggplant, pechay, sitaw, calamansi, cassava and camote. Other fruit-bearing trees include coconut, guyabano and banana.

In Candelaria, there is an arable area of 1,673 hectares of irrigated and non-irrigated (rain-fed areas) devoted to rice planting. The average production in Candelaria is 85 cavans of rice per hectare. The remaining 53,496 hectares of arable lands are planted with mangoes, coconuts, citrus, sugarcane root crops and vegetables.

### 2.4.2.1.5 Livestock and Poultry

Based on the 2018 PSA survey result, the top five (5) livestock/poultry (inventory) in Zambales are Carabao (29,311), Cattle (35,401), Goat (30,870), Duck (47,634) and Chicken (3,266,089).

### 2.4.2.1.6 Fisheries

Based on the 2017-2019 Fisheries Statistics of the Philippines, there was a 3% increase from the fisheries production in Zambales in 2019 compared to 2018.

The common catch in marine fisheries include Anchovies, Mackerel, Tuna, Cavalla, Crevalle, Fimbriata Sardines, Grouper, Bali Sardinella, Roundscad, Skipjack, Snapper, and Squid. The table below shows the fisheries production from 2018 to 2019:

Subsector	Volume of	Amount	Volume of	Amount	
	Production		Production		
	(metric tons)		(metric tons)		
	2018		2019		
Fisheries	43,624.03	5,214,494.51	47,107.78	5,456,433.72	
Commercial	6,270.20	805,859.96	7,709.12	999,981.93	
Fisheries					
Municipal	14,812.99	1,766,578.55	15,754.25	1,868,529.42	
Fisheries					
Marine	14,708.21	1,756,192.24	15,614.62	1,854,491.56	
Inland	104.78	10,386.31	139.63	14,037.86	
Aquaculture	22,540.84	2,642,056.00	23,644.41	2,587,922.37	
Brackishwater	3,536.46	544,980.35	4,189.58	698,780.01	
Fishpond					
Marine Fish	17,800.15	2,052,835.84	17,476.30	1,798,554.22	
Cage					
Seaweed	763.11	3,079.29	1,113.27	5,771.78	
Production					

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### 2.4.2.1.7 Religion

The people of Zambales are predominantly Roman Catholics as shown in the 2015 COP. This religion accounted for 78.5 percent (464,050 persons) of the total population of Zambales. This is followed by Aglipay (5.1 percent) and Iglesia ni Cristo (4.6 percent).

#### 2.4.2.1.8 Language

The province of Zambales uses three (3) main languages, such as Tagalog, Ilocano, Sambal. They also constitute the five largest ethnic groups in Zambales: Tagalogs, Ilocanos, Sambal, Kapampangans and Pangasinans.

#### 2.4.2.1.9 Economy

The province of Zambales was recorded by Bureau of Local Government Finance with annual regular revenue of P1.1B for the fiscal year 2016. This is a 10.3 percent increase from the previous year.



Figure 2-77: Annual Regular Revenue

Based on the 2020 Cities and Municipalities Competitiveness Index (CMCI) developed by the National Competitiveness Council (NCC) with the assistance of the United States Agency for International Development (USAID), Zambales ranked 35<sup>th</sup> amongst the 76 provinces included in the list. Provincial rankings are based on the population and income weighted average of the overall scores of cities and municipalities under it. It also looks into the province's economic dynamism, government efficiency, infrastructure and resiliency.

In the 13 municipalities under Zambales, the top 5 biggest contributors to the province's overall score in the CMCI are Subic (19.5%), Masinloc (15.1%), Castillejos (11.5%), Sta. Cruz (10.9%) and San Antonio (7.9%).



Source: Cities and Municipalities Competitive Index - Department of Trade and Industry

Figure 2-78: Zambales' Municipalities Scores, 2020

### 2.4.2.1.10 Employed Persons by Major Occupation Group

In terms of major occupation group, the top five (5) were, in descending order: 1) Craft and related trades workers (39,631), 2) Service and sales workers (37,681, 3) Elementary occupations (36,697), 4) Skilled agricultural, forestry and fishery workers (35,244), and 5) Plant and machine operators and assemblers (25,206).

### 2.4.2.1.11 Tourism

Owing to the province's location in the western shores of Central Luzon, Zambales is a tourism haven for those looking for islets and bays, white beaches and deep blue sea. To name a few, the tourist spots being visited here are the Potipot Island in Uacon and Uacon Lake in Candelaria, San Salvador Island and Fish Sanctuary in Masinloc, Silanguin Bay in San Antonio, Sagrad Familia Cave in Sta. Cruz and the Mt. Pinatubo Crater and Lake in San Marcelino. There are a lot of Department of Tourism (DOT)accredited resorts and hotels in town, such as Dawal Beach Resort in Candelaria, Bakasyunan Resort And Conference Center in Iba, Club Morocco Beach Resort And Country Club in Subic, Dfarm And Park in Masinloc and Tropicana Oriental Beach Resort.

For those looking for history, the ancestral house of former president Ramon Magsaysay is one of the iconic tourist spots being visited in Zambales.

Among the province's festivities and celebrations, Zambales is noted for its Mango Festival, also known as Dinamulag Festival. It is an annual festival held to celebrate bountiful harvest of the province's mangoes. It was first held in 1999. The province of Zambales was cited as the world's sweetest mangoes by Guinness World Records in 1995 and the country's sweetest mangoes by the Department of Agriculture in 2013.

The province has a variety of festivals that could last a week. It is being celebrated with a lot of street dancing, parade, beauty contests and music competition, and more.

### 2.4.2.1.12 Health and Welfare

Zambales has its own Provincial Health Office as the provincial partner of the Department of Health in overseeing the implementation of all DOH programs in terms of formulation, planning and coordination in the field of health of the province.

The hospitals that are available in Zambales are the Candelaria District Hospital (Candelaria), San Marcelino District Hospital (San Marcelino), Sta. Cecilia Medical Center, Allied Care Experts (ACE) Medical Center – Baypointe, Inc. (Subic), President Ramon Magsaysay Memorial Hospital (Iba) In 2018, the PSA recorded a 3,158 death in the province of Zambales. The mortality statistics was based on the underlying cause of death documented on the medical certificate. The underlying cause has been defined as the disease or injury which led directly to death; or the circumstances of the accident or violence which produced the fatal injury.

The top five (5) causes of death in Zambales in year 2018 were the diseases of the heart, cerebro-vascular disease, malignan neoplasm, pneumonia and diabetes.

Table 2-45: Mortality Statistics of Zambales in 2018					
CAUSE OF DEATH	NO. OF DEATHS				
Diseases of the Heart	942				
Cerebro-Vascular Disease	399				
Malignant Neoplasm	390				
Pneumonia	317				
Diabetes Mellitus	220				
Chronic Lower Respiratory Diseases	199				
TB All Forms	165				
Transport Accidents	105				
Diseases of the Genito Urinary System	89				
Cond. Originating in the perinatal period	68				
Liver Disease	59				
Accidental Drowning & Submersion	42				
Septicemia	32				
Gastric and Duodenal Ulcer	28				
Assault	24				
Intestinal Infectious Disease	22				
Congenital Anomalies	18				
Malnutrition	17				
Falls	11				
Rabies	8				
HIV Disease	3				
Total	3,158				

2.4.2.2 Demography Profile of Municipalitied of Sta. Cruz and Candelaria, Zambales

The municipalities of Sta. Cruz and Candelaria, only comprised the 9.8 percent (27,174 persons) and 4.6 percent (58,151 persons) of the total population of Zambales, respectively.

Sta. Cruz is a first class municipality in the province of Zambales with a land area of 438.46 square kilometers. The 2015 COP recorded 58,151 individuals in Sta. Cruz, which represents 9.84 percent of Zambales' total population. The survey showed that there were more males (29,728) than the female population in Sta. Cruz. The municipality had a 1.47 percent growth rate from 2010, an increase of 4,284 people.

On the other hand, Candelaria is a 3<sup>rd</sup> class municipality with smaller land area of 333.59 and population of 27,174 individuals. The same as of Sta. Cruz, there were more males (13,879) than the female population in Candelaria. The municipality had a 1.58 percent growth rate from 2010, an increase of 2,154 people.

Municipality	Income Class	Land Area (in km²)	Population	Household	Annual Growth Rate	Male	Female
Sta. Cruz	1 <sup>st</sup>	438.46	58,151	13,865	1.47%	29,728	28,423
Candelaria	3 <sup>rd</sup>	333.59	27,174	6,061	1.58%	13,879	13,295

Table 2-46: Population Highlight of Candelaria and Sta. Cruz in 2015

Sta. Cruz is politically subdivided into 25 barangays, while Candelaria has 16 barangays.

Table 2-47: No of Population of Barangays in Candelaria and Sta. Cruz in 2015

CANDELARIA			SANTA CRUZ		
Babancal	1,769		Babuyan 523		
Binabalian	1,951	Bolitoc		3,375	
Catol	1,344		Bangcol	925	
Dampay	927		Bayto	3,925	
Lauis	1,894		Biay	2,379	
Libertador	1,360		Canaynayan	1,225	
Malabon (San Roque)	2,627		Gama	2,025	
Malimanga	1,148		Guinabon	1,351	
Pamibian	1,316		Guisguis	3,356	
Panayonan	1,067	Lipay 6,1		6,190	
Pinagrealan	1,183	Lomboy 1,		1,553	
Poblacion	1,093 Lucapon North		2,521		
Sinabacan	3,563	Lucapon South 3		3,941	
Taposo	1,088	8 Malabago 2,		2,299	
Uacon	3,471		Naulo	2,021	
Yamot	1,373		Poblacion North	3,033	
Total	27,174		Pagatpat	3,101	
			Pamonoran	1,193	
			Sabang	1,138	
			San Fernando	2,227	
			Poblacion South	3,437	
			Tabalong	593	
			Tubotubo North	2,514	
			Tubotubo South	2,062	
			Bulawon	1,244	
			Total	58,151	

2.4.2.2.1 Population by Age Group

Aggregating the age groups in these 16 barangays in Candelaria, those aged 14 and below (consisting of the young dependent population which include infants/babies, children and young

adolescents/teenagers) has an aggregate of 32.6 percent (8,849 people). Those aged 15 up to 64 (roughly, the economically active population and actual or potential members of the work force) constitute a total of 60.6 percent (16,455 people). Finally, the old dependent population consisting of senior citizens (aged 65 and over) has a total of 6.9 percent (1,870 people).



Figure 2-79: Aggregation by Age Group in Candelaria

Aggregating the age groups in the 25 barangays in Sta. Cruz, those aged 14 and below (consisting of the young dependent population which include infants/babies, children and young adolescents/teenagers) has an aggregate of 33.2 percent (19,298 people). Those aged 15 up to 64 (roughly, the economically active population and actual or potential members of the work force) constitute a total of 60.9 percent (35,440 people). The old dependent population consisting of senior citizens (aged 65 and over) has a total of 5.9 percent (3,413 people).



Figure 2-80Aggregation by Age Group in Sta. Cruz

# 2.4.2.2.2 Education and Literacy

The municipality of Candelaria was recorded to have 7,617 population aged 5 to 24 years old attending school in 2015. Of those population aged 10 years old and over, Candelaria had 20,996 individuals who can read and write. This accounted to 77.3 percent of its total population of 27,174.

With regard to availability of government-subsidized education, Candelaria has 16 elementary schools, four (4) secondary schools and one (1) tertiary level school.

The municipality of Sta. Cruz was recorded to have 15,935 population aged 5 to 24 years old attending school. Of those population aged 10 years old and over, Sta. Cruz has 44,771 individuals who can read and write. This accounted to 77.0 percent of its total population of 58,151.

For government-subsidized education, Sta. Cruz has 27 elementary schools, nine (9) public secondary schools and one (1) tertiary level school. A private-owned tertiary school is also available in the area.

School Level	Candelaria	Sta. Cruz	
Elementary	Babancal ES	Almasin ES	
Candelaria – 16	Binabalian ES	Babuyan ES	
Sta. Cruz – 27	Candelaria Central	Bangcol ES	
	Catol ES	Bulawon ES	
	Dampay ES	Canaynayan ES	
	Lauis ES	Don Marcelo C. Marty ES	
	Libertador ES	Gama ES	
	Malimanga ES	Guinabon ES	
	Pamibian IS	Guisguis ES	
	Pinagrealan ES	Malabago ES	
	San Roque ES	Pagatpat ES	
	San Roque ES Annex	Pamonoran ES	
	Sinabacan ES	Sta. Cruz North CS	
	Taposo ES	Tabalong ES	
	Uacon IS	Acoje ES	
	Yamot ES	Bayto ES (Biay ES)	
		Bolitoc ES	
		Bolitoc ES – Annex	
		Lucapon South ES	
		Lupa ES	
		Mapalad ES	
		Naulo ES	
		Pecson Mem. ES	
		Sabang ES	
		San Fernando ES	
		Sta. Cruz South CS	
		Tubotubo ES	

### Table 2-48: List of Schools in Candelaria and Sta. Cruz

High School	Candelaria School of Fisheries	Acoje NHS		
Candelaria – 4	Lauis National High School	Guisguis NHS		
Sta. Cruz – 9	Pamibian IS	Mena Mem. NHS – San		
	Uacon IS	Fernando HS		
		Mena Mem. NHS (Bolitoc NHS)		
		Sta. Cruz NHS		
		Sta. Cruz NHS – Don Marcelo		
		C. Marty HS		
		Sta. Cruz NHS – Jesus F.		
		Magsaysay HS Annex		
		Sta. Cruz NHS – Lipay HS		
		Sta. Cruz South HS		
College	Ramon Magsaysay	Columban College – private		
Candelaria – 1	Technological University –	(Naulo)		
Sta. Cruz – 2	public (Sinabacan)	Ramon Magsaysay		
		Technological University –		
		public (Naulo)		

### 2.4.2.2.3 Health

In Candelaria, there is a Rural Health Unit in Barangay Poblacion. In Sta. Cruz, two (2) Rural Health Units installed in Barangays Poblacion North and Bayto. Aside from these, a number of barangays have their own health centers with Barangay Health Workers serving as volunteers. For hospitalization needs, Candelaria has a government-run hospital, which is the Candelaria District Hospital. In Sta. Cruz, there is also a state-run hospital, which is the Medicare Community Hospital.

# 2.4.2.2.4 Employment

In terms of major occupation group, the municipality of Candelaria recorded 9,211 total gainful workers, while the municipality of Sta. Cruz had 21,627. The top 3 major occupation groups in both municipalities are skilled agricultural, forestry and fishery workers at 22.9 percent (7,067), elementary occupations at 22 percent (6,769), service and sales workers at 17.8 percent (5,495).

Major Occupation Group	Candelaria	Sta. Cruz
Managers	696	1,529
Professionals	526	997
Technicians and associate professionals	317	541
Clerical support workers	326	654
Service and sales workers	1,515	3,980
Skilled agricultural, forestry, and fishery workers	2,190	4,877
Craft and related trades workers	789	1,658
Plant and machine operators and	943	2,447
ussenioiets		

### Table 2-49: Major Occupation Group in Candelaria and Sta. Cruz

Elementary occupations	1,876	4,893
Armed forces occupations	32	38
Other occupation, not elsewhere classified	-	-
Not reported	1	13
Total	9,211	21,627
	30,838	

#### 2.4.2.2.5 Economy

The municipality of Candelaria was recorded by Bureau of Local Government Finance (BLGF) to have an annual regular revenue of PhP111,355,191.48 for the fiscal year 2016. This represented a 6.7 percent increase from the previous year.



Figure 2-81: Candelaria Annual Regular Revenue from 2009 to 2016

The municipality of Sta. Cruz was recorded by BLGF to have an annual regular revenue of PhP206,239,057.94 for the fiscal year 2016. This is a 9.5 percent increase from the previous year.



Figure 2-82: Sta. Cruz Annual Regular Revenue from 2009 to 2016

Commerce in Sta. Cruz is well-developed. There are several banks that can be found in its town proper, such as the Philippine National Bank, Banco de Oro, Bank of Commerce and other rural banks. Remittance centers are also present in the area like Palawan Pawnshop, Cebuana Lhuiller, LBC Express and Western Union.

Sta. Cruz is known for its biggest public market in Zambales, the Sta. Cruz Public Market. Sta. Cruz also has own department store named Magic Mall. Other merchandise stores are available in the municipality such as 7-11, Mercury Drug, Watson Pharmacy and a number of sari-sari stores. Different business establishments can be found in the town proper to cater all the daily needs and other commodities of the nearby communities.

On the other hand, Candelaria has a lot of business establishments operating in its area, majority of which are sari-sari stores. Other shops such as vulcanizing shops, construction supply, gasoline station, bicycle/tricycle shops, optical shop, funeral parlor, school supplies and dress shop cater to the community of Candelaria.

# 2.4.2.2.6 Housing and Shelter Profile

Based on the 2015 COP survey result, Candelaria and Sta. Cruz had a total occupied housing unit of 19,926. The percentage of occupied housing units in Candelaria and Sta. Cruz by the type of construction materials of the outer walls were nearly the same. The wall materials were mostly made of concrete/brick/stone at 61.9 percent (12,149), followed by bamboo/sawali/cogon/nipa at 19.0 percent (3,628), half concrete/brick/stone and half wood at 12.3 percent (2,406) and wood at 4.4 percent (924). Other materials used were galvanized iron/aluminum, makeshift/salvaged/improvised materials and trapal, which contributed to 1.0 percent or less of the total occupied housing units.



# Figure 2-83: Type of Construction Materials (Outer Wall of the House)

On roof materials used in the above type of housing, 84.8 percent (16,387) were mostly made of galvanized iron/aluminum, followed by bamboo/cogon/nipa/anahaw at 9.08 percent (1,847), half galvanized iron and half concrete at 4.7 percent (1,134) and tile/concrete/clay/tile at 1.0 percent (235). Other materials used were galvanized iron/aluminum, makeshift/salvaged/improvised materials and trapal, which contributed to less than 1 percent of the total occupied housing units.



**Figure 2-84: Type of Roof Materials** 

Combining both Candeleria and Sta. Cruz, 90.0 percent (17,927) of the total households had a single house type of building, 7.3 percent (1,456) lives in a duplex and 2.6 percent (515) lives in a multi-residential unit. The rest of the households were observed to be living in a commercial/industrial/agricultural property/land (22) and institutional living quarter (1).



Figure 2-85: Type of House/Building

Combining both Candelaria and Sta. Cruz, 62.9 percent (12,534) own/possesses the house and lot, 24.9 percent (4,966) owns the house and rent-free lot with consent of owner, 5.7 (1,145) percent are rent-free house and lot with consent of owner, and 4.0 percent (789) are renting the house/room including lot.



Figure 2-86: Tenure Status of the Housing Unit and Lot

# 2.4.2.2.7 Utilities

The electricity in Candelaria and Sta. Cruz is provided by the Zambales Multi-Purpose Electric Cooperative (ZAMECO).

Based on the 2015 COP survey result, majority of the households in Candelaria and Sta. Cruz sourced their lighting primarily from electricity at 94.9 percent (18,908). This is followed by use of kerosene/gaas at 3.4 percent (785). Other sources with less than one (1) percent of the households using it were solar panel (80), solar lamp (55), LPG (23), others-not mentioned (66) and oil (2).



Figure 2-87: Kind of Fuel for Lighting

There are two (2) water districts that supply potable water to the municipalities of Sta. Cruz and Candelaria. These are the Sta. Cruz Water District and the Candelaria Water District.

The top 5 source of water supply for drinking in the households of Candelaria and Sta. Cruz were from own tubed/piped deep well at 36.6 percent (7,299). This is followed by shared tubed/piped deep well at 30.6 percent (6,088). Third, they use bottled water at 17.3 percent (3,453). Fourth, they source it from shared faucet/community water system at 5.8 percent (969). And fifth, they use own use faucet community water system at 4.8 percent (963). The rest of the households sourced their drinking water

from protected spring (359), peddler (254), tubed/piped shallow well (275), dug well (194), lake, river, rain and others (36) and unprotected spring (23).



Figure 2-88: Source of Water Supply for Drinking

The top 4 water sources for cooking of Candelaria and Sta. Cruz were from their own tubed/piped deep well (48.9%), shared tubed/piped deep well (31.2%), own faucet/community water system (8.9%) and shared community faucet (5.2%). The rest of the households use tubed/piped shallow well (1.33%), bottled water (1.31%), protected spring (1.25%), dug well (1.2%), peddler (0.5%), lake/river/rain and others (0.2%) and unprotected spring (0.1%).



Figure 2-89: Source of Water Supply for Cooking

# 2.4.2.2.8 Transportation and Communication

Zambales can be reached via land travel from Metro Manila and nearby provinces. Local bus operators ply by the route 24 hours a day. It is about 210 kilometers away from Manila. Its closest functional airport is the Clark International Airport in Pampanga.

Big bus companies like Victory Liner and Five Star ply in the area that can go as far as Manila, Dagupan, Baguio, Tarlac, and Caloocan. Mini-buses are also available to take the locals to Olongapo. The local transportation in the area is mostly tricycle, which operates within its municipality. Jeepneys are also available to routes of Sta. Cruz – Candelaria – Palauig (Zambales) and to Infanta – Dasol – Alaminos (Pangasinan).

The municipalities of Candelaria and Sta. Cruz are provided with mobile communication and internet connection through Smart Telecommunication and Globe Telecommunication services. Aside from the two (2) telecommunication companies, PLDT has launched its Fiber internet to the people of Zambales.

### 2.4.2.3 Population Profile of Impact Barangays

The 15 impact barangays had a total population of 35,825 based on the 2015 COP. The table below shows the number of population of impact barangays:

Municipality	Barangay	No. of
		Population
Candelaria	Uacon (host)	3,471
	Lauis	1,894
	Malabon	2,627
	Malimanga	1,148
	Pamibian	1,316
	Pinagrealan	1,183
	Sinabacan	3,563
	Taposo	1,088
	Yamot	1,373
Sta. Cruz	Lucapon South (host)	3,941
	Bayto	3,925
	Biay	2,379
	Bolitoc	3,375
	Lucapon North	2,521
	Naulo	2,021
Total		35,825

# Table 2-50: Population of Host and Neighboring Barangays

Among the 15 impact barangays, Lucapon South is the most populous. It is followed by Bayto, Sinabacan, Uacon and Bolitoc. These five (5) barangays has a population of more than 3,000 people. The least populous is Brgy. Taposo with 1,088 people.



Figure 2-90: Population of 15 Impact Barangays

Aggregating the age groups together in these 15 impact barangays, those aged 14 and below, consisting of the young dependent population which include infants/babies, children and young adolescents/teenagers, has an aggregate of 33.7 percent (12,066 people). Those aged 15 up to 64, roughly, the economically active population and actual or potential members of the work force, constitute a total of 60.2 percent (21,579 people). The old dependent population consisting of senior citizens (aged 65 and over) has a total of 6.1% (2,180 people).



