SOCIETATEA COMERCIALA
ROSIA MONTANA
GOLD CORPORATION S.A.

PROJECT PRESENTATION REPORT

November 2004

Issued for:

S.C. Roşia Montană Gold Corporation S.A.
321, Strada Piata
3385 Roşia Montană
Albă County, Romania

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Abbreviations and Conventions

%	Percent
°C	Degrees Centigrade
μT	Microtesla
A/m	Amperes per Metre
AARL	Anglo American Research Laboratory
ABA	Acid Base Accounting
Ag	Silver
ANFO	Ammonium Nitrate-Fuel Oil mixture
Aq	Aqueous
ARD	Acid Rock Drainage
As	Arsenic
Au	Gold
$Au(CN)_2$	Gold Cyanide
Ba	Barium
BAT	Best Available Techniques
BCUM	University “1 December 1918” Albă Iulia, The Research Centre with Multiple Users, Albă Iulia - archaeological topography, digital mapping and geophysics studies
$Ca (OH)_2$	Calcium Hydroxide
$CaCl_2$	Calcium Chloride
$CaCO_3$	Calcium Carbonate
$CaSO_4$	Calcium Sulphate
Cd	Cadmium
CH_4	Methane
CHMP	Cultural Heritage Management Plan
CIL	Carbon in Leach
CIMEC	The Institute for Cultural Memory, Bucharest – administrator of the database and the digital archive of the programme
CMB	The Museum Complex Bucovina, Suceava (in 2001-2002)
CMC	The Centre for Cultural Management and Education, Bucharest - for ethnographical and ethnological studies
CMP	Cyanide Management Plan
CN	Cyanide
CO	Carbon Monoxide
Co	Cobalt
CO_2	Carbon Dioxide
CPPCN	Design Centre for National Cultural Heritage
Cr	Chromium
CRUTA	The Romanian Centre for the Use of Teledetection in Agriculture, Bucharest - digital mapping
Cu	Copper
$Cu(OH)_2$	Copper Hydroxide
$CuSO_4$	Copper Sulphate
DCS	Distributed Control System

Doré	Bar of semi-purified gold (e.g. bullion). After being mined, the first stage in the purification process of the gold ore produces a cast bar (gold dore) that is approximately 90% gold. The other 10% is mostly metals like silver and copper.
EC – Phare	The Phare programme is one of the three pre-accession instruments financed by the European Union to assist the applicant countries of Central and Eastern Europe in their preparations for joining the European Union
EGO	Emergency Governmental Ordinance
EIA	Environmental Impact Assessment
EPI	Environmental Protection Inspectorate
Equator Principles	the commitments of international finance institutions, with the aim to ensure that projects are developed in a socially responsible manner and reflect sound environmental management practice
ESMS	Environmental and Social Management System
EU	European Union
$Fe(CN)_6$	Iron Cyanide
$Fe(OH)_3$	Ferric Hydroxide
$FeSO_4$	Iron Sulphate
G	Gaseous
g/h	Grammes per hour
g/t	Grammes per Tonne
g/t Ag	Grammes per Tonne Silver
g/t Au	Grammes per Tonne Gold
Gei-PROSECO	Geophysics studies
GeoEcoMar	Geophysics studies
GIS	Geographic Information Systems
Grid Reference Coordinates	Stereo 70 System
H_2O	Water
H_2SO_4	Sulphuric Acid
ha	Hectares
HCl	Hydrochloric Acid
HCN	Hydrocyanic Acid
HCO_3	Carbonic Acid
Hg	Mercury
HgS	Hydrogen Sulphate
Hp	Horse Power
HV	High Voltage
Hz	Hertz
IAB	The “Vasile Parvan” Institute of Archaeology of the Romanian Academy, Bucharest
IAIA	The Institute of Archaeology and Art History of the Romanian Academy, Cluj Napoca
ICNIRP	International Commission on Non-Ionising Radiation Protection
ICOMOS	International Council on Monuments and Sites
IFC	International Finance Corporation
IMC	Independent Mining Consultants, Inc.

INMI	The National Institute for Historical Monuments, Bucharest (former CPPCN)
Intel91	Geophysics studies
IUCN	The World Conservation Union
kg	Kilogrammes
kg/blast	Kilgrammes per blast
kg/h	Kilogrammes per hour
km	Kilometres
kV	Kilovolt
LEPA	Local Environmental Protection Agency
l	Litres
l/day	Litres per day
l/s	Litres per second
l/sec	Litre per second
m	Metres
M oz	Million ounces
m^3	Cubic metres
m^3/hr	Cubic metres per hour
MASL	Metres Above Sea Level
MCC	Ministry of Cultural and Religious Affairs
MEWM	Ministry of Environment and Water Management
MCDR	The Museum of Dacian and Roman Civilization, Deva
MCE	Maximum Credible Earthquake
MDE	Maximum Design Earthquake
MG	Milligauss
mg/m^3	Milligrammes per Metre Cubed
mg/Nm^3	Milligrammes per Normal Metre Cubed
Minvest - C.N.C.A.F.	Minvest S.A. Deva
MJI	The Bacau County Museum, Bacau (in 2001)
mm	Millimetres
Mm^3	Million cubic metre
Mn	Manganese
$Mn(OH)_2$	Manganese Hydroxide
MNIR	National Museum of History of Romania
MNIT	The National History Museum of Transylvania, Cluj Napoca
$MnSO_4$	Manganese Sulphate
MNUAI	Union Museum in Albă Iulia
MoE	Ministry of Environment
MRCP	Mine Reclamation and Closure Plan
Mt	Million Tonnes
MT	Millitelsa
Mt/a	Million Tonnes per Annum
MW	Megawatt
MWH	Montgomery Watson Harza Romania and USA
MW-hr	Megawatt hour
$Na_2S_2O_5$	Sodium Metabisulphite

NaCl	Sodium Chloride
NAMR	National Agency for Mineral Resources
NaOH	Sodium Hydroxide
NGO	Non-Governmental Organization
NH_4	Ammonium
Ni	Nickel
$Ni(OH)_2$	Nickel Hydroxide
$NiSO_4$	Nickel Sulphate
Nm^3/h	Normal cubic metres per hour
Nonel	Non Electric
NO_x, N_2O	Nitrogen Oxides
O.D.	Operational Directive, World Bank Group
O.P.	Operational Policy, World Bank Group
O_2	Oxygen
O_3	Ozone
OBE	Operating Basis Earthquake
OCN	Cyanate
OH	Hydroxide
OPUS	Atelier de Arhitectura, Bucharest - for the architectural evaluation, record cards for the historical buildings, for project restoration of the roman precinct and other historical buildings
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PCDP	Public Consultation and Information Disclosure Plan
pH	Measure of acidity or alkalinity
PLC	Programmable Logic Controller
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
POP	Persistent Organic Pollutants
PUG	General Urbanism Plans
PUZ	Zoning Urbanism Plan
QA/QC	Quality Assurance/Quality Control
RMGC - S.C.	Roşia Montană Gold Corporation S.A..
ROM	Run Of Mill
RRAP	Resettlement & Relocation Action Plan
S	Sulphur
SAG	Semi-Autonomous Grinding
SAPARD	Special Accession Programme for Agriculture and Rural Development
Sb	Antimony
SCS	Secondary Containment System
Se	Selenium
Sn	Tin
SO_2	Sulphur Dioxide
SOP	Standard Operating Procedures
t	Tonne
t/h	Tonnes per Hour
TBD	To Be Determined

TMF	Tailings Management Facility
Troy ounce of gold	A unit of mass used to measure precious metals and defined so that there are 12 troy ounces in a troy pound. One troy ounce is equal to 31.103 g.
TSP	Total Suspended Particles
UB-FIB	University of Bucharest, the Faculty of History
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientifice and Cultural Organisation
USD	United States Dollars
UTAH	The University “Le Mirail,” Toulouse, France
UV	Ultra Violet
V	Vanadium
V/m	Volts per Metre
Video	Video Publishing House, Bucharest
VOC	Volatile Organic Compounds
WAD	Weak Acid Dissociable
WBG	World Bank Group
Zn	Zinc
$Zn(CN)_4$	Zinc Cyanide
$Zn(OH)_2$	Zinc Hydroxide
$ZnSO_4$	Zinc Sulphate
Zr	Zirconium

1 GENERAL DATA

1.1 PROJECT REFERENCE DATA

Project Name: Roşia Montană Project

Location: Roşia Montană and Abrud, Albă County

License Title Holder: S.C. Roşia Montană Gold Corporation S.A.