Figure 2-91: Aggregated Population of Candelaria and Sta. Cruz by Age Group

In the 2015 COP, most of the population of the 15 impact barangays belonged to the economically active population and actual/potential members of the workforce (15 to 64 years old) with 60.2 percent (21,579). Those who belonged to the senior age level (65 years old and over) were documented at 6.1 percent (2,180).

Barangay	Population	Aged 14 and below	Economically Population Actual/Potential Members of	Active and the	65 and over
			Workforce (15 to 6	4 yo)	
Candelaria					

Uacon (host)	3,471	1,177	2,039	255
Lauis	1,894	598	1,142	154
Malabon	2,627	793	1,671	163
Malimanga	1,148	389	697	62
Pamibian	1,316	389	804	123
Pinagrealan	1,183	445	687	51
Sinabacan	3,563	1,170	2,183	210
Taposo	1,088	390	641	57
Yamot	1,373	527	786	60
Subtotal	17,663	5,878 (33.3%)	10,650 (60.3%)	1,135 (6.4%)
Sta. Cruz				
Lucapon South	3,941	1,391	2,321	229
(host)				
Bayto	3,925	1,279	2,428	218
Biay	2,379	784	1,438	157
Bolitoc	3,375	1,165	2,016	194
Lucapon North	2,521	842	1,531	148
Naulo	2,021	727	1,195	99
Subtotal	18,162	6,188 (34.1%)	10,929 (60.2%)	1,045 (5.8%)
Total	35,825	12,066 (33.7%)	21,579 (60.2%)	2,180 (6.1%)

### 2.4.2.3.1 Perception Survey

The perception survey covered the (7) impact barangays of the project. The perception survey in six (6) barangays was conducted on 24-26 June 2021. Due to COVID-19 death of one of the barangay officers and a number of COVID-related cases in Lucapon South, the Barangay Captain of Lucapon South requested for the postponement of the perception survey to give time for contact tracing and minimize further transmission. Therefore, the perception survey for Lucapon South was adjusted to 2-4 July 2021.

The seven (7) identified barangays covered in this survey were chosen based on: 1) those that are direct impact or hosts, and 2) those that are being used as hauling roads. Hence, the survey was conducted in the two (2) host barangays (Uacon, Candelaria and Lucapon South, Sta. Cruz) and the other five (5) neighboring barangays in Sta. Cruz (Bayto, Biay, Bolitoc, Lucapon North and Naulo).

### Table 2-52: Perception Survey Activity

Activity	Timeframe	Location	
	24-26 June 2021	Barangay Uacon - Candelaria	
		Barangay Bayto - Sta.Cruz	
		Barangay Biay - Sta.Cruz	
Perception Survey		Barangay Bolitoc - Sta.Cruz	
		Barangay Lucapon North - Sta.Cruz	
		Barangay Naulo - Sta.Cruz	
		Barangay Lucapon South - Sta.Cruz	
	2-4 July 2021	Barangay Lucapon South – Sta. Cruz.	

Out of the 21,633 population in Candelaria and Sta. Cruz, there are 4,326 households as the target population. The survey sample size in the perception survey was 159.
The allocation of number of respondents by barangay was based on being the host barangays and the neighboring barangays. Since the two (2) host barangays are Uacon and Lucapon South, in which the actual mining area is located, 60 percent of the household respondents were allocated to them. The remaining 40 percent was allocated to the five (5) neighboring barangays. The table below shows the distribution of number of respondents:

Municipality	Barangay	Allocated Number of Household Respondents
	Hosts:	
Candelaria	Uacon	44
Sta. Cruz	Lucapon South	51
		95 (60%)
	Neighboring	
Sta. Cruz	Bayto	18
Sta. Cruz	Biay	11
Sta. Cruz	Bolitoc	15
Sta. Cruz	Lucapon North	11
Sta. Cruz	Naulo	9
		64 (40%)
Total		159

### Table 2-53: Allocation on Number of Respondents

#### 2.4.2.3.2 Demographics

There were 159 sample respondents interviewed for the survey. Of this, there were 84 females (52%) and 75 males (48%). Most of the respondents were between age 30-39 years old (44, 28%) and are mostly married (109, 73%). The most number of household members were from the age bracket of 11-20 years old at 151 individuals (72%).



Figure 2-92: a) Gender and b) Age of Respondents



Figure 2-93: a) Civil Status and b) No. of Household Members

There were 115 respondents interviewed from Sta. Cruz. However, only 74 respondents (47%) answered that they were born in Sta. Cruz, followed by those born in Candelaria with 63 respondents (40%). Of the 144 respondents (91%) who were born in Zambales, 72 respondents (47%) have the ethnic origin of Zambal. Other ethnic origins present are Tagalog (54, 36%), Ilocano (17, 11%) and Visaya (9, 6%).



Figure 2-94: a) Birthplace and b) Ethnic Origin

There are 44 respondents (30%) who have been living in their residency for more than 51 years. Those who have been living for more than 10 years accounted for 94 respondents (59%). Half of the respondents do not own their land but allowed free use and 40 percent (63) owned their land. There are 12 (8%) inhabitants who dwell in the land that they do not own or rent, without the consent of the owner.



Figure 2-95: a) Years of Residency and b) Status of Tenure

Most of the respondents have a single-type of building. This accounts to 97 percent (154) of the total respondents. Sixty-two percent (99 respondents) of 159 respondents used mixed concrete and wood in their house.



Figure 2-96: a) Type of Building and b) Type of House

### 2.4.2.3.3 Religion

Majority of the respondents (151, 95%) are Catholics and 8 respondents are from the minorities, such as the Iglesia ni Cristo (3, 2%), Born Again (2, 1%) and Baptist, Methodist and Mormon (3, 2%).



Figure 2-97: Religion

## 2.4.2.3.4 Educational Profile

In terms of respondents' educational attainment, 41 respondents (26%) are high school undergraduates and 37 respondents (23%) are high school graduates. Only 12 (8%) of the respondents were able to finish college education.



Figure 2-98: Educational Attainment

When asked if any of the members of the family were able to study in a public school and a private school, 146 (92%) said that their family members are studying/were able to study in a public school and 52 (33%) are studying/were able to study in a private school. Since the Department of Education's (DepEd) new system of remote learning due to the pandemic, students are studying independently with guidance from other members in the household. When asked if the respondents are satisfied with the new system of education, 107 respondents (67%) said "Yes", while the 45 (28%) said "No". The reasons stated for "No" were "mahirap magturo ng module" and "walang internet at gadget".

The respondents were also asked if they have any member in the family who is a scholar. 121 (76%) said that they none of the family members are receiving scholarship, while 36 (36%) said that a family member is receiving a scholarship from institutions, such as Commission on Higher Education (CHED), DepEd, barangay offices, mining companies and individuals/politicians.



Figure 2-99: a) Type of School and b) Satisfaction on Education



Figure 2-100: Scholarship

# 2.4.2.3.5 Employment

On the respondents' employment status, 30 respondents (27%) are working in the private office, 29 respondents (19%) are in the government office and majority (64, 54%) is self-employed. Other respondents are retired, students and not employed.

Of the 46 percent (123) who are working in the private and government office, 18 respondents (31%) are regular employees and 41 respondents (69%) are casual employees. Those belong to the self-employed population are into fishing, farming, transportation and in service/sales. Combining the three (3) employment type, majority (99, 81%) of the respondents work at their own barangay, 21 respondents (17%) work outside of their barangay and 3 respondents (2%) at the National Capital Region (NCR).







Figure 2-102: Place of Work

To discuss on the standard occupational classification of the respondents, majority (33, 21%) is in elementary occupations or the laborers and unskilled workers, 29 respondents (18%) belong to the skilled agricultural, forestry and fishery workers, 23 respondents (14%) are part of the service and sales workers, 20 respondents (13%) are running their own business, such as the sari-sari store, and 12 respondents (8%) are in the category of plant and machine operators and assemblers.



Figure 2-103: Occupational Classification

The respondents were also asked if there is any member of the family who is working at a mining company, 72 respondents (45%) said "Yes" and 87 (55%) said "No".



Figure 2-104: Respondents Working in the Mining Industry

The breadwinner in the family is mostly the father at 114 respondents (70%). The mother (10%) and the child/children (20%) also bring income into the family. The monthly income of the family is below P11,999.00 as stated by 117 respondents (79%), 18 respondents (12%) have a monthly income between P12,000.00 to P15,999.00, six respondents (4%) between P16,000.00 to P19,999.00, and the rest (8, 5%) have a monthly income between P20,000.00 to P59,999.00.



Figure 2-105: a) Breadwinner and b) Monthly Family Income

## 2.4.2.3.6 Transportation and Communication

The respondents are mostly using public transportation with 94 respondents (59%). The remaining 41 percent have their own mode of transportation, such as the tricycle (22), motorcycle (19), car (10) and owner-type jeep (1).

For the mode of communication, all respondents (159) use their cellphone as the means to contact other people and six (4%) uses email too.

2021 EPRMP



Figure 2-106: a) Mode of Transportation and b) Mode of Communication

# 2.4.2.3.7 Health and Welfare

The respondents were asked if there are underlying health problems in their family. One hundred two respondents (64%) mentioned of having major health concerns in the family, while 57 respondents (36%) answered none. Those who feel ill seek medical treatment from different treatment facilities: the Barangay Health Center (38%), public hospital (29%), private clinic (18%) and private hospital (4%).



Figure 2-107: a) Health Concerns and b) Treatment Facilities

The top 6 diseases/health problems in the family as stated by 111 respondents (54.1%) are hypertension (46, 29%), asthma (14, 9%), lung disease (8, 5%), heart disease (7, 4%), stroke (6, 4%) and diabetes (5, 3%).



Figure 2-108: Top Six (6) Diseases/Health Problems in the Family

The top 6 health services availed by 159 respondents in their barangay are vaccination (131, 82%), family planning (97, 61%), maternity care (85, 53%), free vitamins and medicines (71, 47%), check-up (32, 20%) and deworming (25, 16%).



Figure 2-109: Availed Barangay Health Services

To find out what were the problems encountered by the respondents when they seek medical help from their Barangay Health Center, they mentioned the lack to no available medicine (44%). These medicines are usually for those with diabetes, hypertension, tuberculosis, etc. There is also a problem of no ambulance or service for emergency situation (38%), no presence of doctor or nurse (27%) and lack to no medical equipment and laboratories (8%).



Figure 2-110: Problems Encountered in Barangay Health Centers

The case of death in the family in the last five (5) years and its causes were included in the questionnaire. This is to see the mortality rate in the sample population. The survey revealed that 27 respondents (18%) have experienced death in their household. The top three (3) causes of death were heart attack/stroke (11, 61%), hypertension (5, 28%) and cancer (2, 11%). The other causes of death were accident, blood disease, kidney failure, leptospirosis, pneumonia, infant death, old age and medicine overdose.



Figure 2-111: a) Mortality and b) Cause of Death

The respondents were asked on their experience on pollution and disasters. Forty-three respondents (72%) mentioned that the quality of air has changed in the last five (5) years. They perceived that the dust coming from the mining trucks is one contributor and the other is the burning of garbage. On noise, more respondents (80, 55%) experienced disturbing noise. Half of these respondents attributed the noise to the mining trucks and others were from other vehicles and neighbors. On flooding, 93 respondents (59%) have experienced flooding in the last 10 years. The most remarked flooding they experienced was in 2015 due to Typhoon Lando. Others also mentioned that every year they are experiencing flooding in their area. The most affected respondents were from Barangays Uacon, Biay,



Bayto and Lucapon South. Lastly, 55 respondents (35%) mentioned experiencing earthquake in the last 10 years.

Figure 2-112: Environmental Pollution and Disaster

Yes No

## 2.4.2.3.8 Water and Sanitation

🛾 Yes 🔳 No

There are two types of responses made by respondents as their source of drinking water – deep well and water refilling station. One hundred eleven (70%) get their drinking water from water refilling station and 48 respondents (48%) get them from deep well. In terms of water to be used for cooking and other means, the respondents still rely on their own deep well (149, 94%). Other respondents use water from private waterworks (8, 5%) and from the spring/river (2, 1%). When asked if they have experienced any contamination of their water in the last five (5) years, 117 respondents (81%) said "No", while 28 respondents (19%) said "Yes". They are certain of the contamination because the color of the water has changed and they experienced diarrhea after, thus they resorted to buying water from the refilling stations.



Figure 2-113: a) Source of Drinking Water and b) Source of Water for Other Uses



Figure 2-114: Water Contamination

In terms of sanitation facilities, a large number of respondents (151, 95%) are using their own toilet (flush/non-flush) as compared to those who are still using a public/communal toilet (8, 5%). There is no regular garbage collection in the areas of Biay, Naulo, Balutoc, Bayto and Lucapon South (117, 75%). In areas where solid waste cannot be collected, they either use the process of incineration/burning (100, 45%) and/or own backyard landfilling (73, 32%). Others just wait for the day of collection or they bring it to the town proper.



Figure 2-115: a) Type of Toilet and b) Garbage Collection



Figure 2-116: Waste Disposal

2.4.2.3.9 Community Relationship, Culture and Values

On settlement of people in the impact barangays, 34 respondents (21%) knew of in-migration in their barangay and 23 (15%) percent knew of out-migration. The reasons for movements of these people were due to job/business opportunities, marriage to another, or bought a property.

2021 EPRMP



Figure 2-117: In-migration and Out-migration

The respondents were asked for their perception on the relationship of people in the neighborhood and the relationship of the community to its barangay officials. Sixty-two respondents (39%) rated five (5) or highest positive rating on the relationship of neighborhood, while on the relationship with the barangay officials, 68 respondents (43%) rated it three (3) or neutral.



Figure 2-118: a) Relationship of the Neighbourhood and b) Relationship with Barangay

To check the community's awareness on the presence of violence against women and children (VAWC) and crimes, and the interventions done by their barangay office, the respondents were asked if they knew any of these offenses. Twenty-seven respondents (17%) mentioned of knowing a case/cases of VAWC. Twenty-five of these respondents were all pertaining to a rape case. The presence of VAWC in their own barangay was seen in Barangay Uacon where 18 respondents knew of the rape offense and Barangay Naulo has 7 respondents knew of the same offense. In Barangay Biay, two (2) harassment cases were known. As for the intervention, the respondents remarked that barangay officials, police officers and social workers were present to help the victim.





To get the respondents' opinion on what they would want to improve in their community, 41 respondents (25%) would like to have a job or livelihood programs, 23 respondents (14%) would like to have cooperation in the community, 16 respondents (10%) would like to have their roads and drainage fixed. They have remarked that roads are dusty at dry season and muddy at rainy season. The drainages were also clogged, which they believed have caused flooding in their area. Twelve respondents (8%) answered that they do not approve of mining, 7 respondents (4%) like to have facilities, such as evacuation center, church, streetlights, senior citizen center, and health clinics with complete equipment.



Figure 2-120: Improvement in the Community

## 2.4.2.4 Perception on Community Facilities and Services

This part shall discuss the perception of respondents on the facilities and services available in their barangay. The ratings presented were 1 (not at all satisfied), 2 (partly satisfied), 3 (satisfied), 4 (more than satisfied) and 5 (very satisfied).

### 2.4.2.4.1 Livelihood/ Job Opportunities

This covers the level of satisfaction of respondents on the availability of livelihood/job opportunities in the barangay.

Most respondents (71, 45%) rated the economic opportunities in their barangay as level "3" or satisfied and the least respondents (16, 10%) perceived it as "4" or more than satisfied and the lowest rating of "1" received 36 respondents (23%).



Figure 2-121: Level of Satisfaction on Livelihood/Job Opportunities

## 2.4.2.4.2 Health and Welfare

This covers the level of satisfaction of respondents to life and health status of their barangay in terms of availability of medical personnel, health workers, health facilities and other health services.

Most respondents (62, 39%) rated this area "5" or very satisfied. Least respondent (1, 0.6%) rated this as "1" not at all satisfied and the 3.8 percent or 6 respondents rated it as "2" or partly satisfied.





### 2.4.2.4.3 Peace and Order

This covers the level of satisfaction of respondents on how peace and order were implemented and handled in their barangay. This involves crime prevention, law implementation and resolution of the barangay, police authorities and the LGU.

Most respondents (80, 50%) rated the peace and order in their barangay as "3" or satisfied. Least respondents (2, 1%) rated it "1" or not at all satisfied and 9 respondents (6%) rated it as "2" or partly satisfied.



Figure 2-123: Level of Satisfaction on Peace and Order

### 2.4.2.4.4 Sanitation/ Cleanliness

This covers the level of satisfaction of respondents in their barangay's sanitation/sewage/garbage disposal and cleanliness of the area.

Most respondents (92, 58%) rated this area "3" or satisfied. Least respondent (1, 0.6%) rated it "1" or not at all satisfied and 12 (8%) respondents rated it "2" or partly satisfied.





#### 2.4.2.4.5 Education

This covers the level of satisfaction of respondents on the availability of schools, quality of education and presence of competent teachers in their barangay.

Most respondents (70, 44%) rated this area as "3" or satisfied. Least respondent (1, 0.6%) rated it as "1" or not at all satisfied and 8 (5%) respondents rated it "2" or partly satisfied.



Figure 2-125: Level of Satisfaction on Education

#### 2.4.2.4.6 Infrastructure

This covers the level of satisfaction of respondents on the available infrastructure in their area. This includes the roads, bridges, tunnels, ports, drainage system, streetlights, etc.

Most respondents (86, 54%) rated this area as "3" or satisfied. Least respondents (4, 3%) rated this "1" or not at all satisfied and 19 (12%) rated it "2" or partly satisfied.



### Figure 2-126Level of Satisfaction on Infrastructure

### 2.4.2.4.7 Utilities

This covers the level of satisfaction of respondents on water supply, power supply and telecommunication services.

2021 EPRMP

Most respondents (79, 50%) rated this area as "3" or satisfied. Least respondents (2, 1%) rated this "1" or not at all satisfied and 13 (8%) rated it "2" or partly satisfied.



Figure 2-127: Level of Satisfaction on Utilities

### 2.4.2.4.8 Facilities and Amenities

This covers the level of satisfaction of respondents on the presence of facilities and amenities in their community. This includes churches, parks, beaches, daycare, sports facilities, playground, open spaces, etc.

Most respondents (64, 40%) rated this area as "3" or satisfied. Least respondents (8, 5%) rated this "1" or not at all satisfied and 13 (8%) respondents rated it "2" or partly satisfied.



Figure 2-128: Level of Satisfaction on Community Facilities and Amenities

### 2.4.2.4.9 Commercial Services

This covers the level of satisfaction of respondents on the presence of commercial services in their area. This includes the restaurants, stores, hardware supplies, banks, malls, markets, etc.

Most respondents (70, 44%) rated this area as "3" or satisfied. Least respondents (4, 3%) rated this "1" or not at all satisfied and 24 (15%) respondents rated it "2" or partly satisfied.



Figure 2-129Level of Satisfaction on Commercial Services

### 2.4.2.4.10 Barangay Services

This covers the level of satisfaction of respondents on the services of Barangay Office to the community.

Most respondents (57, 36%) rated this area as "5" or very satisfied. Least respondents (2, 1%) rated this "1" or not at all satisfied and 7 (4%) respondents rated it "2" or partly satisfied.



Figure 2-130: Level of Satisfaction on Barangay Services

## 2.4.2.4.11 Transportation

This covers the level of satisfaction of respondents on the management of transportation system in the area. This includes availability of means of transportation and traffic management.

Most respondents (89, 56%) rated this area as "3" or satisfied. Least respondents (2, 1%) rated this "1" or not at all satisfied and 10 (6%) respondents rated it "2" or partly satisfied.



Figure 2-131Level of Satisfaction on Transportation

## 2.4.2.4.12 Disaster Mitigation, Preparedness and Response

This covers the level of satisfaction of respondents on their barangay's mitigation, preparedness and response to disasters or hazards. This includes the readiness of the barangay in reducing the long-term risk of hazards to people, emergency plans and emergency response in case the disaster strikes the community.

Most respondents (69, 43%) rated this area as "3" or satisfied. Least respondent (1, 0.6%) rated this "1" or not at all satisfied and 19 (11%) respondents rated it "2" or partly satisfied.



Figure 2-132: Level of Satisfaction on Disaster Management

## 2.4.2.4.13 Local Government Unit and Other Government Institution Support

This covers the level of satisfaction of respondents on the government institution, especially the LGU, to their community. This includes support in all areas from the province, municipality, police authorities, DSWD, DOH, etc.

Most respondents (66, 41%) rated this area as "3" or satisfied. Least respondent (1, 0.6%) rated this "1" or not at all satisfied and 17 (11%) respondents rated it "2" or partly satisfied.



Figure 2-133: Level of Satisfaction on LGU and other Government Support

### 2.4.2.5 Perception on the Quality of Environmental Factors

This part discusses the perception of respondents on the quality of environmental factors in their barangay. The ratings presented were 1 (very poor), 2 (poor), 3 (satisfactory), 4 (good) and 5 (excellent).

### 2.4.2.5.1 Air

Most respondents (65, 40%) rated the air quality as "3" or satisfactory. Least respondent (2, 1%) rated this "1" or very poor. There are 42 respondents (26%) perceived the quality of air as "5" or excellent.



### Figure 2-134: Perception on the Quality of Air

### 2.4.2.5.2 Noise

Most respondents (61, 38%) rated the noise quality as "3" or satisfactory. Least respondent (3, 2%) rated this "1" or very poor. There are 23 respondents (14%) perceived the quality of noise as "5" or excellent or no disturbing noise at all.



Figure 2-135: Perception on the Quality of Noise

### 2.4.2.5.3 Drinking Water

Most respondents (58, 36%) rated drinking water quality as "5" or excellent. Least respondent (23, 14%) rated this "2" or poor. There are 42 respondents (26%) perceived the quality of drinking water as "3" or satisfactory.



Figure 2-136: Perception on the Quality of Drinking Water

## 2.4.2.5.4 River, Lakes and Creek

Most respondents (85, 53%) rated the quality of the river and creek as "3" or satisfactory. Least respondent (12, 8%) rated this "1" or very poor. There are 15 respondents (9%) perceived the quality of the river, lakes and creek as "5" or excellent.



Figure 2-137: Perception on the Quality of River, Lakes and Creek

### 2.4.2.5.5 Marine/ Sea

Most respondents (63, 40%) rated the quality of the marine/sea as "3" or satisfactory. Least respondent (21, 13%) rated this "1" or very poor. There are 22 respondents (14%) perceived the quality of the marine/sea as "5" or excellent.



Figure 2-138: Perception on the Quality of Marine/Sea

## 2.4.2.5.6 Soil/ Land

Most respondents (80, 50%) rated the quality of soil/land as "3" or satisfactory. Least respondent (6, 4%) rated this as "1" or very poor. There are 17 respondents (10%) perceived the quality of the soil/land as "5" or excellent.



Figure 2-139: Perception on the Quality of Soil/Land

### 2.4.2.5.7 Flora (Plants/ Trees)

Most respondents (80, 50%) rated the quality of soil/land as "3" or satisfactory. Least respondent (9, 6%) rated this as "1" or very poor. There are 24 respondents (15%) perceived the quality of flora as "5" or excellent.



Figure 2-140: Perception on the Quality of Flora

## 2.4.2.5.8 Fauna (Animal Life)

Most respondents (78, 49%) rated the quality of fauna as "3" or satisfactory. Least respondent (13, 8%) rated this as "5" or excellent. There are 21 respondents (13%) both perceived the quality of fauna as "1" or very poor and "2" or poor.



Figure 2-141: Perception on the Quality of Fauna

2.4.2.6 Perception Survey- Awareness and Perception about the Mining Project

### 2.4.2.6.1 Knowledge of the Project

There are 110 respondents (69%) who do not know about the existence of ZDMC's mining project and 49 respondents (31%) know about it.



Figure 2-142: Number of Respondents with Knowledge of the Project

### 2.4.2.6.2 Understanding of the Project

Those who know (49, 31%) about the existence of ZDMC mining project, 45 respondents (92%) said that they have slight to moderate understanding of the project and 4 respondents (8%) said they have adequate understanding.



Figure 2-143: Number of Respondents with Understanding of the Project

## 2.4.2.6.3 Knowledge of the Expansion Plan

Those who know (49, 31%) about the existence of ZDMC mining project, 34 respondents (69%) said that they know about the expansion plan of ZDMC and 15 (31%) said they do not have any knowledge of the expansion plan.



Figure 2-144: Number of Respondents with Knowledge of the Expansion Plan

# 2.4.2.6.4 Source of Information

Those who know (34 respondents) about the expansion plan of ZDMC mentioned that the information mostly came from the barangay office (22, 64%). This is followed by friend/neighbor (7, 21%), social media/internet (2, 6%), organization (2, 6%) and television/radio (1, 3%).



Figure 2-145: Respondents' Source of Information

## 2.4.2.6.5 Attendance to ZDMC's Information Drive

All respondents (159) were asked if they were able to attend any information drive of ZDMC. Ten respondents (6%) said they have attended, while 94 percent (149) have not.



Figure 2-146: Attended the IEC or Information Drive

### 2.4.2.6.6 Perception on ZDMC's Mining Project

To find out how the respondents perceived the presence of ZDMC's mining project, the respondents were asked if they think the mining project would be beneficial to the community. Eighty-seven respondents (55%) said "Yes", while 66 respondents (41%) said "No". Six respondents (4%) did not specify their response.

There are 107 respondents (67%), including those who previously answered that the mining project is not beneficial, said that ZDMC mining project would be beneficial for as long they provide a long-term

social development projects like jobs/livelihood projects, medicines, scholarships, etc. (77, 48%), improve the roads, drainage, streetlights, etc. (17, 11%), help build facilities, such as clinics, evacuation center, church, senior citizen, recreation area, etc. (9, 6%) and be a responsible miner (4, 3%). On the other hand, there are also responses of "stop mining" from 20 respondents (13%).

The low level of awareness on the project indicates that ZDMC needs to be more proactive in its information, education and communication (IEC) campaign efforts to have a fully aware constituents in every impact barangays. This may also improve the social acceptability of the mining project when benefits and accomplishments are presented to the entire community.



Figure 2-147: Responses on whether the mining project is beneficial



Figure 2-148: Responses on how the mining project can help the Community

# 2.4.2.7 SUMMARY OF COMMUNITY ISSUES AND CONCERNS

Below is the table presenting the overall community issues and concerns in the different social aspects as gathered from the perception survey, KIIs and FGDs.

SOCIAL	ISSUES/CONCERNS	RECOMMENDATIONS
ASPECTS		
Livelihood	<ul> <li>Lack of available jobs in the mining companies. Others who were interviewed think that there are "palakasan" happening in the mining companies.</li> <li>Lack of available jobs due to COVID-19. Those who were working outside the municipality lost their jobs; hence, were forced to go back to their barangay</li> <li>Barangay health workers received less than 500 a month, too small to even last a week</li> <li>Sangguniang Kabataan seeks support for the out-of-school youths.</li> </ul>	<ul> <li>For seasonal or non-regular employees, maybe setting up a rotational employment will help all the community members who do not have a job.</li> <li>Help the community set-up a sustainable livelihood projects, from resource mobilization to marketing of the products. The livelihood projects can be from raw materials available/common in the community, can be gender-sensitive and clusterbased.</li> <li>Provide skills development to children and out-of-school youth in areas of leadership, computer literacy, arts, sports, baking, etc. "learn and earn" approach. The goal is they learn skills and increase their employability.</li> <li>Help increase the involvement of young people in the development of programs and policies in the community</li> <li>Provide seminars on family life, values formation, etc.</li> </ul>
Health and Welfare	<ul> <li>Insufficient medical equipment (e.g. stethoscope, thermometer, blood pressure monitor and nebulizer) and facilities with available nurse and doctors, esp. during emergencies in the Barangay Health Centers</li> <li>Lacking/no medical personnel</li> </ul>	<ul> <li>Expand the scope of healthcare system of the barangay.</li> <li>Provide each impact barangays a complete set of medical equipment.</li> <li>Provide preventive medical care, consultations and</li> </ul>

# Table 2-54: Summary of Issues and Concerns

SOCIAL ASPECTS	ISSUES/CONCERNS	RECOMMENDATIONS
	<ul> <li>Lacking medicine</li> <li>No evacuation center</li> <li>Malnutrition amongst children</li> </ul>	<ul> <li>treatments regularly, e.g. every quarter.</li> <li>Strengthen communities so that they can improve their own health (seminars on health)</li> <li>Set-up and train volunteers per sitio/purok who can do health monitoring, first-aid, disaster response, etc.</li> </ul>
Education	<ul> <li>No gadget and internet for online studying/research</li> <li>Insufficient budget for printing (paper and ink) of modules</li> <li>Only few are being given the chance to get scholarships from the mining companies. There is an issue of <i>"palakasan"</i></li> <li>Presence of out-of-school youths</li> <li>Improve the IEC activities of ZDMC. A number of community members do not know about the mining companies operating in the area and the available benefits for them (e.g. people are unaware of the scholarship offering).</li> </ul>	<ul> <li>Provide literacy program for the children, youth and adult. Help the children and youth, together with the barangay head and DepEd, to attend DepEd's Alternative Learning System (ASL).</li> <li>Capacitate community members who can teach/tutor students needing assistance.</li> <li>Intensify IEC activities, use different channels, to distribute information to target population. Make sure that ongoing and future programs are known by all and not just the barangay officials.</li> <li>Ease the screening/eligibility of scholarship applicants. As mentioned by participants during the stakeholders and KII meetings, there are students who do not have the financial capacity to support their education but was not able to pass the exam. They are not as intelligent as those who passed but they are very enthusiastic to study and have the potential.</li> </ul>

2021 EPRMP

SOCIAL ASPECTS	ISSUES/CONCERNS	RECOMMENDATIONS
		With this, maybe the exam should include behavioral/character assessment of the individual and not just the cognitive part.
Peace and Order	<ul> <li>Presence of violence against women and children</li> <li>Rumor-mongering amongst the community</li> </ul>	<ul> <li>Strengthen social relationships and support.</li> <li>Strengthen Barangay Peace and Order Committee/Council</li> <li>Set-up and train volunteers per sitio/purok to monitor peace and order situation in their area.</li> <li>Provide seminars on law regarding VAWC and other laws relevant to the community. The goal is to make the community knowledgeable of their rights and options.</li> </ul>
Environment	<ul> <li>The fishermen believed that the waste from stockpile contaminated the coastal areas. The color of the sea has changed to brown. Hence, affected their source of livelihood</li> <li>Siltation of rivers and Uacon lake</li> <li>People fear the soil erosion and landslide due to mining</li> <li>Mining has done damage to agricultural lands especially when it is rainy season, the mud from the mining sites flow into their farm and their irrigation</li> </ul>	<ul> <li>Capacity building for barangay officials, stakeholders and communities in environmental laws, protection, monitoring and reporting.</li> <li>Strengthen reinforcement of resolutions and laws pertaining to protection of the environment, such as proper garbage disposal, use of illegal type of fishing, etc.</li> <li>Implement measures to protect and monitor compliance of the community and industrial offices in the area.</li> <li>Have a solid waste management system, such as</li> </ul>

SOCIAL ASPECTS	ISSUES/CONCERNS	RECOMMENDATIONS
	<ul> <li>Trucks carrying soil generate dust on the road. These dusts go into people's homes. When it is raining, mud is another problem making the road unsafe for road users</li> <li>The drainage system is blocked by solid waste</li> <li>Lack of garbage collection system.</li> </ul>	<ul> <li>imposing proper segregation, regular collection of garbage and use of 3Rs (recycling, reusing and reducing)</li> <li>Monitor compliance of hauling trucks and penalize those who do not comply.</li> <li>Have a regular drainage/canal cleaning</li> <li>Capacity building to reduce and utilize solid waste products into useful and profitable resources.</li> <li>Provision of Materials Recovery Facility in each barangay to enhance the solid waste management program.</li> <li>Provision of a garbage truck and staff to collect solid waste from impact barangays.</li> </ul>
Utilities and Infrastructures	<ul> <li>Poor communication signal</li> <li>Poor street lighting</li> <li>Poor road condition</li> </ul>	<ul> <li>Collaborate with telecommunication companies on setting up a cell site to barangays with slow connection/no connection.</li> <li>Set-up an internet connection, monitored by community leaders, for the internet needs of students.</li> <li>Provision of a library/study area for each barangay where students can have access to educational materials and the internet.</li> <li>Provide street lighting for the safety of the community.</li> <li>Collaborate with the Barangay Office, LGU, DPWH and other</li> </ul>

SOCIAL ASPECTS	ISSUES/CONCERNS	RECOMMENDATIONS
		mining firms on road improvement.
Transportation	<ul> <li>Trucks creating traffic (when trucks line up on the highway, it is hard for other road users to overtake)</li> <li>Other truck drivers go beyond the speed limit, not covering the trucks to prevent soil from falling, and moving before and after the truck ban,</li> <li>Trucks creating noise, especially before and after the truck ban.</li> <li>The trucks have created damage on the roads.</li> <li>Truck drivers posing danger to those crossing the streets and small vehicle users.</li> </ul>	<ul> <li>Make an agreement amongst impact barangays on traffic management related to hauling trucks, such as truck movements (ex. distance of at least three truck lengths or 50 meters behind a travelling haul truck), signs and speed limits, right of way, parking, and penalties.</li> <li>During the meeting with stakeholders, it was recommended that in order for the residents to identify and report which hauling truck does not follow the rules, trucks should be color-coded or the name of the mining company (in big tarpaulin) be put on the side and back of the truck, together with its plate number.</li> </ul>

### 3 ENVIRONMENTAL MANAGEMENT PLAN

#### 3.1 The Land

#### 3.1.1 Loss of Vegetation Cover

Site clearing of the proposed expansion areas will remove vegetation cover of an area covering approximately 82.39 ha. This impact will be long term, unavoidable highly significant and irreversible.

Based on the mining plan of ZDMC, progressive rehabilitation will be done where parcels are immediately rehabilitated upon depletion of ores and leaves only the current active mining areas open. This ensures that the areas that are being cleared are kept to the minimum.

#### 3.1.2 Habitat Disturbance

The loss of flora especially along forested areas will cause direct habitat loss for faunal species residing within the disturbed areas and vicinities. The removal of fruit bearing trees will deprive other wildlife species of important food sources. Similarly, the loss of mature trees will decrease the sources of seeds and regenerants. Seeds are dispersed by wind action and through the wildlife species that feed on it.

Loss of feeding grounds will displace these wildlife species. Likewise, natural regeneration of nearby areas may be slowed by the loss of mature seed producers. This impact is long term, highly significant, unavoidable, however reversible.

#### 3.1.3 Physiological Stress to Floral and Faunal Species

The construction of mine facilities is expected to generate noise and dust from using heavy equipment and removal of vegetation cover. Noise and dusts have significant impact on wildlife. Most of the wildlife species are not accustomed to loud noises. Nesting habits of birds and other wildlife species are affected by loud noises. On the other hand, excessive dust affects their respiration.

Floral species are likewise affected by excessive dust. Excessive dust may cover the leaf surface and clog the stomates which may stunt plant growth. Fruits that may be covered with dust maybe rendered unpalatable and will further reduce food sources for wildlife species. Regulating speeds of vehicles and equipment in dusty areas to 20 km/hr mitigates dust dispersal. Also, proper maintenance of vehicles and heavy equipment inc. fitting with appropriate mufflers or silencers to decrease noise levels. This impact is short term, unavoidable, moderately significant to significant but reversible.

#### 3.1.4 Change in Community Structure

The removal of vegetation cover in the expansion areas will result in changes with the community structure. Vegetative areas will be converted to mining areas. Species diversity, dominance, frequency will be changed from the loss of cover. This will be further affected by loss of mature trees that could be a source for seeds and regenerants which promotes natural succession. This impact will be long term, unavoidable, and significant.
#### 3.1.5 Wildlife Species Displacement

When wildlife is deprived of their essential requirements for survival, displacement and disappearance of species follows leading to loss of biodiversity and ecological imbalance. Intolerant and less mobile species such as tree frogs and small rodents may die off as a result of the direct loss of habitat while tolerant species will be displaced and may just migrate to nearby areas. However, these species are widely distributed within the MPSA area. There are also wildlife species such as civet cats in the area that are tolerant to habitat alteration which are expected to persist even during the mining development and operation phase. To mitigate this impact, patches of forest should be maintained near the mining areas so as to provide refuge for displaced fauna. This impact is long term, significant and unavoidable but reversible.

#### 3.1.6 Loss of Topsoil and Soil Erosion

Land clearing and earthmoving activities during construction phase of the proposed expansion will remove most of the organic matter content of the topsoil and the overburden materials underneath it. Topsoil and overburden will be stockpiled separately as much as possible. This change will be permanent and mostly irreversible. Topsoil materials from stockpiles if not properly stored will be leached and carried to the water bodies by surface run-off. This impact will be significant and irreversible.

Areas stripped of vegetation cover will be prone to erosion form exposure to wind and rain. Soil erosion however is dependent on climate, topography and soil type. In case the construction/development phase of the proposed expansion area starts during the rainy season, soil erosion is exacerbated in the absence of erosion control measures since finer soil materials are carried easily by surface run off. This impact will be short term, unavoidable, highly significant and irreversible since lost soil will not be recovered.

#### 3.1.7 Soil Contamination

Leaks and oil spill from heavy equipment, vehicles and maintenance activities may contaminate soil with hydrocarbon substances. These are non-biodegradable substances that are toxic to animals and plants. Percolation to the aquifer may also contaminate ground water resources. Surface runoff may carry hydrocarbon residues to the rivers and eventually contaminate coastal waters. This impact however will be short term avoidable, significant but irreversible.

#### 3.1.8 Generation of Solid Wastes

Generation of solid wastes would generally include domestic waste from accommodations and offices. Solid wastes if not properly disposed-off may become an eyesore to the community, may threaten health and sanitation, and contaminate surface waters. This impact is short term, unavoidable, moderately significant-significant but reversible. This impact is highly significant and long term if the stockpiles are not immediately used for rehabilitation.

#### 3.1.9 Change in Landform

The change in landform is an unavoidable and irreversible impact. The mining activity will excavate the ores for export and in the process will change the topography of the project site. In addition, forested

areas will be transformed from forestland to mining areas. Areas devoid of vegetation affect the aesthetics of the mountains. However, with the progressive rehabilitation activities, mining areas will be reclaimed. This impact will be long term, unavoidable, moderately significant and irreversible.

#### 3.1.10 Abandonment

After the ores are exhausted from the expansion area, rehabilitation activities are to be carried out. Without rehabilitation, displacement of soil materials through erosion will continue, thus siltation will likewise continue and affect surface water resources. With progressive rehabilitation according to the mining plans, natural regeneration may take a shorter time to occur and species diversity may be restored faster.

#### 3.2 The Water

#### 3.2.1 Increase in Surface Run-off

The removal of vegetation cover within the proposed expansion area will increase surface runoff. Vegetation retards surface runoff and allows more time for rainfall to infiltrate the ground. It also cushions the impact of raindrops to prevent raindrop erosion. The removal of plant cover will therefore result in increased surface runoff that could result in the decrease in aquifer recharge in the long run and increase in siltation of surface water bodies. During this phase, Upper North Lauis River or Libed River tributaries may increase surface runoff from the preparation of mining areas.

#### 3.2.2 Decrease in Aquifer Recharge

The removal of vegetation and compaction of the ground through the use of earth moving equipment during the construction of building structures and preparation of access roads will reduce the infiltration capacity of the ground to same extent. This impact will be long term, unavoidable but insignificant.

#### 3.2.3 Deterioration of Surface Water Quality

Surface water quality will deteriorate from the following sources:

- Silt carried by surface run off;
- Metal leaching from exposed soil;
- Oil spills and fuel leaks from heavy equipment and fuel storage tank; and
- Solid wastes.

This impact is short term, unavoidable, highly significant but reversible.

#### 3.2.4 Physiological Stress to Aquatic Organisms

Stress to aquatic organisms is mainly brought about by siltation and the introduction of other contaminants such oil and grease and solid wastes. These will result in the following impacts:

- Decrease in photosynthetic activities;
- Decrease in productivity/food sources;
- Smothering or death of benthos;
- Damage to gills of fishes; and
- Decrease in water flow and volume.

This impact will be long term and highly significant but reversible. The increase in silt load will cause reduced light penetration to the water bodies and will decrease photosynthesis of phytoplankton which may affect productivity in river systems. Based on the freshwater assessment, productivity is already limited.

Excessive silt also affects freshwater benthic macroinvertebrates and fish community directly. Benthic macroinvertebrates, being bottom-dwellers are smothered by silt when it settles on the streambed. Habitat alteration due to silt results in the disappearance of intolerant species, e.g., from Orders Trichoptera and Ephemeroptera and Plecoptera.

Studies have also shown that silt causes blockage of fish gills causing physiological damage. Aside from fish, filter feeders like mollusks are also physiologically affected by silt though clogging of gills and abrasion. However, fishing in rivers is not a source of livelihood for residents and thus will not affect food sources of local communities. Fishes are likewise mobile organisms and can migrate to other areas.

Siltation however will be managed by installing soil erosion control facilities. The water flow of surface water bodies is largely dependent on the rate of infiltration at the recharge areas of the watershed. Rivers and streams are dependent on the continuous movement of water to drive ecological functions, e.g., nutrient cycle and removal of waste. Reduction of flow would impede the nutrient cycle and the aquatic organisms of important nutrient requirements like P, N and Ca. This will further stress aquatic organisms. Progressive rehabilitation will ensure that aquifer recharge will not be affected.

#### 3.2.5 Species Displacement and Change in Community Structure

Long term siltation of river systems will render the rivers shallow and the substrate will change from rocky-sandy to silty. This will cause the shift in the community structure (diversity and richness) of river species. The decrease in phytoplankton productivity reduces food sources for larger organisms (zooplankton, benthos and fishes). Silt tolerant benthos will dominate the riverbed.

#### 3.3 The Air

#### 3.3.1 Increase in Noise Levels

Noise generation from the use of heavy equipment is expected. This impact however is short-term, unavoidable and moderately significant. There are no houses within the immediate vicinity of the proposed mining area therefore only workers/operators of heavy equipment will be likely affected. Wildlife species however will be affected by the noise and would cause stress however, wildlife species are mobile and can transfer to other areas once they are disturbed.

#### 3.3.2 Increase in Gaseous Emissions

Based on the assessment, the air quality in the project area is still good. Levels of Nitrogen Dioxide (NO2), and Sulfur Dioxide (SO2), within the areas sampled fall well within the DENR Standards. A slight increase in the concentration of gaseous pollutants is expected from the emissions of heavy equipment and vehicles. Minimal increase of SO2 and NO2 in the expansion areas where heavy equipment are being used and along access routes and haul roads is expected. This impact is short-term unavoidable and negligible.

#### 3.3.3 Dust Generation

The exposure of soil and the loosening of earth materials will cause dust generation. Although this impact could be moderately significant, it is noted that there are no houses within the immediate

vicinity of the mining area. This impact is short-term, reversible but highly significant since it can cause stress to wildlife, vegetation and to the health of workers.

#### 3.4 The People

#### 3.4.1 Socio Economics

Assessing the probable socio-economic impacts of the project takes into account both the probable positive and negative impacts and their scope and magnitude over time and space. The proposed project seeks to revive and expand earlier mining operations that have spanned more than 50 years. Thus, there are legacies of environmental impacts, economic decline, strained relationships, and hope for a better future that needs to be addressed. These are discussed below.

The impacts on socio economics during this stage are:

- Increase in population;
- Employment generation;
- Tax generation; and
- Capital Investments.

#### 3.4.1.1 Increase in Population

Increase in the population of Sitio Acoje is expected during the construction phase. Approximately 195 employees (with possibly their families joining them) are needed during the development stage of the mine. While the Proponent has committed that workers will be sourced from the host communities as a whole, the absence of qualified workers will require non-residents to settle in the project area. This impact will be short term, and moderately significant.

#### 3.4.1.2 Employment Generation

Direct employment will be available during the constructions phase of the expansion project. A total of 195 employees are needed for the construction phase. This phase will last 3 months and will be concentrated initially in Sitio Acoje, Barangay Lucapon South. This will supplement the main source of livelihood of the residents which are basically farming and employment with the Proponent for their drilling and explorations works. Total estimated salaries to be paid during the construction phase is PhP 1.3 M. Quality and skills permitting, the Proponent should hire locally.

Likewise, the development of the project may provide downstream economic activities. It is estimated that the economic multiplier effect to be at 5x, which may open up avenues for additional livelihood opportunities for the residents (<u>www.imaginet.com.ph/mining</u>). If low purchases are at 60% the total amount during the construction phase would be PhP 2.6 M x 5 or PhP 13 M. This may be in from of support services for the contractors. Likewise, the new migrants may purchase locally produced agricultural products from the farmers in the area.

This impact will be short term and highly significant.

This impact will be short term, and highly significant.

highway leading to the project area is in dire need of repair. With the proposed project, repair of this main access road will be undertaken. This will provide benefits to the residents since it will lessen travel time including transport of agricultural products.

Power and communication will also be improved. Currently, power failure is a constant occurrence since the power lines are also in state of disrepair. One of the priority projects of the Proponent is to

repair the power distribution lines in order to provide stable power source to their operations. This will benefit the residents of Sitio Acoje.

On the other hand, the exploration and drilling work has helped establish a Smart Communications cellular tower wherein residents are provided with mobile phone services.

The Proponent will provide its own water distribution, housing and other facilities for its employees, thus it will not compete with the present resources. This impact will be long term and highly significant.