Title Holder Address: 321, Strada Piata
517615 Roşia Montană
Albă County, Romania

Project Design: General Designer and Feasibility Study – IPROMIN S.A., Romania

Environmental Assessment – Agraro s.r.l., Romania

Basic Engineering- SNC Lavalin Engineers & Constructors, Canada

Tailings Dam and Infrastructure Engineering- Montgomery Watson Harza (MWH), Romania and USA

Process Engineering- Ausenco Limited, Australia

Planning and Urbanism Permitting – Proiect Albă, Romania

Socio Economic Analysis, Biodiversity and Landscape – ESG International Inc. (now a unit of Stantec Consulting Ltd.), Canada

Activity Profile: Extraction and processing gold and silver ore

Value of Works: Total Investment: ....605 million USD

Investment during construction: ....437 million USD

Investment during operations: ....123 million USD

Operating costs: ....1.4 billion USD

Total Project Revenue...3.2 billion USD

Total costs...2.1 billion USD

Cash flow before taxes..1.1 billion USD

Income tax ....206 million USD

Cash flow after tax deduction..915 million USD

Taxes on dividends .... 46 million USD

Cash profit ....869 million USD

Initial capital costs are summarised in *Table 1.1* and capital costs for operations activities, including final closure, are presented in *Table 1.2.* Details concerning the direct and indirect benefits for Romania are presented in *Section 2*, *Table 2.1.*

Expenditure to date: Investment to June 30 2004, since inception of project development in 1997, has totalled 102 million USD. Exploration and geological investigation was conducted through to 2000, resulting in the generation of a sufficient resource to commence a definitive feasibility study, followed by a basic engineering study which was completed in 2003. During 2004 work has continued on components of detailed engineering. Since 2002, RMGC has been undertaking the process of acquisition of properties within the project footprint.

Table 1.1 Summary of Initial Capital Cost (000 USD)

Description	Category	Total Cost
Mining Activity	Preparatory Work	19,003
Mining Equipment		73,178
Process Plant	Site, Road and Services	24,846
	Crushing and Grinding	86,864
	Gold Extraction	32,137
	Ancillary Facilities	10,731
	Offices, Shops and Warehouses	19,432
	Subtotal Process Plant	**174,010**
Tailings Facility	Main Dam	79,494
Environmental Facilities	Water Management Dams	14,475
	Storm Water Ponds	1,190
	Sewage Treatment	456
	Wastewater Treatment	3,710
	Cyanide Detoxification	3,976
	Subtotal Environmental	**23,807**
Cultural Heritage		4,072
Community Development		61,615
Social Development Programmes		2,251
	Subtotal Community Development	**63,866**
TOTAL INITIAL CAPITAL		**437,430**

Note: All costs shown are fully burdened with Indirect and Owner’s Cost.

Table 1.2 Summary of Operational Capital Cost (000 USD)

Description	Category	Total Cost
Operational Capital	Mine	50,250
	Plant and Infrastructure	1,144
	Tailings Management Facility	46,407
	Environment	8,180
	Final Closure	33,000
TOTAL OPERATIONAL CAPITAL		**138,981**

Profit Sharing:	80.00% Gabriel Resources	695 million USD
	19.31% Minvest	167 million USD
	0.69% 3 other shareholders	7 million USD

Environmental Protection:

	Portion of Investment for Environmental Protection:	32 million USD
	Tailings Management Facility:	126 million USD

Project Completion Schedule:

Based upon the current identified reserve base, the proposed execution of the period for the project is indicated on the project schedule presented as *Exhibit 1.4 Project Completion Schedule.* The duration of the principal phases of the development, operations and closure is summarised as:

- Construction: 2-3 years
- Operations: 17 years
- Mine Closure: 2 years

1.2 SUBMISSION OF THE PROJECT PRESENTATION REPORT

This Project Presentation Report is submitted by S.C. Roşia Montană Gold Corporation S.A. (RMGC) as a component of its application for the Environmental Agreement for development of the Roşia Montană Gold and Silver Mining Project (the Project) in Albă County, Romania. This document has been prepared to conform to the Project Presentation Report required under Article 12 (2.a) of Ministerial Order 860/2002 of the Ministry of Waters and Environmental Protection.

This submission relates to and accompanies Urbanism Certificate reference issued by Albă County Council (No. 68/20.08.2004). The Urbanism Certificate defines the extent of the Roşia Montană Industrial Zone for development of the Project, the subject of the present application for an Environmental Agreement.

The Project comprises the development, operation, closure and post-closure activities for mining and processing of gold and silver ore. The relevant Mining Development License is for the Roşia Montană Mineral Concession, originally issued as No. 47/1998 to C.N.C.A.F. "Minvest" S.A. Deva (Minvest), subsequently transferred to RMGC as Title Holder by means of Additional Deed No. 3 and the NAMR Order No. 310/09.10.2000; the applicable licence perimeter for this project has been defined in Additional Deed No.6, dated 21/06/2004.

The broad outline of land use required for project development was submitted to Albă County Council in Memoranda for General Urbanism Plans (PUG) for the Roşia Montană and Oras Abrud administrative districts in 2000; amended applications were submitted in April 2002 and the PUG for Abrud and the PUG for Roşia Montană were both approved on 19/07/2002.

The Roşia Montană PUG identified areas adjacent to the Industrial Zone, which have been designated for project-related development as integral parts of the overall project. These areas include:

- The area in the *comuna* of Roşia Montană which is the site for the construction of a new residential area for resettlement of persons, businesses and communal facilities displaced by the project; and,
- A Protected Zone, designated for protection of cultural heritage, comprising the area of Roşia Piata, the eastern part of the Roşia Montană locality, including the main town square and a concentration of buildings declared as having architectural value in addition to churches and access to ancient and more recent mine workings.

A separate Zoning Urbanism Plan (PUZ) has been prepared for the area within the Roşia Montană *comuna* proposed for resettlement of persons and activities displaced from the Roşia Montană area, designated the New Roşia Montană development area; the PUZ was endorsed by Albă County Council with Sole Agreement No.13 of 22 April 2003. The Environmental Permit for the PUZ for the New Roşia Montană development area was issued by the EPI (Albă Iulia), as No.32 of 30 June 2003. The PUZ was supported by the endorsements of all statutory authorities required under the legislation. This area lies outside the scope of this document and the subsequent Environmental Impact Assessment (EIA), which will be submitted for the Roşia Montană Industrial Development Zone.

The National Commission of Historic Monuments, through its authorisations No.61 of February 2002 and No.178 of June 2002, has approved the establishment of the Protected Zone. A separate application for a PUZ for the Protected Zone will be submitted to Albă County Council.

This Project Presentation Report has been prepared to provide information required for the LEPA and the Ministry of Environment and Water Management (MEWM) to undertake the Screening and Scoping stages of the licensing procedure, upon which the basis for the (EIA) will be defined.

RMGC has committed publicly, to project stakeholders, representatives of regulatory bodies and to its financial partners that the EIA will be performed to the applicable components of the following:

- Romanian Laws and Regulations;
- EU Directives; and,
- Equator Principles – the commitments of international finance institutions, with the aim to ensure that projects are developed in a socially responsible manner and reflect sound environmental management practise.

1.3 BACKGROUND

The Project is situated near the village of Roşia Montană in Albă County, approximately 80 km northwest of the regional capital of Albă Iulia, and 85 km north-northeast of the city of Deva in west-central Romania (*Exhibit 1.1 Project Location in Romania*). This location is within the existing Roşia Montană mining district located immediately northeast of the town of Abrud. The project is located in a region known as the Golden Quadrilateral in the Metaliferi Mountains, which belongs to a larger, regional mountain unit, called the Apuseni Mountains of Transylvania *(Exhibit 1.2 Project Regional Setting).* The Golden Quadrilateral has been an important gold producing region in Europe for over 2,000 years.