#### 3.4.2 Public Health

The impacts associated during this phase include:

- Increased incidence of respiratory-related diseases; and
- Occupational risks

#### 3.4.2.1 Increased Incidence of Respiratory-related Diseases

The construction phase will involve the stripping of vegetation cover and soil excavation to prepare the proposed expansion areas. It is expected that it will generate significant amount of dust. This would in turn contribute to air pollution directly or indirectly as synergists or carriers of other pollutants. As a result, it is highly probable that the incidence of COPD and other respiratory diseases will increase for the mine workers.

The expansion areas are far from residential areas and thus would not impact the residents. Although majority of the mining facilities are located within Sitio Acoje, the proponent will utilize as much as possible existing structures and open areas. This will minimize generation of dusts. This impact will be short term, unavoidable, significant but reversible.

#### 3.4.2.2 Occupational Risks

Construction workers are exposed to various occupational risks. These include accidents involving the use of heavy equipment and other occupational hazards at the workplace. Accidents and other health hazards in the workplace are often caused by carelessness and poor housekeeping practices. This impact will be short term, avoidable and significant to highly significant, reversible or irreversible

#### 3.4.3 Employment Generation and Improvement of Income

Employment is a positive impact of the project. Technical and non-technical positions are needed for the expansion of mining operations.

Indirect employment results from increased purchasing power by those employed by the project and from products and services sold to and bought by the project Proponent. At a generally accepted estimate of an economic multiplier effect of 5x, during the operation phase, this would be PhP 53 M x 5 or PhP 265 M. Indirect employment that may be generated will come from the following:

- Transportation;
- Basic utilities;
- Potential livelihood programs included in the social development program (SDP) of the Proponent;
- Food-related services; and
- Other support services.

Resource	Identified Impacts	Duration	Likelihood of Occurrence	Magnitude	Residual impact
	Loss of vegetation cover	Long-term	Unavoidable	Highly significant	Highly significant; irreversible
	Habitat disturbance	Long term	Unavoidable	Highly significant	Significant; Reversible
	Physiological stress to flora and fauna from excessive dust generation and increased in noise levels	Short term	Unavoidable	Moderately significant - Significant	Moderate Significant; Reversible
The Land	Change in community structure	Long term	Unavoidable	significant	Moderately Significant, Reversible
	Species displacement	Long term	Unavoidable	significant	Moderately Significant, Reversible
	Loss of topsoil	Long term	Unavoidable	Highly Significant	Highly significant; irreversible
	Soil erosion	Short term	Unavoidable	Significant	Significant, reversible
	Soil contamination from Oil and Grease	Short term	Avoidable	Significant	Significant; Irreversible
	Generation of solid wastes	Short term	Unavoidable	Moderately Significant – significant	Insignificant; Reversible
	Increase in surface run-off	Long term	Unavoidable	Highly Significant	Insignificant; Reversible
The Water	Siltation of surface water bodies	Short term		Significant	reversible
	Occurrence of flash floods	Long term	Avoidable	Significant	Insignificant; Reversible
	Deterioration of surface water quality from increasing suspended particulates, oil and grease, and from solid wastes	Short term	Unavoidable	Highly Significant	Moderately Significant, reversible

#### Table 3-1: Summary of Environmental Impacts and Residual Effects

Resource	Identified Impacts	Duration	Likelihood of Occurrence	Magnitude	Residual impact
	Increase in noise levels	Short term	Unavoidable	Moderately	Insignificant
				significant	
Air Quality	Increase in gaseous emissions	Short term	Unavoidable	Negligible	Negligible
	Dust generation	Short term	Unavoidable	Highly	Insignificant; Reversible
				Significant	
	Increase in Population	Short term	Unavoidable	Moderately	Insignificant
				significant	
	Employment generation	Short term	Unavoidable	Highly significant	Significant
The People	Generation of taxes	Short term	Unavoidable	Highly	Highly significant
The reopie				significant	
	Capital investments	Long term	Unavoidable	Highly	Highly Significant
				significant	
	Increased incidence of respiratory diseases	diseases Short term Unavoidable Significant		Significant	Insignificant; reversible
	Occupational risks	Short term	Avoidable	Significant –	Insignificant;
				Highly	irreversible/reversible
				significant	

# Table 3-2: Impacts Management Plan

Activities	Environmental Aspect	Environmental Impact	Prevention or Mitigation or Enhancement
<b>Development / Construction</b>	Phase		
	Land	<ul> <li>Loss of topsoil due to ground / site preparation activities</li> <li>Induced landslides and mass washings due to construction activities on high angle slopes</li> </ul>	<ul> <li>The stockpile will be graded to a stable relief</li> <li>The established safe working slopes will be implemented</li> </ul>
	Flora and Fauna	Reduction of vegetative cover and fauna disturbance / displacement	<ul> <li>Replanting of surrounding area after construction, preferably with indigenous plants</li> <li>Vegetation removal will still be kept at minimum such that only necessary / planned clearings would be undertaken</li> </ul>
	Water Quality	<ul> <li>Sedimentation of nearby water body(ies)</li> </ul>	Access roads will be provided with drains to contain and limit sedimentation
<ul> <li>Site preparation (clearing, grubbing, and stripping of topsoil)</li> <li>Construction of haul roads</li> <li>Stockpiling of topsoil</li> </ul>	Air Quality	Air pollution due to fugitive dust from ground clearing operations	<ul> <li>Regular spraying of water in areas where a land development activity is concentrated</li> <li>Replacement of vegetation in non-structure areas</li> <li>Compacting of exposed soil</li> <li>Provision of tarpaulin cover on trucks loaded with construction materials</li> <li>Immediate hauling of spoils</li> <li>Impose speed restrictions for trucks</li> </ul>
		<ul> <li>Air pollution due to SO<sub>x</sub>, NO<sub>x</sub>, and TSP emissions from heavy equipment</li> </ul>	<ul> <li>Regular maintenance of heavy equipment and motor vehicles</li> </ul>
	Sound Levels	Noise due to the increase in sound levels from construction activities	<ul> <li>Regular maintenance of motor mufflers</li> <li>Provision of barriers and shielding stationary vibrating equipment</li> <li>Provision of ear mufflers to workers</li> </ul>
	People	Psycho-social	IEC on the nature and operation of mining and mitigating measures

		<ul> <li>Economic</li> <li>Generation of employment</li> <li>Generation of livelihood opportunities spurred by the multiplier effect of the mining activities</li> </ul>	<ul> <li>Local hiring priority for qualified barangay residents</li> <li>Barangay consultation on job requirements and qualification</li> <li>Training to upgrade local skills of residents who can hired by the project</li> </ul>
		<ul> <li>Health and Safety</li> <li>Health problems due to diseases, overuse of public utilities / services</li> <li>Competition of resources</li> <li>Social conflicts, peace and order</li> <li>Increase in population due to solid and liquid waste</li> </ul>	<ul> <li>Health certificate for workers prior to hiring into the project</li> <li>Partner with LGU the implementation of the Social and Development Program</li> <li>Sprinkling of roads during dry season</li> <li>Management of entry of migrant workers</li> <li>Increase and train Barangay Tanod to be deployed in areas where migrant workers reside</li> </ul>
		<ul> <li>Peace and order</li> <li>Economic activities and other services near the mining area might cause problems of congestion, peace and order and security breaches</li> </ul>	Coordination with the Barangay LGU to ensure authorized establishments and control of unauthorized entry of outsiders as well as the management of waste
<u>Operation</u> Mining	Land	<ul> <li>Landslides and mass washings maybe induced by operation activities at high angle slopes</li> </ul>	<ul> <li>The stockpile will still be graded to a stable relief</li> <li>The established safe working slopes will still be implemented</li> <li>Installation of landslide control structures</li> </ul>
	Water	<ul> <li>Increase in surface runoff and down slope sedimentation</li> <li>Decline in river carrying capacity due to siltation</li> </ul>	Site water management will be implemented to mitigate any change in water quality this include strengthen water monitoring system by installing water meters at source points and keeping a record daily water extraction and consumption

Ambient air quality	□ Fugitive particulate pollution	<ul> <li>Installation, proper operation, and maintenance of the appropriate air pollution control device</li> <li>Provide adequate PPEs for workers</li> <li>Water spraying to exposed areas during high winds</li> <li>Optimize active extraction areas at the mining</li> </ul>
	<ul> <li>Fugitive particulate pollution (from mining hauling roads)</li> </ul>	<ul> <li>Vehicle restrictions that limit the speed, weight or number of vehicles on the road</li> <li>Surface improvement by paving or adding gravel or slag to a dirt road</li> </ul>
Ambient sound level	☐ Generation of noise	<ul> <li>Incorporation of noise criteria in the specifications and selection of equipment</li> <li>Provision of ear plugs to workers</li> <li>Planting of the appropriate vegetation as buffer</li> </ul>
People	□ Safety and health risks to workers	<ul> <li>Continue provision of PPE to every personnel</li> <li>Continue conduct of safety orientation and training</li> </ul>

Impact Description	Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
Construction Phase			•	·	
The Land					
Removal of vegetation and habitat loss	Tree inventory prior to clearing activities; additional vegetation survey for mining blocks C7 & C9 prior to mining.Identified ecologically important species to be used in rehabilitation program. Revegetation of affected areas and retaining existing vegetation not affected by construction of mine support facilities	Included in EPEP budget – Tree inventory & reforestation/replanting costs	Proponent / Contractor	During construction period	Include as ECC conditionality;Contractor's Environmental Program
Habitat disturbance	Maintenance of vegetation cover in the peripheries of the	Part of Reforestation			
causing loss of important plant species that are sources of seeds/regenerants and habitats for faunal species	mining area. Proper maintenance of vehicles and heavy equipment inc. fitting with appropriate mufflers or silencers to decrease noise levels Sprinkling of water on access roads and working areas especially during dry months to minimize dust generation. Regulating speeds of vehicles and equipment in dusty areas to 20 km/hr.	Program costs Part of Contractor's environmental programcosts	Proponent / Contractor	During construction period	Include as ECC conditionality;Contractor's Environmental Program
Physiological stress to flora and fauna from excessive dust generation and increased in noise levels	Sprinkling of water on access roads and working areas especially during dry months to minimize dust generation. Regulating speeds of vehicles and equipment in dusty areas to 20 km/hr. Proper maintenance of vehicles and heavy equipment inc. fitting with appropriate mufflers or silencers to decrease noise levels	Part of Contractor's environmental programcosts	Contractor	During construction period	Contractor's EnvironmentalProgram
Species displacement	Proper maintenance of vehicles and heavy equipment inc. fitting with appropriate mufflers or silencers to decreasenoise levels Maintenance of vegetation cover in the peripheries of the construction area(s)	Part of Contractor's environmental programcosts Part of Reforestation Program costs	Contractor Proponent / Contractor	During construction period	Include as ECC conditionality;Contractor's Environmental Program
Change in community structure	Establishment or maintenance of buffer areas and assisted revegetation to create green corridors	Included in EPEP budget – Reforestation Program costs	Proponent	During the construction period	Proponent's Environmental Protection and Enhancement Program (EPEP); Contractor'sEnvironmental

#### Table 3-3: Environmental Management Plan

Impact Description	Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
					Program
Wildlife Displacement	patches of forest should be maintained near the mining areas so as to provide refuge for displaced fauna.	Part of Reforestation Program costs	Contractor	During the construction period	Contractor's EnvironmentalProgram
Loss of topsoil	Retention of vegetation on the construction site(s) will be retained as much as possible Revegetation of the open/exposed areas, wherever possible	Part of Reforestation Program costs	Contractor	During the construction period	Contractor's EnvironmentalProgram
	Carry out land clearing during the dry season	Part of Construction costs	Contractor	During the construction period	Contractor's EnvironmentalProgram
	Maintaining a stockpile for topsoil in a designated area awayfrom creeks	Part of Project Cost	Proponent / Contractor	Duration of the project	Contractor's EnvironmentalProgram
Soil erosion	Minimized grading and earthworks in erosion-prone areas Keeping stockpiles with moderate slopes to minimize higherosion rate Use of a combination of permanent engineering structures and vegetative means to stabilize toe and slopes of stockpiles Provision of barriers and other erosion control measures	Part of Project Cost/Mine Rehabilitation costs	Proponent / Contractor	During the construction period	Include in TOR of Contractor;Contractor's Environmental Program
Change in land form	Maintain vegetation cover in the designated buffer zonesand in the peripheries of roads and mine pits	Part of Reforestation Program costs	Proponent / Contractor	Duration of the Project	Include as ECC conditionality
Soil contamination with oil& grease	Proper material handling and equipment maintenance bythe Proponent and its Contractor Maintenance of vehicles only at motorpool Good housekeeping practices including proper handling and clean-up of oil at the construction site, or working areas where necessary	Part of Construction costs	Proponent / Contractor	During construction phase	Include in TOR of Contractor;Contractor's Environmental Program
Generation of solid wastes	Implementation of a good housekeeping scheme including disposal of solid wastes in the designated disposal / storage areas	No cost	Contractor	During construction period	Include in TOR of Contractor;Contractor's Environmental Program
ine water			1	1	

Impact Description	Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
Increase in surface run-off	Implementation of stormwater management system to routeexcess water from the open / construction areas into natural drainage/ waterways Regular inspection/cleaning of drainage channels of sediments and debris that may inhibit the flow of water	Part of the construction cost	Contractor	During construction period	Include in TOR of Contractor;Contractor's Environmental Program
Siltation of surface water bodies	Proper installation of drainage system to divert the flow ofwater from sloping areas Designate a central maintenance area (motorpool) for the repair of vehicles and other equipment Proper collection and disposal of used oil and grease to prevent accidental spillage	Part of the construction cost	Contractor	During the constructio nperiod	Include in TOR of Contractor;Contractor's Environmental Program
Deterioration of surface water quality	Implementation of good housekeeping scheme to include prohibition of washing vehicles and/or heavy equipmentalong rivers/creeks Maintenance of all heavy equipment only in the motorpooland designated area within the Contractors yard Regular clean-up/collection of solid wastes and removal to designated disposal area	Part of construction cost	Contractor	During the constructio nperiod	Include in TOR of Contractor;Contractor's Environmental Program
The AIR	~ ^ •				
Increase in noise levels	Use of properly maintained heavy equipment installed with mufflers Protection of existing vegetation near the mining area(s) to serve as noise barrier	Part of the construction cost	Contractor	During constructio nperiod	Include in TOR of Contractor;Contractor's Environmental Program
Increase in gaseous emissions	Use of properly maintained motor vehicles and heavyequipment Use of higher grade motor fuel during the construction phase	Part of the construction cost	Contractor	During constructio nperiod	Include in TOR of Contractor;Contractor's Environmental Program
Dust generation	Regular sprinkling of water along exposed areas especially during dry periods Limiting the speed of service vehicles, hauling trucks and other heavy equipment Proper handling of construction materials and equipment	Part of construction cost	Contractor	During the constructio nperiod	Include in TOR of Contractor;Contractor's Environmental Program
	Prioritization of local residents in employment				

Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
Provision of appropriate skills training for workers includinglocal hires to control unnecessary increase in local population	Part of Construction cost; SDMP budget for skills training	Contractor /Proponent	During construction phase / mine development	Include as ECC conditionality;Include in the TOR of the Contractor
Prioritization of local residents in employment Provision of appropriate skills training for workers includinglocal hires; training for local residents on livelihood skills	Part of Construction cost; SDMP budget for skills training	Contractor /Proponent	During construction phase / mine development	Include as ECC conditionality;Include in the TOR of the Contractor
Proper maintenance of rehabilitated infrastructure/facilitieswill enhance this positive impact.	Part of Project Cost	Proponent	During mine developmen tphase	Include as ECC conditionality
Pertinent fees to be paid promptly	-	Proponent	During pre- operations phase	Included in requirements for permitsapplication at municipal level
Use of properly maintained heavy equipment installed withmufflers Limiting the speed of service vehicles, hauling trucks and other heavy equipment	Part of Construction cost	Contractor	During constructio n	Include in TOR of Contractor;Contractor's Environmental Program
Improvement of health care facilities in the hostcommunities	Part of SDMP budget	Proponent	During constructio n	Include as ECC conditionality; to be included in Proponent'sSDMP
Implementation of dust-suppression measures Provision of acceptable accommodations for workers Workers to wear proper personal protective equipment within the worksite	Part of Construction cost	Contractor	During constructio n	Include in TOR of Contractor;Contractor's Environmental Program
Implementation of a Construction Safety Plan by Contractor Provision of safety training for all workers Provision of appropriate signages at work areas and other safeguards Workers to wear PPEs within the worksite Limiting the speed of service vehicles, hauling trucks and other heavy equipment Medical check ups and monitoring of workers Implementation of good housekeeping practices withinconstruction/work areas	Part of Construction cost	Proponent / Contractor	During constructio n	Include in TOR of Contractor;Contractor's Environmental Program
	Mitigation (if negative), Enhancement (if positive)           Provision of appropriate skills training for workers includinglocal hires to control unnecessary increase in local population           Prioritization of local residents in employment           Provision of appropriate skills training for workers includinglocal hires; training for local residents on livelihood skills           Proper maintenance of rehabilitated infrastructure/facilitieswill enhance this positive impact.           Pertinent fees to be paid promptly           Use of properly maintained heavy equipment installed withmufflers           Limiting the speed of service vehicles, hauling trucks and other heavy equipment           Improvement of health care facilities in the hostcommunities           Implementation of dust-suppression measures Provision of acceptable accommodations for workers           Workers to wear proper personal protective equipment within the worksite           Implementation of a Construction Safety Plan by Contractor Provision of acteptable signages at work areas and other safeguards           Workers to wear PPEs within the worksite           Limiting the speed of service vehicles, hauling trucks and other heavy equipment           Medical check ups and monitoring of workers           Implementation of acceptable accommodations for workers           Implementation of good housekeeping practices withinconstruction/work areas	Mitigation (if negative), Enhancement (if positive)Cost of Mitigation or EnhancementProvision of appropriate skills training for workers includinglocal hires to control unnecessary increase in local populationPart of Construction cost; SDMP budget for skills trainingPrioritization of local residents in employment Provision of appropriate skills training for workers includinglocal hires; training for local residents on livelihood skillsPart of Construction cost; SDMP budget for skills trainingProper maintenance of rehabilitated infrastructure/facilitieswill enhance this positive impact.Part of Project CostPertinent fees to be paid promptly Limiting the speed of service vehicles, hauling trucks and other heavy equipmentPart of Construction cost; SDMP budgetImplementation of dust-suppression measures Provision of acceptable accommodations for workersPart of Construction costWorkers to wear Prepare proper personal protective equipment within the worksitePart of Construction costImplementation of a Construction Safety Plan by Contractor Provision of appropriate signages at work areas and other safeguardsPart of Construction costWorkers to wear PPEs within the worksite Limiting the speed of service vehicles, hauling trucks and other heavy equipmentPart of Construction costImplementation of a propriate signages at work areas and other safeguardsPart of Construction costWorkers to wear PPEs within the worksite Limiting the speed of service vehicles, hauling trucks and other heavy equipmentPart of Construction costMedical check ups and monitoring of workers Implementation of good housekeeping practicesPart	Mitigation (ff negative), Enhancement (if positive)Cost of Mitigation or EnhancementInstitutional PlanProvision of appropriate skills training for workers includinglocal hires to control unnecessary increase in local populationPart of Construction cost; SDMP budget for skills trainingContractor (ProponentPrioritization of local residents in employment Provision of appropriate skills training for workers includinglocal hires; training for local residents on livelihood skillsPart of Construction cost; SDMP budget for skills trainingContractor (ProponentProper maintenance of rehabilitated infrastructure/facilitieswill enhance this positive impact.Part of Project CostProponentPertinent fees to be paid promptly-ProponentProponentUse of properly maintained heavy equipment installed withmufflers Limiting the speed of service vehicles, hauling trucks and other heavy equipmentPart of SDMP budgetProponentImplementation of dust-suppression measures Provision of acceptable accommodations for workers Workers to wear proper personal protective equipment within the worksitePart of Construction cost Part of Construction costContractorImplementation of a Construction Safety Plan by Contractor Workers to wear PPEs within the worksite Limiting the speed of service vehicles, hauling trucks and other heavy equipmentPart of Construction costContractorImplementation of appropriate signages at work areas and other safeguardsPart of Construction costContractorWorkers to wear PPEs within the worksite Limiting the speed of service vehicles, hauling trucks and other heavy equipment	Mitigation (f negative), Enhancement (if positive)Cost of Mitigation or EnhancementInstitutional PlanScheduleProvision of appropriate skills training for workers includinglocal hires to control unnecessary increase in local populationPart of Construction cost; SDMP budget for skills trainingContractor (ProponentDuring construction phase / mine developmentPrioritization of local residents in employment includinglocal hires; training for local residents on livelihood skillsPart of Construction cost; SDMP budget for skills trainingContractor (ProponentDuring construction phase / mine developmentProvision of appropriate skills training for workers includinglocal hires; training for local residents on livelihood skillsPart of Construction cost; SDMP budget for skills trainingContractor (ProponentDuring mease / mine developmentProper maintenance of rehabilitated infrastructure/facilitieswill enhance this positive impact.Part of Project CostProponentDuring pro- operations phaseUse of properly maintained heavy equipment installed withmufffersPart of Construction cost ProponentContractorDuring construction on nImprovement of health care facilities in the hostcommunitiesPart of SDMP budgetProponentDuring construction on struction or phaseImplementation of a construction Safety Plan by Contractor Provision of acceptable accommodations for workers Workers to wear proper personal protective equipmentPart of Construction cost ProponentDuring construction nImplementation of a acconstruction Safety Pla

Impact Description	Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
Operations Phase				4	
The Land					
Removal of vegetation and habitat loss	Implementation of progressive rehabilitation in mined outareas Establishment of a nursery to raise the seedlings and planting materials of endemic and indigenous species for use in rehabilitation program.	Included in EPEP budget – Reforestation Program costs	Proponent	Duration of the <u>Project</u> Start of operations phase of the Project	Include as ECC conditionality; tobe included in Proponent's EPEP
Displacement of wildlife population & physiologicalstress to flora and fauna	Proper maintenance of vehicles and heavy equipment inc. fitting with appropriate mufflers or silencers to decrease noise levels	Part of Contractor's environmental program costs	Contractor	During operations	Include in TOR of Contractor;Contractor's
	Sprinkling water on access roads and working areas during dry months Regulation of speed of vehicles and heavy equipment to minimize dust generation	Part of Dust Emission Control costs	Contractor	phase	Environmental Program
	Establishment or maintenance of buffer areas and assisted revegetation to create green corridors	Progressive rehabilitation Included in EPEP budget	Proponent	During operations phase	Include as ECC conditionality
Removal of vegetation cover resulting to total loss of cover of 200 has for the mine pits and adjacent areas	Mining method to be employed will involve dividing the mining area into several sub-blocks allowing gradual removal of affected vegetation & progressive rehabilitation of opened areas	Part of Project Operating costs/ Reforestation Program costs	Proponent	During operations phase	Include as ECC conditionality
Habitat disturbance	Proper maintenance of vehicles and heavy equipment inc. fitting with appropriate mufflers or silencers to decrease noise levels Sprinkling of water on access roads and working areas especially during dry months to minimize dust generation. Regulating speeds of vehicles and equipment in dusty areas to 20 km/hr.	Part of project Operating costs	Proponent / Contractor	During operations phase	Include as ECC conditionality;Contractor's Environmental Program
Physiological stress to flora and fauna from excessive dust and increased in noise level	Sprinkling of water on access roads and working areas especially during dry months to minimize dust generation. Regulating speeds of vehicles and equipment in dusty areas to 20 km/hr.	Part of project Operating costs	Proponent / Contractor	During operations phase	Include as ECC conditionality;Contractor's Environmental Program