The site lies within the 2,388 ha Roşia Montană mining exploitation concession licensed to RMGC, one of two mineral concessions maintained by the company in the region *(Exhibit 1.3 RMGC Mining Concession).* The Roşia Montană mining license gives the right to develop and mine the gold-silver and polymetallic resources and reserves based on the mining parameters specified in this document.

The existing mine, the Roşia min operation, is a small-scale and degraded open pit mine owned and operated by the state-owned company Minvest; the Roşia min mineral processing plant and associated facilities fall outside the Roşia Montană mining license. The proposed project will be developed to replace the existing mine and will be a large scale modern mine and advanced gold recovery plant that will establish a new standard for the Romanian mining industry.

The development work undertaken to prepare for the Project began in 1997 with planning and exploration activities. Development will continue through permitting and approval activities, followed by construction and commissioning activities culminating in operation. A timetable for the development of the project is provided in *Exhibit 1.4.* Operations will be continuous over 17 years based on the ore reserves upon which this development proposal is based. The operational period may extend as a result of further exploration. The Project will comprise at least 25 years of activity, to be followed by a mine closure phase of at least a year with subsequent monitoring and follow-up work.

The proposed development comprises activities beyond the mine and gold recovery plant as it also includes the following:

- Mitigation of environmental impacts related to centuries of ancient and more recent mining;
- Cultural heritage activities (archaeological surveys, assessments, rescue archaeological excavation, cataloguing and preservation of artefacts, in situ conservation of the most important and representative archaeological structures);
- Assistance for the closing of the current government subsidized mining operation (Roşia min); and,
- Resettlement of persons and facilities in impacted areas and the social support activities related to these activities.

These components are reported together within this Project Presentation Report.

The legacy of centuries of underground mine development, the first of which pre-date the Roman period, combined with the more recent surface mining, has resulted in an area of haphazard and uncontrolled waste rock disposal, open underground mine workings, active and abandoned tailings disposal sites and the accumulation of extensive acid rock drainage (ARD). Contaminated streams and land close to existing settlements characterize the site area. Heavy metal contaminants and acidic waters are currently at levels that greatly exceed Romanian and international norms and the existing toxic conditions have led to extensive contamination of the local rivers and watercourses. These watercourses comprise a portion of the Aries watershed, occupying the upper waters of the Danube Basin.

The existing contamination will remain untreated without the development of the Roşia Montană project, unless an alternative plan is developed in the future. The Project includes in its scope the facilities required to mitigate these impacts through the systematic interception and containment of contaminated watercourses, treatment of the contaminated waters and the isolation and later recovery of many of the waste rock piles within the project boundary. The project has been planned and is being designed to international standards and will employ Best Available Techniques (BAT) and internationally proven management practices throughout for safe operation and environmental protection and as direct mitigation of the existing conditions.

Romania's mining industry has been in serious decline in recent years and is still undergoing a significant downsizing and restructuring process. In 1977, there were over 175,000 mining employees in the country and today there are less than 65,000. Most mines are not profitable and further restructuring is anticipated.

The existing Roşiamin mine is subsidized by the central government. The progressive closure of this operation has already resulted in the loss of more than 800 jobs; the additional loss of 500 more jobs will have a significant social, environmental and economic impact on Roşia Montană and Abrud. Another local mining operation, the Rosia Poieni copper mine operated by "Cupromin", located in a nearby valley, is also reported as being slated for closure in the near future. The closure of the two mines will have a serious negative impact on the economic vitality of the entire region.

The Project proposed by RMGC, when undertaken in co-operation with Minvest, the Government of Romania, and local communities, will have the effect of addressing and partially mitigating some of these impacts. The Project is a large investment in Romania and its successful implementation is expected to encourage other foreign investments in natural resource projects in the region.

It should be recognised that, unlike many other industrial facilities whose designs remain fixed, mining projects by their nature are dynamic and will continue to evolve in order to react appropriately to environmental circumstances. RMGC will therefore institutionalize a process of continual improvement, the Environmental and Social Management System (ESMS), to ensure that the project design and operations, and supporting management plans and procedures, are also dynamic and adaptable toward improved compliance through the life of the project.

Exhibit 1.1 Project Location in Romania

Exhibit 1.2 Project Regional Setting

Exhibit 1.3 RMGC Mining Concession

Exhibit 1.4 Summary of Project Completion Schedule

2 SPECIFIC PROJECT DATA

2.1 PROJECT OWNERSHIP, PURPOSE, AND BENEFITS

2.1.1 Project Ownership

The Roşia Montană Project is owned and managed by RMGC. Gabriel Resources (the principal shareholder in RMGC) started exploration work in May 1995 with a drilling programme on the non-active Roşia min tailings dam in Gura Rosiei (Grid Reference 350278E 535114N) located to the south of the current ore preparation plant at Gura Rosiei, along the Abrud Valley and parallel with the Abrud-Campeni Road. At that time, an agreement was made between Gabriel Resources and Regia Autonoma a Cuprului Deva (now Minvest) to allow drilling activities on tailings.

In 1997, a joint venture comprising Regia Autonoma a Cuprului Deva, (later Minvest) (19.31%), Gabriel Resources Limited (Canada) (80%), and three minority shareholders (Cartel Bau, Foricon S.A. and Comat S.A., each with 0.23%) formed a new company, named S.C. Eurogold Resources S.A. S.C. Eurogold Resources S.A. was registered in August 1997 for the purpose of performing all types of exploration activities within the Roşia Montană perimeter.

In 1999, S.C. Eurogold Resources S.A. changed its name to S.C. Roşia Montană Gold Corporation S.A. (RMGC). An Exploitation Concession License was granted, in accordance with the *Mining Law No. 61/1998*, by the National Agency for Mineral Resources (NAMR) to Minvest (the titleholder) and RMGC (as an affiliated company) in December 1998 and the license came into force in June 1999. In October 2000, the license was transferred from Minvest to RMGC, with Minvest as an affiliated titleholder. As such, Minvest is entitled to continue its current small-scale Roşia min mining operations at Roşia Montană, while RMGC conducts exploration and early project development activities. Until such time as RMGC makes a production decision in relation to the Roşia Montană Project, Minvest remains responsible for all current mining operations at Roşia min, unless a decision is made to cease operations before that time. All environmental liabilities related to the previous mining and processing activities, including the upcoming closure of the Roşia min operations, remain the responsibility of Minvest and survive any change in the operational status.

RMGC is responsible for carrying out and funding all exploration and development activities associated with the new Project. To operate the new facility under the license, an amendment to the exploitation license is necessary. The license will be issued by NAMR, and RMGC aims to finalize the amendment application once the EIA is approved. The license has an initial term of 20 years and is renewable for successive 5-year periods.

2.1.2 Project Purpose

The objective of the Roşia Montană Project is to use Best Available Techniques (BAT) and modern, proven technology to operate a gold and silver mine, process plant and supporting infrastructure consistent with the social, economic and environmental requirements of the host communities, the local government, the Government of Romania, European Union (EU) Directives and, where they represent recognised international practice, also World Bank Group policies. The Project is expected to help restore economic vitality to the Region by providing economic development at the local, regional and national levels through the creation of jobs and revenues flowing to the private sector and the Government. The Project will establish the practice of modern mining, ore processing and related support activities in the region. In addition to local, regional and national benefits, the Project will provide investors with a reasonable rate of return on investment.

The project includes the pre-construction, exploration and planning work that started in 1997, and that will continue through construction and into operation. The mining and processing of gold-silver ore will occur at the nominal production rate of 13 million tonnes per annum (Mt/a). The ore is found in four main deposits known as Cetate, Cîrnic, Orlea and Jig/Igre (*Exhibit 2.1 Surface Geology in Roşia Montană*).

Based on current estimates and valuation, the operations phase will last approximately 17 years, with active mining of the pits through Year 14 and mineral processing continuing through Year 17. In addition, there is significant potential to extend the mine life, should additional resources become proven. Therefore, the entire project life, including the exploration and pre-development phase that started in 1997 is at least 25 years in duration with additional, though reduced, economic activity during the mine closure phase.

The proposed Roşia Montană Project includes the following principal elements:

- Rescue archaeological excavation, protection, preservation and public presentation of the most important cultural heritage items, including both movable and immovable items, archaeological supervision and monitoring;
- Resettlement programme;
- Local economic and social development support for persons disturbed by the new operations;
- Support for regional development aimed at the promotion of sustainable development activities;
- Conventional open pit mine;
- Removal and stockpiling of overburden, soil and waste rock (rock which does not contain economic levels of gold or silver);
- Processing of gold-silver ore using conventional gold recovery techniques;
- Recovery of gold and silver metal;
- Management of site water including the capture and recycling of historically contaminated runoff and seepage in Roşia Montană Valley and Corna Valley (clean water diversion will be used to minimise future contamination; contaminated water will be captured and directed to a newly constructed water treatment plant where it will be treated for reuse; a limited discharge from the water treatment plant or from the freshwater supply system will provide the necessary maintenance of base flows in the Roşia and Corna streams);
- Deposition of process tailings in a tailings management facility (TMF) designed to recover water and store ~224 Mt of tailings (fine waste rock);
- Operation of associated infrastructure including: freshwater supply pipeline, tailings delivery and reclaim water pipelines, power line, local and wide area electronic communication networks, electrical substation, mine roads, offices, workshop, warehouse, laboratory, wastewater treatment plant; and,
- Closure planning and final rehabilitation and closure.

2.1.3 Summary of Project Public Benefits

The Roşia Montană Project is located in an area of Romania that has seen extensive mining activities over some 2000 years, but which is now in a state of advanced decline. The development of a new mine at Roşia Montană will provide significant benefits to Romania, its economy and its citizens, including:

- **Clean-Up of Historical Environmental Damage:** The project will have the direct benefit of improving and mitigating much of the significant amount of environmental damage that has been caused in the project area by previous mining techniques. Without such remediation, these areas of the environment would continue to sustain unattended damage;
- **Introduction of Best Available Techniques:** The Project will introduce to Romania the Best Available Techniques currently employed by the international mining industry. The introduction of these technologies is expected to support the creation of a new foundation for the revitalization of the Romanian mining industry;

- **Compliance with Internationally Recognised Standards:** The new mine, process plant and tailings storage facility will be developed in accordance with all relevant Romanian laws and regulations and EU Directives. The development of the new enterprise will demonstrate to the EU that Romania has both the desire and the capability to support and regulate industrial developments in accordance with all EU requirements;
- **Economic Benefits:** The Project will generate direct and indirect tax revenue, royalties on the mine production, and employment opportunities from both the mine construction and operation and support activities. These benefits will amount to some 1.6 billion USD over the first 17 years of the life of the Project. A detailed breakdown of the funds is given in *Table 2.1;*
- **Skills and Training:** The project will create a significant number of temporary and permanent new jobs that will require extensive training in modern mining and process plant methods, operational, maintenance, and personal safety skills, environmental monitoring and management control, and awareness and the management of product quality. Such skills and their related benefits may be transferred to other areas of industry and the commercial sector. These highly skilled workers and the tenor of a modern and well-managed mining operation in the region will contribute to the foundation of a new Romanian management approach and labour pool with the skills and qualifications to compete internationally;
- **Cultural Heritage:** Discovery investigation, collection, presentation and display of archaeological artefacts and other items of heritage in the framework of an extensive research programme of rescue excavations and preservation of the most important movable and immovable archaeological heritage items and historical buildings; and,
- **Direct Foreign Investment:** The Project will bring substantial direct foreign investment to Romania, through the purchase of goods and services necessary for the development, construction and operation of the new mine. Romania will benefit by being perceived in the international community as open to foreign investment.

The total direct benefits for Romania will therefore amount to 583 million USD that will enter the local and central budgets without direct government investment and without governmental guarantees. This amount represents 52% of the Project gross profit (1.121 billion USD).

Table 2.1 The distribution of funds generated by the Project that will remain in Romania
(Monetary amounts assume a gold price of 350 USD per troy ounce and 17 years of operation)

Category	Amount (millions USD)
Direct benefits	
Taxes on profit	206
Net dividends for Minvest	167
2% royalty	64
Taxes on dividends	46
Central taxes and fees	69
Subtotal	552
Direct benefits for the local community	
Local taxes and fees (including payroll taxes)	19

Other local fees	12
Subtotal	31
Total direct benefits	**583**
Indirect benefits	
Romanian contractors	974
Development of local community	40
Cancellation of existing subsidy (annual)	3
Archaeological research and preservation	7
Total indirect benefits	**1.024**
TOTAL	**1.607**

The benefits experienced during the pre-construction period (1997 to 2003) include:

- Employment creation: ranging from ~200 to ~500 jobs (some work is seasonal);
- Spending of over 102 million USD on exploration, permitting, feasibility studies, and basic and detailed engineering services;
- Employment created indirectly (it is estimated that approximately two to three jobs are created for every one direct pre-construction job);
- Training programmes for local population;
- Exploration activities designed to quantify and increase the understanding of geological resources of the region;
- Archaeological and cultural heritage investigation, recovery, reporting and presentation of artefacts and publication of results to date;
- Support for the creation of a protected zone encompassing core cultural heritage assets; and,
- Support for the development of the local communities.

Anticipated benefits during the 24 to 36 month construction phase are projected to include:

- Direct employment with approximately 1,200 jobs during construction;
- Additional employment of local workers (as many workers will assist in the closure of the old operations and prepare the area for the new operation);
- Indirect employment, with approximately three jobs created for every one direct construction job. This would include mine construction support, hotels, restaurants, construction material suppliers, financial services, fuel supply, and many other types of service and supply;
- Maintaining and conserving the Protected Zone, comprising the most important elements of cultural heritage; preservation of the historical buildings situated in the "Roşia Montană Historic Centre";
- Research programmes for archaeology and historical heritage; publication of results, recovery and display of artefacts and other cultural property revealed during the development and operation of the project in a purpose-built museum and in situ preservation of the most important archaeological structures; and
- Capital expenditures of approximately 437 million USD.

Benefits during the 17-year mining and mineral processing operational phase are expected to include:

- Improvements in local environmental conditions through mitigation measures addressing existing historical environmental impacts on water quality and historic tailings from past operations;
- Reduction in contaminant loading into the Aries watershed and downstream water courses, including the Danube River Basin;
- Direct employment of workers to fill approximately 560 jobs for the operation of the modern mine and plant;
- Creation of additional local indirect jobs (estimated at approximately three to five jobs for every job created at the mine) in areas such as hotels, restaurants, fuel stations, retail shops, maintenance, banking, and other types of service and supply;
- Ongoing capital expenditures of approximately 123 million USD;
- Operating costs expected to be about 150 USD per troy ounce of gold (~5 USD per gram) over the life of the mine;
- Education and training in modern mining practises and associated activities (e.g., mine training programmes, mobile equipment operations, machine operations and maintenance, information technologies, instrumentation and automation systems);
- Award of contracts to local businesses, for activities such as vehicle repairs, tire maintenance, building maintenance, fuel/oil supply, limestone and reagents supply, replacement parts supply, equipment and rebuild services, office support services, waste management (recycling and re-use), catering, and many other types of service and supply;
- Increase in the local tax base and revenue resulting in the potential for improvement to general social conditions;
- Increases in real property values;
- Improved communications systems in the local communities and region; and,
- Upgraded infrastructure (roads, housing, etc).

2.1.4 Regional Planning and Land Use

The general concept for project development was presented in applications for General Urbanism Plans (PUGs) submitted to the administrative districts of Oras Abrud and Roşia Montană. The PUGs indicated the proposed location of project activities with particular reference to:

- The Roşia Montană Industrial Zone, comprising the project activities of mining, emplacement of waste rock, milling and processing of ore and gold extraction in a process plant, disposal of tailings in a TMF with corresponding tailings dam and secondary containment dam, and water management and treatment of historic and project-related mining impacted waters, using water containment dams, pipelines, conduits and a wastewater treatment plant;
- An area for the construction of a new residential area in the area of the Roşia Montană *comuna* for resettlement of persons, businesses and communal facilities displaced by the project; and,
- A zone of cultural heritage asset value, to be designated for protection of cultural patrimony, comprising the area of Roşia Piata, the eastern part of the Roşia Montană settlement, including the main town square and a concentration of buildings declared as having architectural merit in addition to churches and access to ancient and more recent mine workings.