Impact Description	Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
Physiological stress to	Proper maintenance of vehicles and heavy equipment inc.				
flora and fauna from	fitting with appropriate mufflers or silencers to decrease				
excessive dust and increased in noise level	noise levels				
Species displacement and	Maintenance of vegetation cover in the peripheries of the	Part of Reforestation	Proponent	Duration of the	Include as ECC conditionality
change in community structure	mining area.	Program costs		project	
Loss of toposil	Revegetation of the open/exposed areas	Part of Reforestation Program costs	Proponent / Contractor	Duration of the project	Include in the TOR of the Contractor: include as
Loss of topsoff	Maintaining a stockpile for topsoil in a designated area away from creeks & mining activities	Part of Project Cost		r)	ECCconditionality
Soil erosion	Installation of proper drainage system for the ore stockpiles			During operations phase	
	Diversion of run-off away from steep slopes and denudedareas by constructing interceptors, drains, and berms		Proponent / Contractor		
	Keeping stockpiles with moderate slopes to minimize higherosion rate	Part of Project costs; EPEP			Include as ECC conditionaly;Contractor's
	Use of a combination of permanent engineering structures				Environmental Program
	and vegetative means to stabilize toe and slopes of stockpiles				
	Regular inspection and maintenance of erosion control structures, drainage channels, culverts				
	Progressive rehabilitation		<b>D</b>		
Change in land form	Maintain vegetation cover in the designated buffer zones and in the peripheries of roads and mine pits	Part of Reforestation Program costs	Proponent / Contractor	Duration of the Project	Include as ECC conditionality
Soil contamination with	Proper material handling and equipment maintenance bythe Proponent and its Contractor				
ond grease	Maintenance of vehicles/heavy equipment strictly at motorpool	Part of Project Operating	Proponent /	During	Include in the TOR of
	Regular maintenance of the oil and water separator will be done to ensure optimum performance	costs	Contractor	operations phase	theContractor; Contractor's
	Good housekeeping practices including proper handling and clean-up of oil at the motorpool				Environmental Program
Generation of solid wastes	Implementation of a Solid Waste Management Program involving the local community				

Impact Description	Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
	Waste management measures to include wastes segregation and placement of garbage collection bins in <u>strategic areas; regular collection of solid wastes</u> Maintenance of garbage disposal facility	Part of Project Operating costs	Proponent	During operations phase	Include as ECC conditionality
	Maintenance of appropriately designed storage area for hazardous wastes				
The Water					
Increase in water run-off	Increased surface run-off due to development of the mining areas routed to the siltation pond(s); regular desilting of silt pond(s)				
	Proper design of drainage channels; and regular inspection/cleaning of drainage channels of sediments and debris that may inhibit the flow of water	Part of Project Operating costs	Proponent / Contractor	During operations phase	Include as ECC conditionality;Include in the TOR of the Contractor
	Regular monitoring of the drainage facilities and siltation pond(s) particularly during the rainy season to ensure optimum performance				
Occurrence of flash floods	Inspection of drainage channels at least once every quarter and after every major rain events.				
	Regular inspection and proper maintenance of sediment control structures (e.g., siltation ponds, etc.)	Part of Project Operating costs	Proponent / Contractor	During operations phase	Include as ECC conditionality;Include in the TOR of the Contractor
	Peripheries of the drainage facilities will be re-vegetated to handle increased surface runoff from the mining areas				
Decrease in aquifer recharge and competition	Progressive rehabilitation to be undertaken.	Part of Project Operating	Proponent	During operations	Include as ECC conditionality
tor water resources	Water supply source(s) will be provided	costs		phase	
Deterioration of	Identification of critical areas in the minesite which are				
waterquality	subject to severe erosion and off-site areas which are vulnerable to damage from erosion and/or sedimentation - anti-soil erosion measures to be applied, as required.	-		Derring	
	Provision of septic tanks for all housing units and offices regular maintenance of these facilities for optimum performance	Part of Project Operating costs	Proponent	operations phase	Include as ECC conditionality

Impact Description	Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
	Implementation of a solid waste management program involving local community to prevent contamination of waterbodies Proper handling, storage and disposal of hazardous wastes				
	Sediment and runoff control measures at the stockpile area to prevent siltation of the coastal waters	Part of Project Operating costs	Proponent / Contractor	During operations phase	Include as ECC conditionality;Include in the TOR of the Contractor; Contractor's Environmental Program
	Prevention of disposal of wastewater from ships (at ship loading area)	No cost	Proponent / Contractor	During operations phase	TOR of the Contractor; Contractor's EnvironmentalProgram
Physiological stress to aquatic organisms	Measures to mitigate impacts of soil erosion, siltation and contamination of surface water bodies would help prevent this impact.	Part of Project Operating costs	Proponent / Contractor	During operations phase	Include as ECC conditionality;Include in the TOR of the Contractor; Contractor's Environmental Program
The Air					
Increased noise levels	Use of properly maintained heavy equipment installed withmufflers Protection of existing vegetation near the mining area to serve as noise barrier	Part of the Project operating costs	Contractor	During operations period	Include in the TOR/scope ofwork of the Contractor
Generation of gaseous emissions	Use of properly maintained motor vehicles and heavyequipment	Part of the Project operating costs		<b></b>	
Increased dust generation	Regular water sprinkling along exposed areas especially during dry periods Limiting the speed of service vehicles, hauling trucks and other heavy equipment; Covering haulage trucks with tarpaulin or canvas to prevent the unwanted discharge of materials and dusts	Part of Dust Emission Control costs	Contractor	During operations period	Include in the TOR of theContractor; Contractor's Environmental Program
The People					
In migration	Prioritization of local residents in employment Provision of appropriate skills training for workers including local hires to control unnecessary increase in local population Prioritization of local residents in amployment	Part of Project Operating costs; SDMP budget for skills training	Contractor / Proponent	During operations phase	Include as ECC conditionality;Include in the TOR of the Contractor
	Prioritization of local residents in employment	0		1	

Impact Description	Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
Employment & livelihoodopportunities	Provision of appropriate skills training for workers including local hires to control unnecessary increase in local population Introduction of livelihood projects ( skills training for localcommunity as part of SDMP	Part of Project Operating costs; SDMP budget for livelihood projects & skillstraining	Contractor / Proponent	During operations phase	Include as ECC conditionality;Include in the TOR of the Contractor
Social development and Management Plan	Implementation of SDMP which includes assistance for infrastructure projects in the community Proper maintenance of rehabilitated infrastructure/facilitieswill enhance this positive impact	Part of Project Cost / SDMP Budget	Proponent	During operations phase	Include as ECC conditionality
Government revenues and fees	Taxes and local fees to be paid promptly	-	Proponent	During operations phase	Included in requirements for permitsapplication at municipal level
Increase in incidence of respiratory diseases	SDMP includes provision of basic social services including medical & dental missions, Medical Clinic on-site, etc. Implementation of dust-suppression measures	Part of SDMP Budget / Dust Emission Control costs	Proponent	During operations phase	Include as ECC conditionality
Increased noise generation	Use of properly maintained heavy equipment installed withmufflers	Part of Operating cost	Contractor	During operations phase	Include in TOR of Contractor; Contractor's EnvironmentalProgram
Increase incidence of vehicular accidents	Limiting the speed of service vehicles, hauling trucks and other heavy equipment	Part of Project operating costs / Safety & Health Management costs	Proponent	During operations phase	Include in TOR of Contractor; Contractor's EnvironmentalProgram
Contamination of drinkingwater resources (surface water)	Measures to mitigate impacts of soil erosion, siltation and contamination of surface water bodies would help prevent this impact.	Part of Project Operating costs	Proponent / Contractor	During operations phase	Include as ECC conditionality;Include in the TOR of the Contractor; Contractor's Environmental Program
<ul> <li>Occupational Health &amp; Safety hazards:</li> <li>Airborne dusts, vapours and mists containing heavy metals and other noxious substances.</li> <li>Vehicular accidents</li> <li>Loss of hearing</li> </ul>	Personal Protective Equipment (PPEs) for workers Conduct of training programs / drills for allworkers/employees: Safe job procedures Basic firefighting Housekeeping (5S) OHSAS Systems Emergency preparedness & response Defensive driving First aid	Part of Project operating costs / Safety & Health Management costs	Proponent / Contractor	During operations phase	Include as ECC conditionality;Include in the TOR of the Contractor

	Impact Description	Mitigation (if negative), Enhancement (if positive)	Cost of Mitigation or Enhancement	Institutional Plan	Schedule	Guarantees
-	Silicosis and	Ensure proper ventilation in work areas				
	respiratory	Safety & health communications campaign				
	problems	Implementation of good housekeeping practices within work				
-	Noise pollution	areas				
-	Emissions of noxious	Strictly implement excavation design and system, i.e.,				
	gases	bench heights, width and angles				
-	Land slides,					
	mudslides,					
	wall/structure					
	collapse,					
	etc.					

# 4 ENVIRONMENTAL RISK ASSESSMENT AND EMERGENCY RESPONSE POLICY AND GUIDELINES

This Environmental Risk Assessment (ERA) was conducted for the Project with reference to the prescribed methodology outlined in Annex 2-7e of the Revised Procedural Manual of DAO 2003-30, DMC 2010-14, and the Technical Screening Checklist for the Project. The Revised Procedural Manual (RPM) of DENR Administrative Order (DAO) 2003–30 defines the Environmental Risk Assessment (ERA) as a process of analyzing and describing the risks associated with a project or activity to the ecosystems, human health and welfare.

During the risk assessment, hazards are evaluated in terms of the likelihood that a problem may occur and the damage it would cause if such an event did occur. Adequate safety and emergency preparedness require considering all the possible hazards that could be encountered. Some hazards, however, are more likely to cause problems than others at a given time and some would result in greater damage than others. For mining and mineral processing operations, agreement on how to recognize the various types of risks encountered and the management practices to address these risks is vital for the sustainability of mining activities.

#### 4.1 Risk Assessment

The ERA conducted for the project applies the generic framework of Australia and New Zealand (AS/NZS 4360:2004) for establishing the context, identifying, analyzing, evaluating, treating, monitoring and communicating risk. Specifically, this ERA makes use of the Qualitative Method which is a quick and relatively easy to use method. Broad consequences and likelihoods can be identified. The qualitative risk assessment can provide a general understanding of comparative risk between risk events, and the risk matrix can be used to separate risk events into risk classes (ratings). Qualitative methods use descriptive terms to identify and record consequences and likelihoods of events and resultant risk.

**Figure 4-1** outlines the AS/NZS 4360:2004 Risk Management Standard process for identifying, analyzing and managing risks, including technical risks. It also emphasizes the importance of stakeholder engagement, risk communication, and community consultation processes at each stage.

The objective of risk analysis is to produce outputs that can be used to evaluate the nature and distribution of risk, and to develop appropriate strategies to manage the risk.



#### Figure 4-1. AS/NZS 4360:2004 Risk Management Steps

#### 4.1.1 Consequence Rating

Qualitative measures of "<u>Consequence</u>" or impact (based on AS/NZS 4360:1999)

LEVEL	DESCRIPTOR	CONSEQUENCE
1	Insignificant	Minimal, if any impact for some workers, communities. Potentially some
		impact for a small number of (<10) individuals.
		Denoting an insignificant or trivial effect as a result of an event occurring
2	Minor	Low level impact for some workers, communities, or high impact for a small
		number (<10) of individuals.
		Denoting small effects following the occurrence of an event or series of
2	Madarata	Uich level impact for some workers, communities, or moderate impact for
3	woderate	communities (Barangay level)
		communities (Darangay lever)
		Defined as noticeable event or a series of events that can be rectified in the long
		term
4	Major	High level of impact for workers, communities (Barangay level)
		Describing key events leading to fatalities, breakdown of social order, loss of
		abundance and/or loss of species, and widespread contamination resulting to
		reduction of air and water qualities
5	Catastrophic	High level of impact (Municipal level)
		Describing disastrous events that would lead to multiple fatalities, complete
		breakdown of social order, local extinction of population and widespread
		contamination that cannot be immediately remediated

## 4.1.2 Likelihood Rating

LEVEL	DESCRIPTOR	DESCRIPTION
А	Almost certain	Is expected to occur in most circumstances (80 - < 100%)
В	Likely	Will probably occur in most circumstances (60 - < 80%)
С	Possible	Might occur at some time (40 - < 60%)
D	Unlikely	Could occur at some time (20 - < 40%)
E	Rare	May occur only in exceptional circumstances (< 20%)

## Qualitative measures of "Likelihood"

#### 4.1.3 Qualitative Risk Matrix

	Γ		Con	sequence I	evel		Ĩ
	-	1	2	3	4	5	
Likelihood level	Descriptor	Insignificant	Minor	Moderate	Major	Catastrophic	Risk rating
A	Almost certain	A1	A2	A3	44	AS	Extreme
В	Likely	B1	B2	B3	84	85	High
С	Possible	C1	C2	C3	C4		Moderate
D	Unlikely	D1	D2	D3	D4	05	Low
E	Rare	E1	E2	E3	E4	E5	

#### Table 4-1. Qualitative Risk Matrix

Source: Bowden, Lane and Martin (2001)

Extreme Risk	Immediate action required
High Risk	Management measures must be employed
Moderate Risk	Management measures must be identified
Low Risk	Management by routine procedures

### 4.1.4 Source of Risk and Management Measures

Potential	Cause / Triggers	Impact / Possible	What / Who will be	W	/ithou	t Controls	Proposed / Existing Controls		Vith (	Controls
Hazard		consequences	affected	CR *	LR*	Risk Level		CR *	LR *	Risk Level
Vehicular accidents	Reckless driving, Poor maintenance of vehicle lack of safety warning devices	Body injury or death	Safety Workers	5	D	D5 (Extreme)	<ul> <li>Strict implementation speed limits</li> <li>Install safety signage</li> <li>Conduct relevant safety trainings and seminars regularly</li> <li>Daily safety briefing (pep talks)</li> </ul>	5	E	E5 (High)
Noise	Hauling Trucks	Health problem	Health Workers Nearby community	1	D	D1 (Low)	<ul> <li>Limit operation during nighttime</li> <li>Use mufflers</li> <li>Provide PPEs to workers</li> </ul>	1	E	E1 (Low)
Silt / Sediments from stockpiles	Heavy rains	Siltation	Environment Uacon Lake Cabaluan River Lauis River	2	С	C2 (Moderate)	<ul> <li>Construct drainage canals leading to settling ponds with adequate capacities</li> </ul>	2	E	E2 (Low)
			Coastal area of Bolitoc				<ul> <li>Regular maintenance/ desilting of drainage canals and settling ponds</li> <li>Maintain vegetative buffers</li> <li>Waste Management</li> </ul>			

# Table 4-2. Sources of Risks and Corresponding Management Measures

	e what / who will be	N	<u>ithout</u>	t Controls	Proposed / Existing Controls	V	<u>Vith (</u>	Controls
consequences	affected	CR	LR*	Risk Level		CR	LR	<b>Risk Level</b>
		*				*	*	
Damage to properti	es Safety/Environment	2	D	D2	• Limit disturbed areas	2	Е	E2
g and	Low-lying areas			(Low)	Progressive			(Low)
t/					rehabilitation of the			
1					quarry area and			
					enhancement planting			
					of the surrounding			
					areas			
					• Regular cleaning of			
					natural drainage			
					channels			
					Climate Change			
					Mitigation and			
					Adaptation (National			
					Greening Program)			
					0 0 /			
	g and tt/ n	consequences     affected       g and tt/ n     Damage to properties     Safety/Environment Low-lying areas	consequences     affected     CR *       g and tt/ n     Damage to properties     Safety/Environment Low-lying areas     2	consequences       affected       CR *       LR*         g and tt/ n       Damage to properties       Safety/Environment Low-lying areas       2       D	consequences       affected       CR *       LR*       Risk Level         g and tt/n       Damage to properties       Safety/Environment Low-lying areas       2       D       D2 (Low)	consequences       affected       CR *       LR*       Risk Level         g and tt/ n       Damage to properties       Safety/Environment Low-lying areas       2       D       D2 (Low)       • Limit disturbed areas         of the n       Low-lying areas       Image to properties       Safety/Environment Low-lying areas       2       D       D2 (Low)       • Progressive rehabilitation of the quarry area and enhancement planting of the surrounding areas         e       Image to properties       Regular cleaning of natural drainage channels       • Regular cleaning of natural drainage channels         f       Image to properties       Image to properties       Image to properties       Image to properties         g and tt/       Image to properties       Safety/Environment Low-lying areas       Image to properties       Image to properties         tt/       Image to properties       Safety/Environment Low-lying areas       Image to properties       Image to properties         tt/       Image to properties         Image to properties       Image to properties       Image to properties       Image to properties       Image to properties         Image to properties       Image to properties       Image to properties       Image to properties       Image to p	consequences       affected       CR *       LR*       Risk Level       CR *       CR *         g and ht/ n       Damage to properties       Safety/Environment Low-lying areas       2       D       D2 (Low)       • Limit disturbed areas       2         • Progressive rehabilitation of the quarry area and enhancement planting of the surrounding areas       • Regular cleaning of natural drainage channels       • Regular cleaning of natural drainage channels         • Climate       Change Mitigation       • Climate       Change Mitigation	consequences       affected       CR *       LR*       Risk Level       CR *       LR *         g and it/ n       Damage to properties       Safety/Environment Low-lying areas       2       D       D2 (Low)       • Limit disturbed areas       2       E         • Progressive rehabilitation of the quarry area and enhancement planting of the surrounding areas       • Regular cleaning of natural drainage channels       • Regular cleaning of natural drainage data daptation (National Greening Program)       • Climate Hitigation Adaptation (National Greening Program)       • Hitigation Hitigation Hitigation

Potential	ntial Cause / Triggers Impact / Possible What / Who wi		What / Who will	Without Controls		Controls	Proposed / Existing Controls		Vith (	Controls
Hazard		consequences	be affected	CR	LR*	<b>Risk Level</b>		CR	LR	<b>Risk Level</b>
				*				*	*	
Handling	Unsafe acts	Oil spills	Safety/	4	С	C4	• Implement Oil Spill	4	E	E4
and use of	Catastrophic	Water/ Soil	Environment				Contingency Plan			
hazardous	events	contamination	Water quality				• Provide secondary			
materials	Lack of proper	Depletion of	(groundwat er,				containment			
	training	non- renewable	marine)				• Proper training of			
	Lack of	resource	Marine life				personnel handling			
	secondary						hazardous materials			
	containment						• Fuel consumption			
							monitoring			
							Preventive			
							maintenance plan and			
							schedule			
							<ul> <li>Installation of oil &amp;</li> </ul>			
							water separator			
							water separator			
Fugitive	Hauling operations	Air pollution	Health/	2	В	B2	Set speed limits	2	D	D2
dust		Health problem	Environment			(High)	Periodic road watering			(Low)
		Smothering of	Workers				Cover haul trucks			
		vegetation	Community				Provide PPEs to workers			
Natural	catastrophic events	Stoppage of operation	Socio-economic	3	D	D3	Implement Emergency	2	D	D2
hazards	like typhoon,		Workers			(Moderate)	Response Plan			(Low)
(calamities)	earthquake, etc.		Operations			,	Implement disaster risk			, , ,
()	1,		1				reduction programs			

Potential	Cause / Triggers	Impact / Possible	What / Who will	W	ithout	Controls	Proposed / Existing Controls	V	Vith (	Controls
Hazard		consequences	be affected	CR	LR*	Risk Level		CR	LR	Risk Level
		_		*				*	*	
Issuance of a	Stoppage of	Stoppage of project	Socio-economic	5	D	D5	Continuous	5	E	E5
Ceased and	project due to	operation. Penalties.	Workers			(Extreme)	implementation of the			(High)
Desist Order	non-compliance	Filing of court cases	Operations				approved IMP and			
(CDO)	with regulatory	Loss of income					compliance to			
	requirements.						government			
							regulations.			
							• Regular training of			
							PCOs			
							• Conduct IEC programs			
							for workersregarding			
							environmental			
							compliance			
Increase in	Unpopularity of	Delays in project	Socio-economic	3	С	C3	Implementation of the	3	Е	E3
anti-project	the	implementation	Workers			(High)	SDMP during operations.			(Moderate)
sentiments,	project	Loss of income	Operations				Harmonized relationship			
strained	implementation	Protests/ rallies	-				with the host community			
relationship	due to						through regular IEC			
with the	poor						Campaign			
LGU	Project-LGU						Implement EPEP			
	relationship						commitments			
	-		1	1						

\*Note: CR - Consequence Rating; LR – Likelihood Rating

#### 4.2 Risk Management

ZDMC will implement the following Risk Action Plan to manage the risks related to the Project.

RISK ASSESSMENT		MITIGATING MEASURE		REMARKS	
•	Siltation and dust associated to operations	•	Provision of signage, or safety cordon, or provision	•	The effectively of the measures
	(loading, unloading and hauling)		of safety berm		will be determined through:
•	Workers being struck/ entrapped/ pinned by moving	•	Provision of storm water drainage to manage	•	Daily monitoring of hazard
	vehicles		silted waters during heavy rainfall.		areas
•	Slope/ face instability giving rise to rock falls or	•	Provision of safety signage on areas where risks are	•	Analysis of safety accident
	slides		present such as high wall edges, areas below high		reports
•	Moving vehicle pose hazards to workers and		wall and areas where there is possibility of falling	•	Review and revisions of
	community. The risk of entrapping/ pinning/ striking		rocks.		Mining methodology
	workers would greatly increase if operators of	•	Brief the workers to follow company procedures.		
	moving vehicles are not skilled or qualified operators		Violators will be dealt accordingly to avoid repeat		
•	Face instability will cause rock falls and/or slides. It		of similar violations.		
	can happen due to adverse geologic condition or	•	Only qualified operators will be allowed. Proper		
	inappropriate work methods. Those at greatest risks		coordination of vehicle movement in the work area.		
	are the workers exposed or near these slopes.	•	Regular inspection of the benches for signs of		
			instability.		
		•	Implementation of Mining Program benches design.		