The Zoning Urbanism Plan (PUZ) for the Roşia Montană Industrial Development Zone was documented and submitted to Alba County Council (Technical County Commission of Territorial Planning, Urbanism and Public Works), which issued the Sole Agreement No. 7 of 1 July 2002, subject to environmental endorsement, after amendment of the PUGs to correspond to the PUZ. Continuing project development has required amendment to the PUZ, and a new application will be submitted after approval of the Urbanism Certificate, which was prepared in agreement with the current project proposals.

The Urbanism Certificate (No. 68/20.08.2004) presents the perimeter of the Roşia Montană Industrial Zone, which comprises a total area of 1,346.17 ha. This area includes the estimated area for both of two alternatives for a by-pass road to provide access from Abrud to Roşia Poieni, a northern route via the lower Roşia Valley and passing north of the operations area, representing 51.8 ha, and a southern route from near Bucium Sat and following the watershed south of the operations area, representing 44.9 ha. Only one of these alternatives will be used based on selection during the EIA process and subject to agreement with affected parties and the regional authorities. Based on the preferred northern diversion alone, the affected area will be 1,233 ha.

The total area includes small parcels of land which will not be directly impacted by project operations but which remain isolated between project activities; these total 68.3 ha. The Industrial Zone excludes the Protected Zone for cultural patrimony.

The area for the proposed industrial facilities is comprised of the following components:

Description	**Sub-area (ha)**	**Total area (ha)**
Mine pits:		202.3
- Cîrnic	71.7	
- Cetate	68.5	
- Orlea	37.5	
- Jig	24.6	
Waste dumps & stockpiles		214.1
- Cîrnic waste dump	149.8	
- Cetate waste dump & low grade stockpile	64.3	
Dams		72.4
- Tailings Management Facility Dam	67.9	
- Cetate Waste & Mine Drainage Pond Dam	4.5	
Impoundments		305.3
- Tailings Management Facility	299.8	
- Cetate Waste & Mine Drainage Pond	5.5	
Quarries		26.8
- La Piriul Porcului Sandstone	8.7	
- Sulei Andesite	18.1	
Roads		295.7
- Unsurfaced roads	163.4	
- Plant Access Road	35.1	
- By-pass alternatives (northern and southern)	96.7	
- Closure of public road DJ 742	0.5	
Plant site		51.4
Construction camp		5.5
Explosives storage		1.1
Topsoil piles		42.6
Diversion ditches		31.4
Main power lines (110 kV)		29.2
TOTAL OCCUPIED AREA		**1277.8**

The area of Roşia Montană Industrial Zone falls within three territorial administrations: Roşia Montană, Abrud and Bucium. Current land use within the area of the Industrial Zone is as follows:

Land Use Category	Surface Area (ha)
Pasture	733.4
Forest	345.9
Constructions	141.2
Agriculture	12.1
Orchards	1.2
Forested pasture	12.8
Brush (forest cover <3 m high)	17.3
Roads	52.6
Non-productive land	15.9
Water (streams and lakes)	11.6
Rail track (Rosiamin ore train route)	2.3
TOTAL INDUSTRIAL ZONE	**1,346.2**

The establishment of the Protected Zone has been approved by the National Commission of Historic Monuments of the Ministry of Culture and Religious Affairs (MCC), Bucharest, through its authorisations No.61 of February 2002 and No.178 of June 2002. The latter required that, at a later design phase, there will be submission of a PUZ for the Protected Zone and a *Management and Rehabilitation Plan* for the Protected Zone, to be developed in conjunction with the progressive designation of valuable constructions and the legal status of buildings. The Protected Zone includes thirty-three historic monuments, including three churches, the entrance to the Catalina-Monulesti mine gallery and the proposed location for a future museum. The PUZ for the Protected Zone will constitute a separate submission to Alba County Council.

2.2 PROJECT DESCRIPTION

A summary of the principal features of the Project is presented in *Table 2.2 Key Project Data.*

Table 2.2 Key Project Data

Item	Description
Project Setting	• Located in Roşia Montană, Albă County, central west Romania; 80 km from Albă Iulia • An old mining district contained within a small-scale subsistence farming community • Mountainous terrain and narrow valleys • Continental temperate climate; temperatures from –22.5°C (Dec-Feb) to 28.7°C (Aug) • Cold winters, significant snowfall for 4 – 6 months • Annual precipitation: 600 mm to 883 mm
Existing Infrastructure	• National highways (sealed roads) to nearby major commercial and residential areas; within 2-3 hours of airports with international service • Power: available from national grid • Water: available from Aries River, some 10 km north of Roşia Montană
Mine Operations	• Four open-pits: Cetate, Cîrnic, Orlea and Jig • Mineable reserves 218 Mt ore, 1.52 g/t Au and 7.47 g/t Ag Recovered metal production: 272.7t (8.8 M oz) Au and 945.5t (30.4 M oz) Ag • Annual ore production: between 12.5 and 20.4 Mt • Life of mine strip ratio: 1.2:1 • Conventional drill and blast – load and haul operation • 19.5 m^3 hydraulic shovels and 150 t haul trucks

Table 2.2 Key Project Data

Item	Description
Ore Processing	• Duration of ore processing activity: approximately 17 years • Single stage crushing of run-of-mine ore using a gyratory crusher • Wet grinding in one SAG mill and two ball mills • Cyanide leaching of ground ore using conventional Carbon-in-leach (CIL) process • Elution process to transfer precious metals into a pregnant solution while collecting carbon for reactivation • Electro-winning of precious metals from solution and smelting to produce doré bullion • Thickening of tailings and recycle of the majority of process water • Detoxification of the cyanide in the tailings and disposal of tailings to the Tailings Management Facility
Process Infrastructure	• TMF with downstream secondary containment dam • Reclaim system to pump decant water on the TMF back to the process plant • Water management dams to collect acid rock drainage from ancient mining and from project-related activity • Wastewater treatment plant for amelioration of ARD to meet discharge standards and permit use in process plant • Metallurgical laboratory • Warehouse and storage facilities • Maintenance and administrative buildings

2.2.1 Project Description for Pre-Construction Period

The ongoing pre-construction period includes the following:

- Continuous exploration activities throughout the local and regional area;
- Liaison with and support for Minvest in their planning for the closure of the current government subsidized mining operation;
- Identification and planning for the mitigation of the negative environmental impacts resulting from old mining and associated activities;
- Financing activities;
- Property acquisition and concession agreements for land required by the project;
- Cultural heritage and cultural property related activities;
- Community relocation and resettlement activities (including construction of housing, commercial, municipal, and county infrastructure);
- Support for regional and local development planning; and,
- Co-ordination with relevant stakeholders.

2.2.1.1 Exploration

The pre-construction period of the Project commenced in June 1997 with exploration activities. This programme included:

- Geological mapping including mineralogical and petrographic studies and alteration and structural mapping;
- Surface and underground diamond and reverse circulation drilling;

- Underground and surface channel sampling and mapping;
- Geophysical surveys, including bulk density measurements;
- Metallurgical test work;
- Down-hole, underground and surface surveying;
- Assaying and geochemical analysis (Analabs, Bondar-Clegg, ALS-Chemex and SGS);
- Quality control and quality assurance procedure development and implementation; and,
- Database and geological and resource model development.

To date, a total of 151,943 samples have been collected, which make up the base for the resource model and include 92,359 m of drilling made up of 28,439 m of diamond core drilling and 63,920 m of reverse circulation drilling as well as 59,584 m of channel sampling. In addition, a total of 5,173 bulk density samples has been selected and measured for the determination of the bulk density. The exploration database has been used as the base for all resource and reserve modelling work. Progressive development of the project has included the following studies:

- Resource Estimation and Scoping Study, Resource Service Group, August 1998;
- Pre-Feasibility Study, Pincock Allen & Holt, December 1999;
- Updated Resource Estimation, Resource Service Group, September 2000;
- Feasibility Study, GRD-Minproc, August 2001;
- Optimisation Study, SNC-Lavalin, March 2002;
- Resource and Reserve Audit, Independent Mining Consultants, February 2003;
- Basic Engineering Study, SNC-Lavalin, March 2003; and,
- Resource and Reserve Report, Ipromin, March 2003.

All data collected and used for the studies has been collected subject to best industry practice and best available technology has been used in the case of all programs and studies. The reporting has been done to conform to all International and Romanian codes, laws and applicable regulations including the JORC code, Canadian law NI43-101 and Romanian Law 61/1998 and Law 83/2003.

In addition to purely exploration activities, other programmes and activities have included the following over the pre-construction period:

- Geotechnical investigations, including drilling, geophysical surveys, tests and pitting;
- Condemnation drilling and sampling activities;
- Generation of topography maps, air photos and satellite imagery;
- Setting up of a full assay and geochemical analytical assay laboratory, managed by SGS;
- Environmental rehabilitation, re-vegetation, impact studies and monitoring activities; and,
- Environmental, social and climatic base-line studies.

A number of different sampling methods have been used, including surface channel and selective grab sampling, underground channel sampling, and diamond and reverse circulation drilling to determine the gold and silver grades of the various deposits. Detailed geological mapping, petrological studies and geophysical studies have also been undertaken on the deposits. Most of the work to date has focused on the Cetate and Cîrnic deposits, which are seen as the primary mining areas for the first seven years of the operation. In addition, deposits have been defined in the Orlea, Carnicel Jig, Carpeni and Igre areas. At times, up to 12 drill rigs have been operating to support exploration and other activities. Additional resource potential has been identified in the area, which has to date not been drill defined.

For the exploration work, geological, geophysical, and geotechnical data were digitally logged in the field and then downloaded into databases and processed by the latest internationally recognised exploration and mining software. Geochemical data, once analysed, was merged with the data sets and processed to produce detailed three-dimensional models of the deposits, which have been used in the ongoing interpretation, evaluation and exploration and development work.

A sophisticated block model was developed as part of the initial drill definition and has been further developed for resource and reserve definition using ordinary kriging with a block size of 20 m by 20 m on plan with a 10 m bench height. The block model incorporates, in addition to gold and silver data, extensive details on geological characteristics, sulphur content, including sulphide and sulphate information, metallurgical properties, hardness, geotechnical information, ARD characteristics and detailed geochemical data (up to 52 elements).

The model was assembled in the Stereo 70 grid system and the bench toe elevations correspond to even 10 m elevations. The block model grades were estimated by linear kriging, with reasonable estimation and composite count parameters. Independent Mining Consultants, Inc. (IMC) reviewed and verified the model and, based upon this evaluation, developed the current mine plan (IMC, 2003).

In addition, extensive geotechnical work, including drilling, test pit excavation, rock and soil sampling have been undertaken in support of the development of the mine. Also, condemnation drilling of areas planned for infrastructure has been undertaken to ensure construction is not undertaken over areas of economic ore.

To ensure best Romanian and international practices were met, an extensive system of check samples, duplicate samples, standards and blanks, and repeat analyses of samples at independent laboratories were conducted to verify the integrity of assay results. Registered mine surveyors were used to locate and survey samples and ensure accuracy of the block model. Down-hole survey cameras were used to ensure accurate control of down-hole drill data.

Exploration work has shown good potential to add to the resources identified at Roşia Montană, and it is considered likely that additional resources will be added, which will extend the scope and life of development in the area. Exploration work is ongoing within all license areas, and licenses for additional ground adjacent to Roşia Montană will be applied for where potential is seen to exist. Development of any new areas would be subject to additional permitting and approvals, as appropriate.

At peak periods, up to 350 people have been employed for exploration activities, with an ongoing workforce of about 245 people, during the last two years. The majority of those employed are local residents. As part of the exploration programme, RMGC built, equipped, and has operated a modern analytical laboratory at Roşia Montană to analyse and assay samples collected from the exploration programme. The chemists and staff have all been locally hired. To date, over 23 million USD have been spent on exploration activities alone. A lower level of exploration activities will continue throughout the life of the Project to define the limits of the ore bodies at Roşia Montană.

2.2.1.2 Redevelopment of Existing Mine

Minvest is responsible for the temporary shutdown of the current mining and processing operation and for the management of social, physical, environmental and other consequences resulting from these operations. RMGC is liaising with Minvest on the development of a programme that will allow the current operations to cease in a way that is compatible with the plans being developed by RMGC for the proposed new facilities to be established and operated. In many cases it will be necessary to remove the Minvest facilities in order to allow for the new RMGC operations.

Currently, a technical evaluation of the implications, which might result from ceasing the existing Minvest operations, is underway. Part of this technical evaluation comprises environmental balance (or audit) studies being completed in accordance with Romanian regulatory requirements. The balance studies will identify the environmental and other implications resulting from or associated with the cessation of Minvest's operations or past mining operations within the RMGC mining license area (s defined in June 2004). Once this is completed, the actions needed to secure the requisite approvals to cease operating the Minvest operations in the area will be identified, and it will then be necessary for Minvest to implement these requirements.

Once the technical evaluation is complete, RMGC will continue to liaise with Minvest as they develop and implement the programme for the clean-up and closure of the current mining, processing and other operations. While Minvest retains full legal responsibility for all liabilities resulting from Minvest's activities in the area, RMGC has committed to support Minvest with technical support, consulting assistance, and possible financing for some of these activities in the form of a loan.

Minvest is understood to be developing a plan to address the social impacts, particularly on its workforce. While it is anticipated that some of its current employees will retire and that others will be retrenched, it is expected that others will find work on the rehabilitation programme, construction of the new mine, or (later) in the new operations. RMGC will work with Minvest and others to identify personnel with the potential for future employment for future RMGC operations. At an appropriate time, training programmes will be designed and implemented to retrain workers for the new operation.

It is also expected that some others will find employment in time within a rejuvenated regional economy with local businesses that will provide goods and services to the new operation and its workforce.

2.2.1.3 Cultural Heritage & Cultural Property

2.2.1.3.1 Identification of Cultural Heritage Assets

Roşia Montană has experienced mining activities for more than 2,000 years, with a corresponding long history of human habitation and industry and is a location recognised for its cultural heritage. The study and evaluation of cultural heritage invariably begins with a background or literature review study. In cases where such study yields insufficient information, a limited field study may follow. The purpose of such fieldwork is to define, to the extent possible, the likely nature and extent of the archaeological deposits in the area under consideration.

At an early stage in project development, in 2000, RMGC financed a diagnostic study in order to identify, catalogue, and evaluate the archaeological and cultural resources at Roşia Montană. The archaeological investigation is an "essential working tool in developing strategies for the protection of the archaeological heritage. At the same time inventories constitute primary resource databases for scientific study and research" (ICOMOS, 1990).

The evaluation report represents a digest of information on the character and significance of the deposits under review. The archaeological diagnosis of the Roşia Montană site was undertaken in the first half of 2000 and formed the basis of archaeological investigation planned for the period of 2001-2006. The study was performed by a team of archaeologists and architects from the National Union Museum in Albă Iulia (MNUAI) and the Design Centre for National Cultural Heritage (CPPCN), which undertook an archaeological survey and prospection of all the sites of scientific interest in the project-affected area in 2000, as well as an architectural and historic study.

The following steps were undertaken for the 2000 reconnaissance study:

- Archive investigation (Albă Iulia and Campeni State Archive, Minvest Archive in Deva - the Posepny Map);
- Synthesis study based on already published information on the Roşia Montană site (main references: *Inscriptiones Daciae Romanae* I, Archaeological Repository of Albă County);
- Archaeological evaluation of the photo archive of Roşia Montană site (1984 aerial photography);
- Surface survey and field-walking on the Roşia Montană Valley and Corna Valley;
- Geophysical survey in Tăul Cornei and Ţarina areas;
- Trial trenches in the areas identified as having "archaeological potential;" and,
- Processing, recording and storage of artefacts.

From the beginning of the project, RMGC and the Ministry of Cultural and Religious Affairs (MCC) established a partnership aiming to set a new standard for the co-operation between major investors and the institutions entrusted with the protection of Romania's cultural patrimony. Due to the fact that RMGC transparently informed the MCC on the development of the mining project, a National Programme was set up to ensure that all the scientific and material controls were properly in place. The scientific coordinator of the programme is the National Museum of History of Romania in Bucharest (MNIR) and, since March 2001, RMGC has financed the "Alburnus Maior" National Research Programme. Significant efforts have been made by the Project to avoid any unnecessary or irreversible losses of cultural heritage assets.