#### Table 4-3. Risk Management – Safety

	RISK ASSESSMENT	MI	TIGATING MEASURE		REMARKS
•	Slumping/landslide of slopes in the quarry	•	Vegetation of areas where there is high water	Th	ne effectively of the measures will
•	Ineffective drainage system in the quarry area		runoff	be	determined through:
•	Failure of pollution control facilities (Silt ponds)	•	Construction of silt traps and drainage canals to		
•	Accidental oil spills due to equipment failure or lack		divert excess runoff	•	Daily monitoring of hazard
	of training of workers handling hazardous materials	•	Maintain drainage system and ensure that its		areas
•	Premature closure of company		design serve its purpose	•	Analysis of environmental
•	Negative sentiments to mining of some sectors	•	Regular cleaning and desilting of drainage canals and		monitoring reports
•	<ul> <li>Strained relationship with the LGU caused by unpopularity of the project implementation due to poor Project-LGU relationship</li> <li>•</li> </ul>	• • • •	Progressive rehabilitation of affected areas Ensure that only qualified personnel operate equipment handling hazardous materials Establishment of Oil Spill Recovery Team (OSRT) Monitor/ implement SDMP Conduct regular IEC for the stakeholders to fully understand the project	•	will be determined through: Monitoring and analysis of the progress of the project
		•	Help the stakeholders with their need, coordinate with LGU and NGO for the implementation of the project and assist the community with their social and economic development that will directly minimize if not eliminate their negative outlook to mining.		

#### Table 4-4. Risk Management – Environment

#### 4.3 Safety Performance

One of the commitments of ZDMC is a Health and Safety Policy. In able to manage a safe and responsible mining operation, ZDMC provided a safe and healthy working condition to its employees and outsource process/service providers, and adhering to safety and health standards. Incident prevention is the corporate goal of ZDMC's Safety and Health Program. The goal is to minimize potential hazards and risks associated with the operation of ZDMC. ZDMC regularly coordinates with the government, public and private sectors in seeking solutions to safety and health problems and related community issues.

## 4.4 Emergency Preparedness and Response Guidelines

ZDMC's Emergency Preparedness and Response Procedure purpose is to maintain a system in carrying out emergency preparedness and response actions to minimize impacts of emergency situations towards the environment which includes risks, injuries, death to its employees, service providers and other parties.

The procedures shall include an emergency plan that shall outline the actions to be taken when specific emergency situation arises. The involvement of external parties in emergency planning and response shall be clearly identified and communicated.

Emergency equipment needed shall be identified, acquired and provided in the right quantities. These are alarm systems, emergency lighting and power, means of escape, safe refuge, critical isolation valves, switches and cut-outs, firefighting equipment, first aid equipment (including emergency shower and eye wash stations, etc.) and communication facilities.

Periodic emergency drills shall be conducted to test the procedures and measure the readiness of emergency response teams.

#### 4.4.1 Crisis Management Plan

The organization of a Crisis Management Team and supporting units is a top priority item of ZDMC. The team shall be activated immediately when an emergency is reported.

A Crisis Manager shall be designated to spearhead the orderly response to any declared emergency situation.

#### 4.4.2 Emergency Procedure

For each type of emergency, a documented and updated procedure shall automatically govern the response in the shortest possible response time. All procedures are to be subject of intensive training and drill to be conducted regularly.

#### 4.4.3 Fire

A fuel handling and storage facilities must be covered with fire emergency procedures to meet these occurrences. All necessary fire prevention, warning, suppression and control equipment shall be provided.

Fire prevention and firefighting programs shall be established and manned on a constant basis to handle fire emergencies that may occur at fire risk areas in the mining areas, mine camps and nearby communities.

#### 4.4.4 Landslide and Land Subsidence

Continuous geotechnical assessments of the mining areas and affected sites (haul and access roads, other facilities) shall provide inputs to contingency plans for these types of emergencies. Critical localities near inhabited areas shall be prioritized when responding to these incidents.

During the construction/development and operational phases, sources of landslides and subsidence should be identified. Early detection of landslides and subsidence occurrences could prevent loss of lives, damage to property and others.

Training of workers on this is very important for them to be responsive and attentive in the application of controls to avoid or minimize the degree of danger.

Aside from attending training, information on landslides and subsidence can be disseminated to workers through posters, leaflets, meetings and other media advertisements.

#### 4.4.5 Kidnapping and Unrests

Handling this type of emergency requires the participation of external authorities. It has to be clearly established that there are specific legal and criminal aspects for this events hence, emergency procedures should take this into account.

In general, ZDMC shall have the policy of not entertaining conditions where ransom payments are imposed.

#### 4.4.6 Oil/Fuel/Acid/Chemical Spills

Procedures for handling, transport, storage and use of oils, fuels, acids and chemicals should incorporate specific steps in controlling the potential and actual occurrences of spillages and leakages. The necessary control and clean up equipment, supplies and personal protective equipment for emergency personnel shall at all times be available in the right quantities.

Good housekeeping practices must be observed in the workplaces. Spills of oil/fuel/acid/chemical are to be collected and contained in appropriate containers and stored in the designated hazardous waste materials storage area.

#### 4.4.7 Flooding, Storm, and Heavy Rains

Adequate early warning notification and information dissemination shall be ensured for these emergency procedures. Readiness to implement evacuation procedures shall also be ensured. Constant open channels of communication with government agencies on weather conditions announcements and disaster response procedures shall be maintained.

The workers should be attentive on this situation to prevent loss of lives, damage to properties and others.

#### 4.4.8 Vehicular Accident

The proper first aid and medical evacuation procedures in handling injured persons involved in vehicular accidents shall form part of these emergency procedures. Considering the 35 kilometer road network from the mine site to the loading port, it is vital that emergencies of this type be immediately communicated for immediate action.

Included in the SOPs and WIs are the company policies and guidelines to prevent vehicular accidents within and outside the ZDMC area. The ZDMC contractors and workers are bound to comply with this and necessary penalties are to be applied.

#### 4.4.9 Animal Bites

Medical first aid procedures shall be applied immediately. The availability of medicines and specific treatment drugs (i.e. anti-venin serum) must be ensured including properly trained medical personnel.

#### 4.4.10 Development Programs

Support systems and programs shall continuously be adopted to ensure that the health and safety performance of ZDMC be upgraded and improved in the long term.

# 5 SOCIAL DEVELOPMENT PROGRAM (SDP) FRAMEWORK AND INFORMATION, EDUCATION, AND COMMUNICATION (IEC) IMPLEMENTATION

#### 5.1 Social Development and Management Plan Implementation Status

Based on ZDMC's 5-year Social Development and Management Plan (SDMP) for the period 2018-2022, ZDMC's development strategies are focused on four (4) major component areas: 1) Education, 2) Health, 3) Livelihood, and 4) Social Services. These areas were the result of the discussions and consultations made by ZDMC with 15 project impact barangays on 16 August to 07 September 2017. The table below presents the implementation status of assistance to the impact barangays:

STATUS OF IPLEMENTATION
ompleted
penditures:
Php 1,278,428.80
S IPL omp per Ph

#### Table 5-1 SDMP Implementation Status for the period 2018-2020:

	<b>20</b> Dec			
	29 Day-care			
	Students			
	Academic			
	Activities			
2. Livelihood		Barangay and Farmers Association.	ZDMC	Completed
		0 9		Expenditures:
a development and enhancement	50 Members of			Litpentateat est
of oconomically yighto	TODA provided			Php 406 520 78
	ioda piovided			r np 490,520.78
resource-based livelihoods and	with Materials.			
other existing livelihoods	70 Drivers and			
	Operators			
	provided with			
	Initial Capital			
	(Motorcycle Parts			
	and Equipment)			
	and Equipment)			
	50 Farmers of			
	Barangay			
	provided with			
	Vegetable Seeds			
b. improvement of agriculture	and Fertilizers.			
and fishery				
c development of competency for				
c. development of competency for				
skins-based employment				
opportunities				
<ul> <li>3. Health <ul> <li>a. improvement of health facilities and support infrastructures</li> </ul> </li> <li>b. capacity building for barangay health workers (BHWs)</li> <li>c. support to preventive health care</li> </ul>	<ul> <li>2 Barangay Health Center provided equipment and Materials.</li> <li>52 Barangay Health workers provided with subsidy.</li> <li>1 Barangay Health Center provided with Basic Medicines, Multi-Vitamins and equipment.</li> </ul>	Barangay and Barangay Health Workers (BHW's)	ZDMC	Completed Expenditures: Php 699,645.04
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<ul> <li>4. Infrastructure</li> <li>a. construction/improvement/maintenance of educational infrastructure and support facilities</li> <li>b. construction/improvement/maintenance of socio-cultural center and barangay facilities</li> </ul>	<ol> <li>School Facility improvement</li> <li>Barangay Chapel improvement,</li> <li>Barangay Hall improvement,</li> </ol>	Barangay and School		Completed Expenditures: Php 455,396.49

	5. Socio-cultural a. enhancement of socio-cultural processes	<ol> <li>water system improvement</li> <li>Barangay Provided support and materials.</li> </ol>	Barangay	ZDMC	Completed Expenditures: <b>Php 851,379.61</b>
	b. improvement of community facilities and skills	<ul> <li>4 Barangay Hall improvement,</li> <li>1 Barangay Chapel improvement,</li> <li>23 Barangay Appointees Provided Materials.</li> <li>15 Barangay Tanod provided support and materials.</li> <li>25 Barangay Tanod, with subsidy.</li> </ul>			
2019	<ol> <li>Education</li> <li>a. development of educational facilities and support infrastructures</li> </ol>	9 School Facility improvement	Barangay /PTA officers and Schools	ZDMC	Completed Expenditures: <b>Php 1,019,168.84</b>
		3Schoolprovidedwith			

b. provision of access to educational assistance and support to school requirements c. promotion of informal education and support to school activities that facilitate the development of skills and students to school activities that facilitate the development of skills and students to scholars <b>1,798</b> Students provided support
b. provision of access to educational assistance and support to school requirementsmaterials.85College Scholars 189High-School Scholars 9Day-Care Worker/teacher, with subsidy.c. promotion of informal education and tugoport to school activities that facilitate provided support and Educational1,798support to school activities that facilitate a end Educationaland Educational and Educational
b. provision of access to educational assistance and support to school requirements1 Daycare Center with support and Educational materials.85College Scholars 189High-School Scholars 9Day-Care Worker/teacher, with subsidy.c. promotion of informal education and support to school activities that facilitate provided support and Educational1,798support to school activities that facilitate urbe dovelopment of skills and students1,798
<ul> <li>b. provision of access to educational assistance and support to school requirements</li> <li>c. promotion of informal education and support to school activities that facilitate the development of skills and students</li> <li>a. 1,798 Students provided support and support and support to school activities that facilitate the development of skills and students</li> </ul>
b. provision of access to educational assistance and support to school requirements c. promotion of informal education and support to school activities that facilitate the development of skills and students
b. provision of access to educational assistance and support to school requirementsmaterials.85College Scholars 189High-School Scholars 9Day-Care Worker/teacher, with subsidy.c. promotion of informal education and support to school activities that facilitate the development of skills and students1,798Students provided support and - EducationalAlternative and - Educational
<ul> <li>b. provision of access to educational assistance and support to school requirements</li> <li>b. provision of access to educational assistance and support to school scholars</li> <li>c. promotion of informal education and support to school activities that facilitate the development of skills and students</li> <li>d. T798 Students provided support and Educational support to school activities that facilitate the development of skills and students</li> </ul>
assistance and support to school requirements       85       College         Scholars       Scholars         189High-School Scholars       9         Day-Care Worker/teacher, with subsidy.       Norker/teacher, with subsidy.         c. promotion of informal education and support to school activities that facilitate the development of skills and students       1,798         Students       provided support
requirements Scholars <b>189</b> High-School Scholars <b>9</b> Day-Care Worker/teacher, with subsidy. c. promotion of informal education and support to school activities that facilitate the development of skills and students and Educational
189High-School         Scholars         9       Day-Care         Worker/teacher,         with subsidy.         c. promotion of informal education and         support to school activities that facilitate         provided support         the development of skills and students
c. promotion of informal education and support to school activities that facilitate       1,798       Students         provided support       and       Educational
9       Day-Care         Worker/teacher,       Worker/teacher,         with subsidy.       Norker/teacher,         c. promotion of informal education and       1,798         support to school activities that facilitate       provided support         the development of skills and students       and
c. promotion of informal education and support to school activities that facilitate       1,798       Students         provided support       and       Educational
<ul> <li>c. promotion of informal education and support to school activities that facilitate</li> <li>the development of skills and students</li> <li>and Educational</li> </ul>
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c. promotion of informal education and <b>1,798</b> Students support to school activities that facilitate provided support the development of skills and students and Educational
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the development of skills and students and Educational
the development of skins and students and Educational
- graduation ceremony Materials for any
School Activities.
4. Intrastructure Barangay Completed
Expenditures:
a. <b>1</b> Water System
of socia gultural conter, and barangay
facilities 1 Barangay Hall
I Datalgay Itali
Intproventent
5. Social Services 150 Barangay ZDMC Completed
Youth provided Expenditures:

	a enhancement of socio-cultural	with Sports			Php 876 836 82
	processes	materials			Inp 0/0,000.02
	processes.	<b>24</b> Barangay			
		24 Darangay			
		health workers			
	b. improvement of community facilities	provided with			
	and skills	materials for			
		the Social			
		Activities.			
		<b>15</b> Barangay			
		provided			
		supplies,			
		materials and			
		equipment.			
		<b>16</b> Barangay			
		Police provided			
		with Subsidy.			
		5			
	6. Disaster Risk Reduction Program	13,250		ZDMC	
		Constituents			
		from Host and			
		Neighbouring			
		Barangay's			
		provided with			
		support relief			
		operation of			
		Barangay during			
		typhoon Lando			
2020	1 Education	-yr-toon Zando.	Barangay /PTA officers Schools and	ZDMC	Completed
2020	1. Duddulon		College Institution	LDMC	Expenditures
	a development of educational facilities	2 School	conege montation.		Experiantareo.
	and support infrastructures	provided with			Php 1 103 271 00
	and support initiastructures	Provided with			1 mp 1,100,27 1.00

support, Educational Materials and Equipment       support, Educational Materials and Equipment.       support, 1 College institution provided with support, Educational Materials and Equipment.       support, 3 Daycare Center provided with support, Educational Materials and Equipment       support, 1 School       support, 1 School         b. provision of access to educational assistance and support to school requirements       1 School improvement, Educational Materials and Equipment       support, 1 School improvement, 1 School improvement, 1 School improvement, 1 School scholars       support, 1 School scholars       support, 1 School scholars         c. promotion of informal education and support to school activities that facilitat the development of skills and students provided with support scholars       support, 1 Students provided with support scholars       support 8 Day-care 8 Day-care acchers provided with support scholars       support 8 Cares       support 8 Cares         2. Livelihood       2. Livelihood       Tothentials and equipment.       Barangay and Cooperative       ZDMC       Completed Expenditures:	· · · · · · · · · · · · · · · · · · ·					
Educational Materials and Equipment 1       College institution provided Materials and Equipment.       I       College institution provided Materials and Equipment.         b. provision of access to educational assistance and support to school requirements       1       School improvement.         12       College improvement.       1       School improvement.         13       School improvement.       1       School improvement.         13       College improvement.       1       School improvement.         13       College improvement.       1       School improvement.         13       Scholars 8       Scholars 8       Improvement.         13       Students provided with Subsigor       Scholars 8       Scholars 8         14       Students provided with sorts materials and equipment.       ZDMC       Completed Expenditures:			support,			
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institution provided       institution provided       institution provided       institution provided         Materials       and Equipment.       3 Daycare Center provided with support, Educational       institution         b. provision of access to educational assistance and support to school requirements       Equipment.       institution         123       College Scholars       123       College Scholars       institution         415       High-School Scholars       8       Day-care       institution         e. promotion of informal education and support to school activities that facilitate the development of skills and students - graduation ceremony       Students provided with subsidy       Students provided with sports materials and equipment.       ZDMC       Completed Expenditures:			1 Collogo			
institution       provided         materials       and         Equipment.       3 Daycare         improvided       attraits         b. provision of access to educational       attraits         assistance       and support to school         requirements       1         Scholars       8         Atto Figh-School         Scholars       8         Daycare         tackside       tackers         provided with       support to school activities that facilitati         provided with       sports materials         and equipment.       31         Students       provided with         sports materials       and equipment.         and equipment.       ZDMC         Completed       Expenditures:			L Conege			
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Equipment.       3 Daycare Center         3 Daycare Center       provided with         support,       Educational         Materials and       Equipment.         Equipments       1 School         requirements       1 School         requirements       1 School         improvement,       1         Scholars       415 High-School         Scholars       415 High-School         Scholars       8 Day-care         teachers       provided with         support to school activities that facilitate       provided with         suports materials       and equipment.         21 Livelihood       Expenditures:			Materials and			
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b. provision of access to educational assistance and support to school improvement,       1       School improvement,         123       College Scholars       115 High-School Scholars       15 High-School Scholars         c. promotion of informal education and support to school activities that facilitate the development of skills and students - graduation ceremony       8       Day-care teachers provided with Subsidy         31       Students provided with sports materials and equipment.       Students provided with sports materials and equipment.       2DMC       Completed Expenditures:		h provision of access to advectional	Equipmont			
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415 High-School       415 High-School         Scholars       Scholars         8       Day-care         rc. promotion of informal education and       teachers         support to school activities that facilitate       provided with         the development of skills and students       Students         - graduation ceremony       31         Students       provided with         sports       mal equipment.         2. Livelihood       Free March         Karper March       Free March         Barangay and Cooperative       ZDMC			Scholars			
Scholars       8       Day-care         c. promotion of informal education and support to school activities that facilitate the development of skills and students - graduation ceremony       provided with Subsidy       Herein to students Subsidy       Herein to students Subsidy         31       Students provided with sports materials and equipment.       Herein to students Subsidy       Herein to students Subsidy         2. Livelihood       Image: Scholars       Barangay and Cooperative       ZDMC       Completed Expenditures:			415 High-School			
8Day-care tachers8Day-care tachers9c. promotion of informal education and support to school activities that facilitati the development of skills and students - graduation ceremonyprovided with Subsidy91Students provided with sports materials and equipment.Provided with sports materials and equipment.Provided with sports materials Barangay and CooperativeZDMCCompleted Expenditures:			Scholars			
c. promotion of informal education and support to school activities that facilitate the development of skills and students - graduation ceremonyteachers provided with Subsidyprovided with supportsupport31Students provided with sports materials and equipment.supportsupport2. LivelihoodIIII2. LivelihoodIII			8 Day-care			
Image: support to school activities that facilitate the development of skills and students - graduation ceremonyprovided with Subsidysubsidysupport Supportsupport Supportsup		c. promotion of informal education and	teachers			
the development of skills and students       Subsidy         - graduation ceremony       31         Students       provided with         sports       materials         and equipment.       ZDMC         2. Livelihood       Expenditures:		support to school activities that facilitate	provided with			
- graduation ceremony     31     Students provided with sports materials and equipment.     Students     -       2. Livelihood     -     -     -     ZDMC     Completed Expenditures:		the development of skills and students	Subsidy			
graduation ceremony     provided with sports materials and equipment.     provided with sports materials and equipment.     provided with sports materials and equipment.       2. Livelihood     Expenditures:     Expenditures:		- graduation ceremony	31 Studente			
2. Livelihood     ZDMC     Completed       With sports materials and equipment.     Barangay and Cooperative     ZDMC     Completed Expenditures:		Staduaton ceremony	provided with			
2. Livelihood     Image: Sports materials and equipment.     Image: Sports materials and equipment.     Image: Sports materials and equipment.       2. Livelihood     Image: Sports materials and equipment.     Image: Sports materials and equipment.     Image: Sports materials and equipment.       2. Livelihood     Image: Sports materials and equipment.     Image: Sports materials and equipment.     Image: Sports materials and equipment.       2. Livelihood     Image: Sports materials and equipment.     Image: Sports materials and equipment.     Image: Sports materials and equipment.			provided with			
2. Livelihood     and equipment.     ZDMC     Completed       Barangay and Cooperative     Expenditures:			sports materials			
2. Livelihood     ZDMC     Completed       Barangay and Cooperative     Expenditures:			and equipment.			
Barangay and Cooperative Expenditures:		2. Livelihood			ZDMC	Completed
				Barangay and Cooperative		Expenditures:

a.development and enhancement of economically viable resource-based livelihoods and other existing livelihoods	1 Community Cooperative provided with materials and capital for micro- enterprise business						Php 5,000.00
<ul><li>b. improvement of agriculture and fishery</li><li>c.development of competency for skills-based employment opportunities</li></ul>	N/A N/A						
<ul><li>3. Health</li><li>a. improvement of health facilities and support infrastructures</li><li>b. capacity building for barangay health workers (BHWs)</li></ul>	2 Barangay Health Center improvements. 45 Barangay Health Workers including Barangay Nutritious Scholar provided with subsidy.	Barangay Workers	and	Barangay	Health	ZDMC	Completed Expenditures: Php 142,306.00

c. support to preventive health care	8 Barangay Health Center Provided with Medical equipment, materials Basic Medicines and Multi-Vitamins.						
<ul> <li>4. Infrastructure</li> <li>a.</li> <li>construction/improvement/maintenance</li> <li>of educational infrastructure and support facilities</li> <li>b.</li> <li>construction/improvement/maintenance</li> <li>of livelihood infrastructure and support facilities</li> <li>c.</li> <li>construction/improvement/maintenance</li> <li>of health infrastructure and support facilities</li> <li>d.</li> <li>construction/improvement/maintenance</li> <li>of socio-cultural center and barangay</li> <li>facilities</li> </ul>	<ol> <li>Daycare Center Improvement,</li> <li>Agricultural Infrastructure Constructed,</li> <li>Health Center Improvement,</li> <li>Cover-court fence constructed</li> <li>Barangay Chapel improvement</li> <li>Barangay Facilities Improvement</li> </ol>	Barangay, Center.	Church	and	Health		Completed Expenditures: Php 419,418.00
5. Social Services		Barangay				ZDMC	Completed Expenditures:

<b>DI</b> 1 1 (0 010 00	
	a.emancement of socio-cultural 5,000
Php 1,169,010.00	processes heads
	Neigh
	baran
	provi
	assort
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	for
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	opera Covid
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	5
	provi
	b. improvement of community facilities suppo
	and skills mater
	equip
	provi
	Assor
	for th
	citize
	PWD
	b. improvement of community facilities and skills b. improvement of community facilities b. improve