Prior to 2000, no archaeological excavation had been performed on the Roşia Montană site in spite of numerous indications regarding its archaeological and historical value. The archaeological programme that RMGC initiated in 2000 at Roşia Montană represents an archaeological undertaking of unprecedented size and scope in Romania. This constitutes a unique opportunity to conduct a programme that employs modern archaeological methodologies and is consistent with the legislative and best practice requirements of the EU, to which Romania is in the process of applying for membership.

In collaboration with MCC and MNIR, RMGC has assembled a multidisciplinary team of Romanian and international experts, in order to conduct the archaeological investigation of the project-affected area. Although Romanians lead the cultural heritage team, international expertise in underground mining archaeology and modern archaeological practice was drawn upon to create the first archaeological programme of this scale in Romania. The benefits of this expertise are clearly evident in the results of this archaeological programme and will result in extensive benefits in terms of capacity building and development of best practice methodology in the field of archaeology in Romania. Additionally, the team included authorised specialists in historical monument conservation as required by Law No. 422/2001.

Extensive underground sites and surface areas have been explored since 2000. The following institutions have been involved:

- The National Museum of History of Romania, Bucharest (MNIR)
- The National Museum of Union, Albă Iulia (MNUAI)
- The National History Museum of Transylvania, Cluj Napoca (MNIT)
- The Museum of Dacian and Roman Civilization, Deva (MCDR)
- The "Vasile Parvan" Institute of Archaeology of the Romanian Academy, Bucharest (IAB)
- The National Institute for Historical Monuments, Bucharest, former CPPCN, (INMI)
- The Institute of Archaeology and Art History of the Romanian Academy, Cluj Napoca (IAIA)

- University of Bucharest, the Faculty of History (UB-FIB)
- The Bacau County Museum, Bacau, in 2001, (MJI)
- The Museum Complex Bucovina, Suceava, in 2001-2002, (CMB)
- The University “Le Mirail,” Toulouse, France (UTAH)
- The Institute for Cultural Memory, Bucharest – administrator of the database and the digital archive of the programme (CIMEC)
- The Romanian Centre for the Use of Teledetection in Agriculture, Bucharest - digital mapping (CRUTA)
- University “1 December 1918” Albă Iulia, The Research Centre with Multiple Users, Albă Iulia - archaeological topography, digital mapping and geophysics studies (BCUM)
- Video Publishing House, Bucharest (Video)
- The Centre for Cultural Management and Education, Bucharest - for ethnographical and ethnological studies (CMC)
- OPUS - Atelier de Arhitectura, Bucharest - for the architectural evaluation, record cards for the historical buildings, for project restoration of the roman precinct and other historical buildings
- Geophysics studies, preformed by the companies GeoEcoMar, Gei-PROSECO and Intel91.

As the largest rescue archaeological programme in the country and one of the most important in Eastern Europe, the Programme has helped to develop the skills and capabilities for archaeology in Romania, including fostering exchanges between international and Romanian archaeologists. This has led to better management of artefacts and strengthening of the institutions entrusted with the safeguarding of the national cultural patrimony. Identified finds include cremation cemeteries dated to the 2^{nd}-3^{rd} c. AD, habitation structures, sacred areas and ancient mine workings and underground galleries. Most of the archaeological remains identified to date are movable heritage items and the scientific study and preservation of these is a major objective of the Programme. The series of “Alburnus Maior” monographs has been launched, comprising volumes dedicated to the archaeological, ethnographical and architectural studies, to publish the results of this programme.

2.2.1.3.2 The Archaeological Investigation Programme

From the outset of the proposed mining project, the archaeological investigation was considered by the MCC, the National Commission for Archaeology and the MNIR as a “rescue/salvage archaeological project.” As it is generally accepted in this specialized work, the role of the archaeologist is to locate and record as many sites as possible before they are potentially impacted by project activities. Liaison with RMGC allowed the archaeological survey to take place progressively in advance of areas which may be impacted by the mining project: this has included the Roşia Valley, Saliste Valley and Corna Valley. Following general best practice, sites with indications of significant archaeological potential required excavations and in some cases caused site development plans to be altered. This was a key advantage of beginning the archaeological work at the earliest stage possible in project development.

Following from the archaeological reconnaissance programme performed in 2000, a programme of investigation was designed for implementation in the summer of 2001 and subsequent years up to the present time. The proposed programme included both surface archaeological investigation and underground mine archaeology.

The surface archaeological programme made use of a variety of methodologies consistent with modern archaeological research and applied a number of techniques and investigative tools including:

- Ground reconnaissance / Survey;
- Aerial reconnaissance;
- Archaeological excavations;
- Geographic Information Systems (GIS);
- Geophysics studies; and,
- Radiocarbon dating.

A practical distinction can be drawn between site discovery conducted at ground level (ground reconnaissance) and discovery from the air or satellite imagery, although field investigations will typically rely on both types of reconnaissance. Methods for identifying individual sites in the Roşia Montană area included consultation of documentary sources and place name evidence, but relied primarily on first-hand field investigation.

Based on the study of documentary sources and the 2000 diagnostic reconnaissance, the archaeological rescue investigation was initiated in 2001 with a systematic ground reconnaissance survey. The area to be searched was divided into sectors, which were then systematically walked. In this way, no part of the area was either under- or over-represented in the survey. Additionally, small excavations (trial trenches) were carried out to supplement or check the surface data, or to test the hypotheses, which have arisen from the survey.

Aerial photography is an important tool used in modern archaeological programmes. Although photo archives from aerial reconnaissance do not themselves reveal archaeological sites, interpretation and analysis by archaeologists can help narrow down where searches should be concentrated.

The photo archive of the Roşia Montană site contains two sets of aerial photography: the 1984 flight (a part of the former Romanian military archive) and the 2000 flight. There are two types of photos: oblique and vertical. The vertical photos were used to provide overlapping stereoscopic pairs of prints, which enabled a scene to be examined in three dimensions, which resulted in added confidence in their interpretation.

Different individuals undertook evaluation and interpretation of the photo archive in 2000 and 2003, resulting in two separate reports. Following the conclusions of the 2003 report, a new flight to obtain additional oblique photos has formed part of the 2004 campaign. In summer 2004, the photo archive of the Roşia Montană site was updated with a new set of aerial images and also a SPOT 5 satellite image of 2 m resolution.

The information obtained from the analysis of the existing photo-archive, together with the 2000 archaeological diagnosis, has allowed determination of areas with high archaeological potential. It is in these areas where intensive rescue excavations have been undertaken since 2001. Further diagnosis in 2003, based on the aerial photo archive, confirmed the general conclusions of the 2000 diagnosis.

Archaeological trenches are most commonly used to determine the location of concealed cultural assets, and once uncovered, further excavation may be conducted as part of Cultural Heritage Management to further determine the most suitable mitigation measures, which could include in-situ preservation or relocation. The use of excavation implies the necessity of making a selection of evidence to be documented and preserved at the cost of losing other information and possibly even the total destruction of the monument (ICOMOS, 1990). However, in the light of the change in land use and construction and excavating activities associated with the Project, this tool was determined to be essential to provide a detailed inventory of cultural property. Excavations have been conducted in accordance with the principles embodied in the 1956 UNESCO Recommendations on International Principles Applicable to Archaeological Excavations and with recognised international and national professional standards.

In 2000, a team of archaeologists from the MNUAI undertook a collaborative effort with a French team (from UTAH) specialised in the exploration and evaluation of ancient mine workings. The survey started at the Cîrnic massif (known as Chernec in the medieval documents), where there are traces of ancient mining works dating from the 2nd and 3rd centuries. These are grouped either as "corande," or as subterranean works (galleries), such as those found at Glam (close to the Piatra Corbului crest), Ranta or Ohaba - Sf. Simion, where 25 wax-coated tablets were found in the 19th century; one of these tablets is dated from February 6th, 131.