Concern	Responsible	Government	Proponent	Indicative Timeline	Source of Fund
	Community	Agency/Non-government			
	Member/Beneficiary	Agency and Services			
1. Education	Students, DepEd	DepEd, Barangay Office,	ZDMC Community Relations Office	Pre-construction Construction,	ZDMC
a. development of educational facilities and infrastructures				Operation, Abandonment	
b. provision of scholarship grant, educational assistance and support to school requirements					
c. promotion of informal education and support to school activities that facilitate the development of skills and students					
d. provision of educational materials, equipment and other physical facilities					
e. support to academic and non- academic activities					
f. provision of subsidy to teachers and daycare workers to elevate the quality of work and education					
2. Livelihood	Farmers, fisherfolks women, youth, senio	<ul><li>TESDA, Barangay Offices,</li><li>POs, NGOs, DTI</li></ul>	ZDMC Community Relations Office	Pre-construction Construction,	ZDMC

# 5.2 Social Development Management Plan Framework for the Expansion Plan

a. development of economically	citizen, PWDs, ZDMC		Operation,	
viable resource-based livelihoods,	local employees		Abandonment	
from resource mobilization to				
marketing of products that is				
gender-sensitive and cluster-based,				
and provide support to livelihood				
programs of the community, e.g.				
handicraft training, textile				
making/design, pottery.				
b. improvement of agriculture and				
fishery by providing skills training;				
support to seminars on sustainable				
agriculture, agroforestry, organic				
farming and fishing; providing				
financial support to fisherfolks and				
farmers for their livelihood needs.				
a development of competence for				
c. development of competency for				
skins-based employment				
"priority biring scheme" for local				
residents/impact barangays				
Testuents/impact barangays				
d provision of skills training e.g.				
haking caregiving housekeeping				
welding barista automotive food				
processing computer repair.				
provision of knowledge				
r		1		

development programs, e.g. computer literacy; e. provision of alternative livelihood programs or skills training for workers that might be affected during the abandonment phase of the project					
<ul> <li>3. Health</li> <li>a. improvement of health facilities and infrastructures</li> <li>b. capacity building for barangay health workers (BHWs) and purok team leaders on disease and accident management</li> <li>c. support to preventive health care, medical consultations, and treatments from medical dectors and</li> </ul>	Health center offices, BHWs, PWDs and communities of direct impact barangays.	Barangay Health Offices, Municipal Health Office, DOH, Person With Disability Affairs, POs and NGOs	ZDMC Community Relations Office	Pre-construction Construction, Operation, Abandonment	ZDMC
d. provision of seminar on hygiene, water and food safety, proper handwashing, proper waste management and healthful housing. e. provision of assistance on maternal care and child health care					

<ul> <li>of each impact barangay, e.g</li> <li>supplemental feeding, in-school</li> <li>supplemental feeding</li> <li>e. provision of mobility aids to</li> <li>PWDs, e.g. wheelchair, hearing aids)</li> </ul>
e. provision of mobility aids to PWDs, e.g. wheelchair, hearing aids)
e. provision of mobility aids to PWDs, e.g. wheelchair, hearing aids)
e. provision of mobility aids to PWDs, e.g. wheelchair, hearing aids)
e. provision of mobility aids to PWDs, e.g. wheelchair, hearing aids)
e. provision of mobility aids to PWDs, e.g. wheelchair, hearing aids)
PWDs, e.g. wheelchair, hearing aids)
TWDS, C.G. Wheelenan, hearing acts)
f. development of PWD-triendly
barangay offices and roads
g. provision of ambulance for
emergency needs of the community
entergency needs of the community
how we have a second to be
h. support to animal vaccination
program for dogs and cats
i. provision of psycho-social services
to project-impact employees
i monision of hesis modifies and
). provision of basic medicine and
vitamin supplies to health centers
and nutrition posts.
k. provision of basic health
equipment to elevate the quality of
corrections provided by boalth workers
services provided by health workers
I. provision of subsidy to health
workers and nutrition scholars to
elevate the quality of services
provided

4. Peace and Order		PNP, Barangay	ZDMC Community	Pre-construction	ZDMC
		Committee on Peace and	Relations Office	Construction,	
a. provision of seminar on values	PNP, Barangay LGU,	Order, POs and NGOs		Operation,	
development, child and family care,	Communities of direct			Abandonment	
and counselling	impact barangays				
b. support to strengthening					
Barangay Peace and Order					
Committee/Council					
a provision of cominant and					
c. provision of seminars and					
Against Women and Children					
crime, rumor-mongering, legal					
process, and other laws relevant to					
the community					
d. support to setting up of					
community "watch dogs" or					
purok/sitio volunteers and crime					
rescue and reporting system					
e. provision of peace and order					
work provided by the Barangey					
Peace and Order					
Committee/Council Tanod and					
Lupon					
L					

5. Environment			DENR,	Baran	gay LGU,	ZDMC Community	Pre-construction	ZDMC
			Municip	pal Offi	ce – Waste	Relations Office	Construction,	
a. Capacity building for barangay	Barangay LC	GU,	Manage	ement (	Office, POs		Operation,	
officials, stakeholders and	communities of dir	ect	and NC	GOs			Abandonment	
communities in environmental laws,	impact barangays							
protection, monitoring and								
reporting.								
b. Strengthen reinforcement of								
resolutions and laws pertaining to								
protection of the environment, such								
as proper garbage disposal, use of								
illegal type of fishing, etc.								
c. Implement measures to protect								
and monitor environmental								
compliance of the community and								
business/industrial offices								
d. provide seminar on solid waste								
management system, such as proper								
segregation, regular collection of								
garbage and use of 3Rs (recycling,								
re-using and reducing)								
a monitor compliance of having								
trucks and populize these who do								
not comply								
not compty.								
f provision of regular								
drainage/canal cleaning								

g. provision of capacity building to					
reduce and utilize solid waste					
products into useful and profitable					
resources.					
h. provision of Materials Recovery					
Facility in each barangay to practice					
the solid waste management					
program.					
i. provision of a garbage truck and					
staff to collect solid waste from					
impact barangays.					
j. provision of desludging services of					
residential septic tanks every 5					
years.					
k. provision of toilet construction					
materials to residents without					
toilets.					
6. Utilities and Infrastructures	Students, youth,	DPWH, DepEd, Barangay	ZDMC Community	Pre-construction	ZDMC
	communities of direct	LGU and other mining	Relations Office	Construction,	
a. provision of sports facilities and	impact barangays	companies, POs and		Operation,	
provision of sports training for the		NGOs		Abandonment	
youth					
b collaboration with					
talecommunication companies on					
softing up a coll site to berengeus					
with dow connection/no connection					
with slow connection/no connection.					

c. provision of a library/study area for each barangay where students can have access to educational materials and the internet.			
e. collaboration with the Barangay Office, LGU, DPWH and other mining firms on road improvement.			
f. support the building of evacuation centers			
g. construction / renovation / improvement and maintenance of livelihood center and support facilities			
h. construction / renovation / improvement and maintenance of educational infrastructures and support facilities			
i. construction / renovation / improvement and maintenance of health centers and nutrition posts			
j. construction / renovation / improvement and maintenance of socio-cultural center and religious sectors infrastructures and support facilities			

<ul> <li>7. Transportation &amp; Traffic Management</li> <li>a. constant and frequent water sprinkling/cleaning up of roads affected by hauling trucks</li> <li>b. regular preventive maintenance of construction vehicles and hauling trucks</li> </ul>	Drivers from mining companies, communities of direct impact barangays, tricycle drivers	Barangay LGU, other mining companies and their drivers, TODA, POs and NGOs	ZDMC Community Relations Office	Pre-construction Construction, Operation	ZDMC
c. enhancement of agreement amongst impact barangays on traffic management related to hauling trucks:					
- c.1 truck movements (distance of at least three truck lengths or 50 meters behind a travelling haul truck), signs and speed limits, right of way, parking, and penalties, and					
- c.2 color-coding of trucks or tarpaulin-labelled trucks (in order for the residents to identify and report which hauling truck does not follow the traffic rules/barangay agreement)					

d. provision/placement of road signs and lighting to ensure public safety along the highway/roads.					
e. provision of driving seminar to company drivers (hauling trucks, construction trucks)					
f. development of renewal policies for hauling truck drivers (for those who continue to violate safe driving agreement with the impact barangays)					
8. Climate Change	Communities of direct	ZDMC	ZDMC Community	Pre-construction	ZDMC
Response/Disaster Risk Reduction	impact barangays,	Municipal DRRM Office,	Relations Office	Construction,	
riogram	omployees	Host Barangay Cantains		Operation	
a assistance in the	employees	POs and NGOs			
formulation/improvement of the					
barangay's DRRMP					
0.7					
b. conduct of IEC on Disaster Risk					
Reduction and Climate Change					
Actions (CCA-DRR)					
c provision of seminars/trainings for					
host communities and mining					
workers on Disaster Risk					
Preparedness and Mitigation, and					
introduction of latest technological					
improvements in CCA-DRR					

d. capacity building of barangay health workers (BHWs) and purok team leaders who can do first aid and disaster response					
e. provision of equipment, construction materials for additional evacuation centers, and aid in response and recovery of affected communities					
f. creation of ZDMC disaster management team and provision of training					
9. Pandemic Response Program	Communities of direct	Barangay LGU, DOH, POs	ZDMC Community	Pre-construction	ZDMC
a. develop a Prevent-Detect-Isolate- Test-Treat strategy for all ZDMC employees and their immediate family	impact barangays, Barangay LGU, ZDMC employees	and NGOs	Relations Office	Construction, Operation	
b. provision of training on pandemic response to barangay offices and ZDMC employees					
b. support the Barangay-based emergency management					
c. support the building of isolation house/health stations per impact					

barangay and development of pandemic protocol			
d. provision of food, hygiene materials and medicine support to affected households			

5.3 Information, Education and Communication Framework for the Expansion Plan

TARGET SECTOR IDENTIFIED AS NEEDING IEC	MAJOR TOPICS OF CONCERN IN RELATION TO PROJECT	IEC SCHEME/ STRATEGY/ METHODS	INFORMATION MEDIUM	INDICATIVE TIMELINES or FREQUENCY	INDICATIVE COST
Residents of direct impact barangays; ZDMC employees, barangay and municipal LGUs, POs, NGOs, relevant groups: Farmers, Fisherfolks, Women, Senior Citizens, PWD and Youth	<ul> <li>Project Background:</li> <li>Project Proponent</li> <li>Scope of the project</li> <li>Project Schedule and Activities</li> <li>Project development phases</li> <li>Necessity of the Project, and Benefits from the Project</li> </ul>	<ul> <li>Conduct of actual and online seminars</li> <li>Mine tours/visits, conference, actual and online forum/workshops, consultation meetings with LGUs</li> <li>Posting on National or Local newspaper, online press releases</li> <li>Online Conferences, Social Media Postings of infographics, and audio- visual presentations</li> <li>Distribution of</li> </ul>			

		Leaflets, Flyers, and Brochures • Posting on Billboards; Maintenance of existing Information desks and centers or establishing a new one on strategic areas		
Residents of direct impact barangays; ZDMC employees, barangay and municipal LGUs, POs, NGOs, relevant groups: Farmers, Fisherfolks, Women, Senior Citizens, PWD and Youth, Project Contractors	<ul> <li>Compliance with the DENR requirements</li> <li>Environmental Management Plan</li> <li>Environmental Compliance and Monitoring</li> <li>Environmental laws and related regulations on EPEP, FMRDP, MMT, MRFC, ECC</li> <li>Clean-Air Act, Clean</li> <li>Water Act, Ecological</li> <li>Solid Waste</li> <li>Management Act and</li> <li>other laws and</li> <li>regulations.</li> </ul>	<ul> <li>Public Meetings (actual or online)</li> <li>Online Conferences, Social Media Postings of infographics, and audio- visual presentations</li> <li>Purok-to-purok information drive</li> <li>Distribution of information materials</li> <li>Maintenance of Information desk and center</li> </ul>		
Residentsofdirectimpactbarangays;ZDMCemployees,	The program of implementing the Social Development	<ul> <li>Information dissemination during meetings of</li> </ul>		

2021 EPRMP

barangay and municipal LGUs, POs, NGOs, relevant groups: Farmers, Fisherfolks, Women, Senior Citizens, PWD and Youth, Project Contractors	<ul> <li>and Management Program, such as:</li> <li>Environmental Health and Sanitation</li> <li>Environmental Conservation, Protection and Management</li> <li>Disaster Risk Preparedness</li> <li>Solid Waste Management in Schools and Households</li> </ul>	organized and assisted POs and sector;Image: Sector and assisted POs and assector;Image: House-to-house and aschools information dissemination;Image: Sector assisted POs and assisted POS assist	
		<ul> <li>Maintenance         <ul> <li>of Information</li> <li>desk and center</li> </ul> </li> <li>Online Conferences,             <ul> <li>Social Media</li> <li>Postings of</li> <li>infographics, and</li> <li>audio- visual</li> <li>presentations</li> </ul> </li> <li>Maintenance of         existing Information         desks and centers or</li> </ul>	

	establishing a new		
	one on strategic		
	areas		
	Conduct Social		
	Impact Assessment		
	to Impact and		
	Project Barangays		

## 6 ENVIRONMENTAL COMPLIANCE MONITORING

#### 6.1 Environmental Performance

#### 6.1.1 The Land

6.1.1.1 Terrestrial Flora and Fauna

The pre-established flora and fauna monitoring plots for the baseline survey will be continuously monitored. Frequency of monitoring activities is recommended to be done at least once every three years, where significant developments may be observed. Buffer zones for protection and aesthetic retention purposes will also be monitored for development and possible species recruitment. The information gathered will also be used, possibly, to correlate sulfur emissions during plant operations to any change in species population.

- 6.1.2 The Water
- 6.1.2.1 Water Quality

6.1.2.1.1 Freshwater

The established monitoring stations will still be utilized for freshwater quality monitoring, where the following parameters will be observed:

General Parameter	Specific Parameters
Physico-chemical	temperature, pH, conductivity, turbidity, dissolved oxygen (DO),
	oxidation-reduction potential, total dissolved solids (TDS), total suspended
	solids (TSS) and salinity
Biological	fecal and total coliform
Nutrient level	nitrate, fluoride and sulfate
Heavy Metal Content	Aluminum, Antimony, Arsenic, Cadmium, Calcium, Chromium (6+), total
	Chromium, Copper, Gold, Iron, Lead, Lithium, Magnesium, Manganese,
	Mercury, Nickel, Potassium, Selenium, Silver, Sodium, Vanadium and
	Zinc

## 6.1.2.1.2 Groundwater

Monitoring of groundwater quality will be continued on the pre-determined sampling stations. Parameters to be observed include pH, conductivity, turbidity, DO, salinity, temperature and TSS, Aluminum,

## 6.1.2.2 Freshwater Ecology

Biannual monitoring (to consider both wet and dry seasons) will be conducted for phytoplankton, zooplankton, benthic organisms, and other aquatic organisms for freshwater ecology. This should also be conducted as part of the water quality monitoring program and its monitoring stations.

#### 6.1.3 The Air

Sampling for noise conditions around the Project area will be continuously monitored, with consideration to the locations mentioned in the ambient air quality monitoring section of the report. Monitoring will be conducted quarterly, during the day and during the evening. This will be essential in analyzing the changes in air quality and noise.

#### 6.1.4 The People

Continued monitoring of the Proponent's commitments to the communities affected will be done as part of the Proponent's SDP implementation. Concerns of all the stakeholders in the impact communities will be gathered thru the Proponent's IEC and will be handled by the Site Communications Unit of the Plant.

#### 6.1.5 Status of ECC Compliance

The ECC conditions are being complied based on the MMT and Self-Monitoring Reports (**Error! Reference source not found.**). Table 6-1 shows the status of the Proponent's compliance to ECC conditions, in consideration to amendments stated in DAO 2003-30.

ECC Condition/s	State	us of	Action Taken
	Yes	No	
ENVIRONMENTAL MANAGEMENT			
1. Observance of good vegetative practices, sound soil management and proper waste management throughout the project implementation such as:	$\checkmark$		
a. Properly stockpiling and disposal of the overburden, waste rock material and mill tails generated from the mining operations, silt materials scooped-out from the silt dams/settling ponds, and other solid waste in permanent, stabilized dumpsites to avoid pollution of any water body and drainage systems, and maintaining them in safe and non- polluting conditions;	$\checkmark$		Complied.
<ul> <li>b. trictly effecting stabilization and erosion control to the mining and to the affected side slopes of the roads and nearby gullies, creeks, rivers and silt dams/settling ponds within the primary impact area;</li> </ul>	$\checkmark$		Complied. Continuous enrichment of slopes by planting vetiver, napier and madre de cacao. During the reporting period, a total of 30,690 slips of grasses were planted in slopes and eroded areas.
c. Using the recovered topsoil for re- soiling, as soil cover for rehabilitation of mined-out areas and waste dumps, for	$\checkmark$		Environment Department practiced soil conservation program thru soil

#### Table 6-1: Status of ECC Compliance

	ECC Condition/s	Stat	us of	Action Taken
		Comp	liance	-
	landscaping of designated suitable areas. Stockpiling should be maintained not more than three (3) meters high and stabilized by vegetation to prevent erosion;	105		amelioration. Topsoil was conserved for future rehabilitation purposes.
	d. Limiting the cleaning of vegetation within the planned areas to be mined and planting idle land areas in the site within appropriate species;	$\checkmark$		No mining operation since 2016. From previous years, a total of 368,180 trees planted within the mine site and neighboring communities. For this year, January to December 2019, a total of 13,925 assorted seedlings were planted in all identified disturbed areas. As of the reporting period a total of 46.925 hectares were planted and continuous enrichment of previously planted areas, for Malimlim site.
2.	Conduct of an effective information, Education and Communication (IEC) Programs to inform and educate all stakeholders, especially its local residents, on the projects mitigating measures embodied in its EPRMP and the conditions stipulated in the ECC for greater awareness, understanding and sustained acceptance of the project. The proponent shall implement an annual detailed IEC program in coordination IEC program in coordination with the Mines and Geosciences Bureau (MGB) Regional Office No. III and EMB Regional Office No. III. It shall also conduct a Knowledge, Attitude, Practice (KAP) Evaluation to determine the effectiveness of the IEC Program, copy of such evaluation provided to the MGB and EMB Regional Offices	V		Continuing activity. Incorporated on Annual Social and Development Program, which has been approved by the Mines and Geosciences Bureau Region III.
3. Ge	Design and construction of roads with minimal land ecological disturbance and with adequate drainage. It shall continuously maintain access roads and other public/private roads within the project site to offset impact of heavy vehicle traffic and nuisances/damages to the people and properties, as well as conduct regular water spraying to control dust generation and require vehicles to maintain low speed in dusty roads and populated areas; eneral Conditions	V		Continuing activity. Maintenance of road during hauling and continuous dust suppression using water truck and maintenance of washbays at Lucapon and Bolitoc, this was implemented as part of Annual Environmental Protection and Enhancement Program.

ECC Condition/s	State	us of	Action Taken
	Comp	liance	
	Yes	No	
4. The mining and mineral processing shall conform with the provisions of RA 6969 (Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990), RA 9003 (Ecological Solid Waste Management Act of 2000), RA No. 9275 (Philippine Clean Water Act of 2004) and RA 8749 (Philippine Clean Air Act of 1999); no forms of wastewater, silt laden run-off or other wastes shall be discharge into the river without undergoing adequate treatment and proponent shall ensure that it will comply to RA 9275 (Philippine Clean Water Act of 2004);	V		Complied. Necessary permits were secured.
<ul> <li>5. The proponent shall comply with the environmental management and protection requirements of the pertinent provisions of the Philippine Mining Act of 1995 (RA 7942 and its Revised Implementing Rules and Regulations (DAO 94-40, as amended), as well as the pertinent provisions of the Memorandum of Agreement between EMB and MGB executed on 16 April 1998, such as, not limited to the following: <ul> <li>a. Submission of a revised Environmental Protection and Enhancement Program (EPEP), with the Final Mine Rehabilitation and/or Decommissioning Plan (FMR/DP) integrated thereto, to the MGB, for approval prior to operation;</li> </ul> </li> </ul>	√		Environmental Protection and Enhancement Program and Final Mine Rehabilitation and/or Decommissioning Plan was already forwarded and submitted to DENR-MGB Central Office and received dated 13 june 2008. Contingent Liability and Rehabilitation Fund Steering Committee Certificate of Approval dated 4 July 2008 with CLRF Certificate of Approval No. EPEP # 084-2008- 01E. A revised EPEP was submitted to MGB 3 on 1 December 2016 for evaluation and approval.
<ul> <li>b. Submission of a revised Social Development and Management Program (SDMP), to the MGB Regional Office III. For approval prior to operation. The EMB shall be furnished with the SDMP within thirty days from its approval;</li> <li>c. Expansion of existing Contigient</li> </ul>	V		Complied.
Liability and Rehabilitation Fund (CLRF) and Environmental Trust Fund (ETF);	√		Steering Committee Certificate of Apprval dated 4 July 2008 with CLRF Certificate of Approval No. EPEP # 084-2008-01E.
d. Maintenance of the existing Mine Environmental Protection and	$\checkmark$		Complied.

ECC Condition/s	Stat	us of	Action Taken
	Comp	liance	
	Yes	No	
Enhancement Office (MEPEO) to			
competently handle the environment-			
related aspect of the project. In addition			
to the monitoring requirements as			
specified in the EMMP, the MEPEO shall			
also monitor the actual project impacts			
vis-à-vis the predicted impacts and			
management measures in the			
EIS/ESRMP and the effect of basting			
activities particularly vibration, noise			
and dust generation;			
e. Maintenance of Mine Renabilitation			Complied. Regular MMI and MRFC
Fund Committee (MRFC and Multi-	N		meeting were conducted quarterly, Q4 MM1
f Maintenance of a Community Polations			Complied
Office	$\checkmark$		Compilea.
6. The proponent shall ensure that its contractors			Complied
and subcontractors properly comply with the	$\checkmark$		
relevant conditions of the ECC			
Restrictions			
7. Surface mining method for the nickel and			
chromite laterite deposits and surface and			
underground mining deposit should be strictly			
observed;			
8. Tree cutting permit will be secured prior to	1		No mining activity as of reporting period,
cutting of trees; and	N		Issuance of tree cutting permit was
D. Transfor of comparable of this project comises the			temporary suspended.
p. Transfer of ownership of this project carries the			
same continuous and restrictions, for Which,	2		
grantee to EMB within fifteen (15) days from	v		
such transfer			
same conditions and restrictions, for which, written notification must be made by herein grantee to EMB within fifteen (15) days from such transfer.	V		

## 6.2 Self-Monitoring Plan

# 6.3 Environmental Monitoring Plan

Shown in Table 6-2 is the Environmental Monitoring Plan for the project.

## 6.4 Multi-Sectoral Monitoring Framework

A Memorandum of Agreement (MOA) on the creation of the Multi-Partite Monitoring Team was made and entered into by the following parties: 1) Department of Environment and Natural Resources (DENR) through Environmental Management Bureau (EMB) and 2) ZDMC.

## 6.5 Environmental Guarantee and Monitoring Fund Commitments

# 6.5.1 Environmental Guarantee Fund (EGF)

<u>Trust Fund</u> – ZDMC secured an Insurance Policy or surety bond for the Trust Fund in the initial amount of <u>Four Million Pesos</u> (PhP 4,000,000.00). The Trust Fund will be used to compensate aggrieved parties for any damages to life or property, undertakes community-based environmental programs, conduct environmental research aimed at strengthening measures to prevent environmental damage and to finance restoration and rehabilitation of environmental quality of the affected area. The Trust Fund shall be replenished to its original amount annually or whenever the amount goes below <u>One Million</u> <u>Pesos</u> (PhP 1,000,000.00). Replenishment of the amount shall be done by ZDMC regularly. The Trust Fund shall be renewed upon every expiration.

<u>Environmental Guarantee Cash Fund</u> - ZDMC opened an account for the Environmental Guarantee Cash Fund at a mutually acceptable commercial bank in the area in the initial amount of <u>One Million</u> <u>Pesos</u> (PhP 1,000,000.00) which shall be earmarked for immediate rehabilitation and compensation of affected communities in case of damage or accidents. It shall also be used to cover the operational costs of the EGF Committee. This Cash Fund shall be placed in an interest-bearing account and such interest shall accrue to the same Cash Fund. The Fund shall be replenished to its original amount annually or whenever the amount goes below <u>Five Hundred Thousand Pesos</u> (PhP 500,000.00).

## 6.5.2 Environmental Monitoring Fund (EMF)

ZDMC opened an account for the Environmental Monitoring Fund of the PROJECT for the exclusive use of the monitoring activities. The amount of Four Hundred Thousand Pesos (Php 400,000.00) shall correspond to the expenses incurred by the MMT for the period such as cost of transportation, board and lodging, MMT meetings, sampling, shipment/transport of samples, documentation (photos, videos, etc.) including preparation and distribution of monitoring reports, laboratory analysis, lease/rental of monitoring equipment, hiring of outside experts/subcontracting of a monitoring work to a neutral party, training of the MMT, public information campaign/dissemination and other such activities relating to the operation of the MMT.

						Table 6-2. En	vironmental	Monitoring Plan						
	Environmen	Parameters to be	Sampling	g and Measuren	nent	Lead Person/	Annual			EQPL Mana	gement Scheme			
Module	tal Sector	monitored	Method	Frequency	Location	Office	Estimated		EQPL Range			Management Measure		
							Cost (Php)	Alert	Action	Limit	Alert	Action	Limit	
	<del></del>					75140	500.000							
Terrestrial Flora		<ul> <li>Total number of trees to be cut</li> <li>Total number of endemic trees to be cut (per species)</li> <li>Total number of endangered trees to be cut (per species)</li> <li>Total area of vegetation to be removed (has)</li> </ul>	100% inventory of trees to be affected -Mapping and ground delineation	Prior to cutting of affected trees/As needed	-Proposed hectares location of Production area -Proposed location of facilities and road	ZDMC Environment Dept. PCO DENR- CENRO, MMT	500,000	Cutting of trees without permit	Cutting of trees without permit	Cutting of trees without permit	Stop unpermitted cu contractor/employee t about necessary perm permit and compensa policies	Coordination with Coordination with Coordination		
Flora and		Naturally growing/	Quadrat Method (Flora)	Quarterly	Flora transects 1 to	ZDMC Environment	500,000	10% reduction in the abundance of	25% reduction in the abundance of	40% reduction in the abundance of	Barangay Officials	Municipal ENRO	Coordination and assessment	
Fauna		<ul> <li>planted species at the buffer zones and at the rehabilitated areas within and outside the direct impact area</li> <li>Richness, Abundance and frequency</li> <li>Diversity indices</li> </ul>	Line Intercept Method (Fauna) Applicable methods based on the Manual on Biodiversity Assessment and Monitoring System (BAMS) of the Biodiversity Management Bureau	vegetation/ habitat clearing activities then Annually at post- clearing.	Fauna transects 1 to 3	PCO		total plant species recorded from the baseline 2017 data	the total plant species recorded from the 2017 baseline data	the total plant species recorded from the 2017 baseline data	Enrichment planting of at least 3 ha of existing vegetation.	Enrichment planting of at least 5 ha of existing vegetation.	with MMT Enrichment planting of at least10ha of existing vegetation.	
WATER			-			-			-	-	-		-	
Water Use	Groundwater Surface water	Volume of water extracted	Flow meters	Daily monitoring Quarterly reporting through the SMR and NWRB reports	Water Sources Sring Cabaluan River Deep wells	Pollution Contro n <sup>Officer /</sup> Mining Operations	Part of AEPEP budget	80% of the limit value	90% of the limit value	<ul> <li>Extraction rate limit set by the NWRB in the water permit</li> <li>Total available water supply</li> </ul>	Check any additional water uses	<ul> <li>Check any additional water uses, Check the water system for any leakages,</li> </ul>	<ul> <li>Check any additional water uses,</li> <li>Check the water system for any leakages, Consider other alternative sources of water</li> </ul>	

Water Quality	Effluent Class C Cabaluan River Balin Buaya-Uacon River Class B Lauis River	<ul> <li>□ TSS</li> <li>□ pH</li> <li>□ Mn</li> <li>□ As</li> <li>□ Cd</li> <li>□ Cr (VI)</li> <li>□ Pb</li> <li>□ Hg</li> <li>□ Ni</li> <li>Nitrate</li> </ul>	In-situ measurement using hand-held water quality tester (pH, Temp.) Grab sampling and laboratory analysis	Monthly monitoring	Settling Ponds ZDMC EFWQ1 – EFWQ8	Pollution Control Officer	Part of AEPEP budget	Class C TSS=80-89 mg/l pH: 6.4-6.8 or 9.0-9.2 Mn: 1.5-1.7 mg/l As: 0.032-0.035 mg/l Cd: 0.008-0.0089 mg/l Cr: 0.016-017 mg/l Pb: 0.08-0.089 mg/l Hg: 0.0032-0.0035 mg/l Ni: 0.800-0.899 NO3-N: 11.2-12.5 mg/l	Class C TSS=90-99 mg/l pH: 6.1-6.3 or 9.3-9.4 Mn: 1.8-1.9 mg/l As: 0.036-0.039 mg/l Cd: 0.009-0.0099 mg/l Cr: 0.018-0.019 mg/l Pb: 0.09-0.099 mg/l Hg: 0.0036-0.0039 mg/l Ni: 0.900-0.999 mg/l NO3-N: 12.6-13.9 mg/l	Class C TSS=100 mg/l pH: 6.0 (min) or 9.5 (max) Mn = 2 mg/l As = 0.04 mg/l Cd = 0.01 mg/l Cr = 0.02 mg/l Pb = 0.1 mg/l Hg = 0.004 mg/l Ni = 1 mg/l NO3-N = 14 mg/l	<ul> <li>Investigate the source and identify possible pollutant sources</li> <li>Conduct corrective actions if needed</li> </ul>	<ul> <li>Investigate the source to identify possible pollutant sources</li> <li>If the problem is within the construction/ operation area, conduct adjustments/ appropriate corrective action at identified pollutant source.</li> </ul>	<ul> <li>Investigate the source to identify possible pollutant sources</li> <li>Provide additional mitigation measures or pollution control facilities</li> <li>Review current design of pollution control facility. Revise/ improve/ make adjustments if necessary</li> </ul>
Water Quality	Freshwater / Surface Water (Ambient) Class C Cabaluan River Balin Buaya-Uacon River Class B Lauis River	<ul> <li>BOD</li> <li>Cl</li> <li>Color</li> <li>DO</li> <li>Fecal Coliform</li> <li>NO3-N</li> <li>Phosphate</li> <li>pH</li> <li>Temp.</li> <li>TSS</li> <li>O&amp;G</li> <li>As</li> <li>Cd</li> <li>Cr(VI)</li> <li>Pb</li> <li>Mn</li> <li>Hg</li> <li>Ni</li> <li>1.</li> </ul>	In-situ measurement using hand-held water quality tester (pH, Temp.) Grab sampling and laboratory analysis	Monthly	All freshwater quality stations ZDMC FWQ1 – ZDMC FWQ19	Pollution Control Officer	Part of AEPEP budget	Class C BOD: 5.6-6.2 mg/l Cl:280-314 mg/l Color: 60-66 TCU DO: 5.6-6.0 mg/l F.Coli: 160-179 MPN/100ml NO3-N: 5.6-6.2 mg/l Phosphate: 0.4-0.44 pH: 7.1-7.4 or 8.8-8.85 Temp: 26.2-27°C or 28.9 29.8 TSS: 64-72 mg/l O&G: 1.5-1.7 mg/l As:0.015-0.017 mg/l Cd:0.004-0.0044 mg/l Cr: 0.008-0.009 mg/l Pb:0.04-0.044 mg/l Mn: 0.16-0.17 mg/l Hg:0.0006-0.0079 mg/l	Class C BOD: 6.3-6.9 mg/l Cl: 315-349 mg/l Color: 67-69 TCU DO: 5.1-5.5 mg/l F.Coli: 180-199 MPN/100ml NO3-N: 6.3-6.9 mg/l Phosphate: 0.45-0.49 mg/l Phosphate: 0.45-0.49 mg/l pH: 6.6-7.0 or 8.86-8.9 -Temp: 25.1-26.1 or 29.9- 30.9 °C TSS: 73-79 mg/l O&G: 1.8-1.9 mg/l As:0.018-0.019 mg/l Cd: 0.0045-0.0049 mg/l Mn: 0.18-0.19 mg/l Mn: 0.18-0.19 mg/l Hg:0.0008-0.0009 mg/l Ni: 0.18-0.19 mg/l	$\begin{array}{l} \hline Class C \\ BOD = 7 mg/l \\ Cl = 350 mg/l \\ Color = 75 TCU \\ DO = 5 mg/l minimum \\ F.Coli = 200 MPN/100ml \\ NO3-N = 7 mg/l \\ Phosphate = 0.5 mg/l \\ Phosphate = 0.5 mg/l \\ pH: 6.5 or 9.0 \\ Temp. 25-31 °C \\ TSS = 80 mg/l \\ O&G = 2 mg/l \\ As = 0.02 mg/l \\ Cd = 0.005 mg/l \\ Cf = 0.015 mg/l \\ Cf = 0.015 mg/l \\ Mn = 0.20 mg/l \\ Hg = 0.001 mg/l \\ Ni = 0.20 mg/l \\ \end{array}$	<ul> <li>Investigate the source and identify possible pollutant sources</li> <li>Conduct corrective actions if needed</li> </ul>	<ul> <li>Investigate the source to identify possible pollutant sources</li> <li>If the problem is within the construction/operation area, conduct adjustments/ appropriate corrective action at identified pollutant source.</li> </ul>	<ul> <li>Investigate the source to identify possible pollutant sources</li> <li>Provide additional mitigation measures or pollution control facilities</li> <li>If source is not project construction, inform MMT regarding possible source for the group's investigation and coordination with LGU</li> </ul>

# AIR

Air Quality	Air Quality (Ambient)		Total Suspended Particulates PM10 SO2 NO2	High-volume / gravimetric 1-hr averaging period Visual inspection of fugitive dust emissions SO2 -Gas sampler/Pararosani line Method NO2-Gas sampler/ Griess-Saltzman	Quarterly using ambient air sampling Daily for visual inspection of fugitive dust emissions along unpaved roads and access roads and haul roads	ZDMC monitoring Sites	ZDMC Environment Dept. PCO	600,000	Noticeable dust and/or presence of haze or 1-hr (µg /Ncm) TSP: 225 PM 10: 140 NO2 : 210 SO2 : 270	Complaint lodged by community or 1-hr (µg /Ncm) TSP: 270 PM 10: 170 NO2: 235 SO2: 305	Concentration at 1-hr (µg /Ncm) □ TSP:30 0 □ PM 10:200 □ NO2: 260 □ SO2: 340	<ul> <li>Inform Operations/ Utilities to check operation of the unit and adjust accordingly</li> <li>ID source of pollutant</li> <li>Evaluate plant process that emits the pollutant</li> <li>Monitor ambient levels at stations/visual inspection of fugitive dust emissions</li> </ul>	<ul> <li>ID source of pollutant</li> <li>Evaluate plant process that emits the pollutant</li> <li>Implement corrective action on plant process that emits the pollutant,</li> <li>Conduct monitoring after corrective action</li> <li>Conduct road watering to control dust emissions due to vehicular traffic and wind erosion</li> </ul>	<ul> <li>ID s polli</li> <li>Con eval exca</li> <li>Con adju and qua</li> <li>Imp corr on p that polli</li> <li>Con mor corr</li> </ul>	source of lutant nduct detailed aluation of ceedance nduct process ustments d/or check fuel ality olement rective action plant process t emits the lutant, nduct nitoring after rective action
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Noise	Ambient Noise	Noise level (dBA) during morning, daytime, evening and night time	Discrete reading	Quarterly	ZDMC monitoring Sites	ZDMC Environment Dept. PCO	Part of air quality monitoring cost or part of ZDMC operational cost	<ul> <li>Equipment or machineries failure or complaints by employees</li> </ul>	□ C k c	Complaint odged by employees/ community	<ul> <li>Noi exc NP stal</li> <li>Coi lody em cor</li> </ul>	vise level ceeds PCC noise andards omplaint dged by nployees/ mmunity	Immediately fix the broken equipment or machineries	<ul> <li>Investigate cause of complaint, determine and address the root cause</li> </ul>	<ul> <li>Conduct plant- wide noise audit of equipment and machineries</li> </ul>
Meteorology	Weathe r	Rainfall, wind speed, wind direction, temperature, humidity	Weather station	Daily	Quarry area	ZDMC Environment Dept. PCO	Part of air quality monitoring cost or part of ZDMC operational cost	□ n/a	□ n	n/a	□ n/a	a	□ n/a	□ n/a	□ n/a
PEOPLE															

#### PEOPLE

People	Community	Needs assessment for the SDMP formulation	Community coordination	Every five years	Host and neighboring barangays / beneficiaries	Community Relations Office	Part of SDMP cost	n/a	n/a	n/a	n/a	n/a	n/a
	SDMP Implementation CSR Programs	Projects under the approved SDMP	Evaluation / Documentation	Quarterly	Host and neighboring barangays / beneficiaries	Community Relations Office Community Relations Officer	Part of SDMP cost	Negative verbal feedback to the Proponent	Formal complaint lodged by the community	Multiple complaints by the community captured by local media organizations	<ul> <li>Proponent to investigate/ inspect subject of negative feedback</li> <li>Coordinate with Barangay and MMT</li> </ul>	<ul> <li>Investigate cause of complaint, determine and address the root cause</li> <li>Coordinate with the municipal government, MMT</li> </ul>	<ul> <li>Conduct regular consultation with relevant and concerned stakeholders of the community.</li> <li>Release an official statement for general consumptio n and employees.</li> <li>Coordinate with MMT and</li> </ul>

Information, Education and Communication programs	Implementation of IEC activities	Evaluation / Documentation	Quarterly	Host and neighboring barangays / beneficiaries	Community Relations Office Community Relations Officer	Part of SDMP cost	Formal complaint lodged by the community including those from local radios	Multiple complaints by the community captured by local media organizations Regional/ National media (TV/Radio/Newspa per)	<ul> <li>Proponent to investigate/ inspect subject of negative feedback</li> <li>Coordinate with Barangay and MMT</li> </ul>		Proponent to investigate/ inspect subject of negative feedback Coordinate with Barangay and MMT		Investigate cause of complaint, determine and address the root cause Coordinate with the municipal government, MMT		Conduct regular consultation with relevant and concerned stakeholders of the community. Release an official statement for general consumption and employees.
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Table 6-3.	Self-	Monit	oring	Plan
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Project Activity	Parameter	Location	Frequency	Responsibility	Estimated Cost (PhP)
Construction Phase					
Site clearing and earthmoving activities	For surface waters: water pH, temperature, DO,BOD, TSS, oil and grease, total and fecal coliforms; Cr <sup>+6</sup> ; For water supply: pH, hardness,total dissolved solids, iron, Cr <sup>+6</sup> , and total and fecal coliforms	Water sampling Stations 4, 5 & 6 identified in the EIS; one (1) and the domestic water source(s) in Sitio Acoje L1100	Monthly	Proponent	25,000.00 per monitoring (laboratory fees)
	Ambient air quality – TSP, SOx, NOx and noise levels	Air sampling Stations 2,3,4, and 5 identified	Quarterly	Proponent	25,000.00 per monitoring (laboratory and equipment rental fees)
	Inventory of hardwoods	All mining blocks	Before start of clearing	Proponent	Part of EPEP costs
Overburden removal; disposal of solid wastes	Housekeeping practices	At designated waste dump & garbage disposal facility	Weekly	Proponent / Contractor	Part of operating cost of Proponent / Contractor
Storage of materials	Erosion/runoff control measures	Stockpile areas	Daily	Proponent / Contractor	Part of operating cost of Proponent / Contractor
Usage of heavy equipment and vehicles	Fuel leaks	Motor pool, equipment depot andfuel storage areas	Weekly	Proponent / Contractor	Part of operating cost of Proponent / Contractor
Construction works	Number of workers hired from concerned LGUs Work-related accidents	Project area	Quarterly	Contractor	Part of operating cost of Contractor
		Construction site(s)	Daily	Project management team / Safety Officer	Part of operating cost of Contractor
	Compliance to ECC		Before construction	Proponent	No costs
Operations Phase					
Mining operations	For surface waters: water pH, temperature, DO,BOD, TSS, oil and grease, total and fecal coliforms; Cr*6; For water supply: pH, hardness,total dissolved solids, iron, Cr*6, and total and fecal coliforms	Stations identified in the EIS	Quarterly	Proponent thru Environmental Management Unit (EMU) ; Multipartite Monitoring Team (MMT)	70,000.00 per monitoring (laboratory fees)

## 7 ABANDONMENT/DECOMMISSIONING / REHABILITATION POLICIES AND GENERIC GUIDELINES

Project abandonment is an unlikely option at this point since there is a pressing need for the Project. Nevertheless, the following is an abandonment framework that will be implemented by the Proponent.

After the expected service life of the Project, parts that are determined to be serviceable will be salvaged for use as replacement parts at the other units of the Proponent. The major structures will be dismantled and the area may be re-developed according to alternative land uses for the site. The major activities will include removal of all buildings, structures, equipment and any other works (including roads, foundations and other made-up surfaces). The Proponent will ensure minimal damage that may be caused by removal of the facilities. An audit of hazardous wastes and environmental site assessment (ESA) will be conducted to account for proper disposal and site treatment if such will be required. The Proponent will leave the site in a secure, clean and tidy condition and will ensure that the site is enclosed by a secure boundary structure.

The abandonment plan will have to be discussed and agreed on with the community. Once the land use plan is firmed up, the implementation schedules, system of environmental compliance guarantees, monitoring, reporting, and cost provisions will be formally submitted to the DENR three years prior to abandonment. The following factors should be emphasized in the abandonment plan:

- The review of the EIS. The EIS will provide the information regarding the state of the environment and the community before the introduction of the project;
- An assessment of the actual impacts generated by the project and the various environmental management measures that were implemented, and those still to be done.
- The aspirations and expectations of the stakeholders at the time the decision is made; and
- An accounting of obligations of the proponent to local parties, including its workers.
- Conduct of an extensive Environmental Audit of hazardous wastes and
- Conduct of an environmental site assessment (ESA) to determine if proper disposal and site treatment may be required and further remediation and rehabilitation should be undertaken.

As required by the DENR (DAO 2003-30), a detailed decommissioning or abandonment plan will be developed one year prior to the end of the Project operating life.
## 8 INSTITUTIONALPLAN FOR EMP IMPLEMENTATION

In order to properly address the environmental, socio-economic, political and public health issues related to the project and the host community, ZDMC has to establish a coordinating body.

- To ensure that the different issues are addressed in a timely manner, environmental issues will be the concern of the Environmental Unit (EU) and the other community issues by the Corporate Social Responsibility (CSR) office.
- To ensure the implementation of all the environmental programs, the proponent shall establish an institutional linkage with the local government units and the Multi-Partite Monitoring Team (MMT).

In addition to this institutional linkage, management shall budget enough resources for the full implementation and support of all the environmental programs. The establishment of the MMT is a requirement of the DENR for the different development projects. The MMT will be responsible in monitoring the implementation of the management plans for the project. The MMT therefore, plays a large role in environmental protection. Internally, the company will have its own environmental education program. Personnel will be oriented on environmental standards in terms of waste management. New workers will be briefed and informed of environmental protection policies and pollution control programs of the company. The company will also produce an Environmental Management Manual which will be distributed to the employees, contractors, the DENR, LGUs and to other interested stakeholders.

ZDMC's existing Organizational Chart is shown in Figure 8-1.



## 8.1 Environmental Unit (EU)

The Environmental Unit (EU) will be directly reporting to the resident manager. The unit shall have the following functions:

- Plan and implement the environmental management plan;
- Monitor compliance of contractor's implementation of the EMP;
- Identify sources of pollution;
- Monitor and evaluate the effectiveness of mitigating/enhancement measures;
- Plan, propose, and implement modifications, or additional environmental measures that are deemed necessary to more effectively protect the environment;
- Coordinate with relevant oversight agencies and other entities including the local government and the community to ensure their effective participation in the implementation of the environmental management plan.

The Pollution Control Officer shall head the Environmental Unit. The PCO should be given enough authority and competence on decision-making with reference to environmental management. The Environmental Management Unit shall initiate together with the DENR office, the establishment of the Multi-partite Monitoring Team (MMT).

## 8.2 Corporate Social Responsibility (CSR)

The Corporate Social Responsibility (CSR) shall also be established to manage the interaction between the project and all stakeholders to ensure the social acceptability and sustainability of the project. The CSR's main task is to initiate agreeable solutions to problems with balanced intentions and motion, implementation of the Information, Education and Communication (IEC) Program and the Social Development Program (SDP) of the project.

The CSR shall also be responsible for coordinating the company's activities with the concerned communities; LGUs and other government agencies. This is important in the operations and functions of the Multi-Partite Monitoring Team. The CSR shall be headed by the Community Relation's Officer (COMREL). At some point in time, it cannot be avoided that there will be disagreements and tension between the project proponent and various stakeholders. It should be the COMREL's task to initiate conflict resolution actions.

Apart from the above, the other functions of the COMREL are:

• Generating and sourcing of funds or networking community leaders with sources of funding for the community's various projects;

- Initiating livelihood activities, conducting a skills inventory survey, sponsoring livelihood training programs or networking host communities with organizations that can assist in setting up livelihood projects;
- Initiating social service and out-reach programs like medical missions, calamity assistance etc.; and community organizing in general.

The COMREL shall be a community organization and development specialist with a background in environmental management. His level of authority within the corporate structure should be high enough to make decisions concerning the company. This level of authority is crucial in establishing the credibility to coordinate and deal with various stakeholders. The COMREL manager can be assisted by two to three other community organization and development specialists, also with backgrounds in environmental management.