Investigations of underground mining works have been conducted in the following locations to date:

- The Cetate Massif (2000-2002);
- Jig Văidoaia Massif (2003-2004);
- Exploration and research for the Cătălina Monuleşti Gallery (2002-2005); and,
- The Cîrnic Massif (1999-2003).

From 2004 to 2006, continuation of researches is planned for archaeological sites already identified as follows:

- Țarina Massif; and,
- Orlea Massif.

There is the possibility that a number of smaller mine workings may have been excavated after the 17th century using hand tools or fire-setting. In these cases, simple exploration and survey of the mine-workings would be insufficient to distinguish these from earlier workings unless supplemented by evidence obtained through excavation of waste or back-fill.

During the research, the French team benefited from support offered by both Rosiamin and RMGC. Thus, they had access to modern plans available on site, copies of such plans, availability of certain heavy equipment and access to underground mining networks inside the Cetate and Cîrnic massifs and other surrounding networks.

<u>The 2001 Archaeological Campaign</u>

From 2001, Dr. Paul Damian, Director of MNIR, was responsible for directing the archaeological investigations in Roşia Montană. In 2001, over 70 specialists and 180 local workers carried out archaeological excavations over an area that will be covered by the processing plant, the proposed access road, a water pipeline and a power line. Also, a specialised team explored the underground Cetate galleries. The results of this research were presented to the National Commission of Archaeology of the MCC, and a *Certificate of Archaeological Discharge No. SA/1320/14.12.2001* was issued, covering all these areas. The "Alburnus Maior," research programme financed by RMGC, received the MCC award "Constantin si Hadrian Daicoviciu" for the year 2001, in March 2002.

In 2001, the archaeological campaign consisted of large-scale excavations in 25 archaeological points (in Roşia Montană area on Carpeni Hill, Nanului Valley, Hop-Găuri and Hăbad sites, Cetate Massif and a survey in Corna Valley), with particular reference to:

- The Găuri – Hop – Hăbad – Tăul Țapului Zone;
- The Nanului Valley Zone;
- The Carpeni Zone; and,
- The Corna Valley (survey).

<u>The 2002 Archaeological Campaign</u>

During 2002, 50 archaeologists, 375 labourers and 12 miners under contract to RMGC conducted extensive research on over 700 ha of land, including the following areas: Corna Valley, Saliste Valley, Carpinis, Gura Rosiei, Tăul Cornei, and Cîrnic (underground). The results were presented to the National Archaeological Commission of the MCC. The *Certificate of Archaeological Discharge No. 1231/19.12.2002* was obtained to cover all but the underground areas and the area of the Roman funerary precinct at Tău Găuri , a monument that will be preserved in situ.

Large-scale excavations were performed in 30 archaeological points with special reference to:

- Corna Valley (including Roman incineration cemetery at Tăul Cornei);
- Tăul Cornei;
- Hop-Găuri zone and Tăul Găuri; and,
- Gura Roşiei - Piatra Albă Zone (the relocation area from New Roşia Montană).

The 2003 Archaeological Campaign

In 2003, 60 archaeologists returned to the field with 180 field workers and 20 miners. The complexity of underground workings in the Cîrnic Massif required further investigation, while work also began in the Jig and the west Ţarina areas. The underground zone was subsequently granted *Certificate of Archaeological Discharge 4/2004,* and additionally a preservation order was issued for the Piatra Corbului natural monument. In February 2004, due to the introduction of Law No. 462/2003, RMGC requested that the MCC issue a new archaeological discharge certificate to cover all the areas discharged since 2001. As a result of this request, *Certificate of Archaeological Discharge 5/2004* was issued.

The 2003 campaign consisted of large-scale excavations in 10 archaeological points (in Roşia Montană area on Carpeni Hill, Tău Găuri area, Cîrnic Massif, Jig Massif, and Ţarina). Exploration of the entire Roşia Montană Valley was not possible, as it is heavily inhabited. However, representative sampling consistent with best archaeological practices was implemented. The key areas of investigation were:

- Jig-Văidoaia Massif;
- Cîrnic Massif; and,
- Ţarina East perimeter.

Archaeological teams used standard methods and excavation procedures and a database was specifically designed to meet the needs of the continuously increasing volume of archaeological data. Digital maps were used and a special GIS application was developed. All these will contribute to develop, for the first time in Romania, the structured management of an archaeological programme. As a result of these efforts, the first volume containing the multidisciplinary research of 2000-2001 was published in 2003.

Future Archaeological Campaigns (2004-2006)

From 2004 to 2006 continuation of research is planned for archaeological sites already identified are follows:

- Ţarina West perimeter;
- Orlea Massif; and,
- Balmoşeşti.

Although the 2004 campaign is largely focused in the Orlea Massif, it will also involve the investigation, where permitted, of private property located in Roşia Valley. Excavations in yards will help to determine if the existing settlement of Roşia Montană has been constructed on top of historic villages that may possibly date back to Roman or Dacian times.

Investigations conducted during this period will also concentrate on promising areas identified during the 2000-2003 campaigns that require additional excavations to get a clearer picture of historical function or significance.

Site development plans for the Project are such that there will be no impacts or construction activities in the areas investigated during this period until several years into the Project. As a result, construction activities, which could begin as early as 2006 elsewhere on the site, will not begin in these areas until proper archaeological investigation consistent with Romanian Law and international best practice has been concluded.

Publications

Findings from the 2000-2001 archaeological investigations are published in the monographic volume *Alburnus Maior, 2003.* This work represents a first for Romanian archaeology and establishes a new standard regarding the publication of findings from rescue excavations in Romania. Subsequent volumes will be published and will include the findings from excavations from 2002-2006. The publication of Volume II – *The Roman Necropolis from Tãul Corna* and Volume III – *The Roman Funerary Precinct from Tãu Gãuri* is scheduled for the end of 2004. In September 2004, the volume "Ethnologic Study Roşia Montană 2001"was published as the first of the Alburnus Maior Anthropos Series, reporting ethnographic and ethnologic studies undertaken in the area.

Conservation of Movable Heritage Items

RMGC has provided the space and means to store artefacts discovered in Roşia Montană, after prior conservation and restoration performed by the museums involved in the programme. To date, there are more than 2,500 heritage items stored in the warehouse of the Archaeological Department is Roşia Montană, under the auspices of the MNIR, Bucharest.

Conservation of Archaeological Structures

After taking account of the specialist knowledge of the site-based archaeologists, the MCC has reached a decision for the preservation in situ of the following structures:

- The Roman Funerary Precinct at Tau Gauri (including restoration of the monument);
- Piatra Corbului on the Cîrnic Massif; and,
- Carpeni Hill archaeological reserve area.

Historical Monuments

In the historical centre of Roşia Montană, based on documentation drafted by CPPCN and OPUS in 2000-2001, in June 2002, the MCC established a Protected Area that currently includes 140 houses, three churches and two cemeteries. Thirty-three of the buildings are listed as historical monuments. A master plan (PUZ) for the Protected Area is under development.

In addition, in Roşia Montană outside the Protected Area, there are nine historical monuments, which are under process of declassification.

2.2.1.3.3 Churches and Cemeteries

There are seven churches and four prayer houses in the area impacted by the Project, all located in the Roşia Montană commune, including Corna village. There are no churches or prayer houses in Gura Cornei (part of the Abrud administrative district).

The churches comprise:

- One Romanian Orthodox church;
- One Greek Catholic church;
- One Roman Catholic church (in the Protected Area);
- One Reformed church (in the Protected Area);
- One Unitarian church (in the Protected Area); and,
- One Pentecostal prayer house

- One Evangelical prayer house.

In Corna there are:

- One Romanian Orthodox church;
- One Greek Catholic church; and,
- Two prayer houses belonging to the Baptist church.

There are also eleven cemeteries in the area impacted by the Project, not including private cemeteries: six in Roşia Montană, two in Corna and three in Gura Cornei.

Specifically, in Roşia Montană the cemeteries are as follows:

- One cemetery belonging to Roşia Montană Commune;
- Two cemeteries belonging to the Romanian Orthodox church;
- One Roman Catholic cemetery (in the Protected Area);
- One Greek Catholic cemetery; and,
- One Unitarian cemetery (in the Protected Area).

In Corna, there is:

- One cemetery belonging to Corna village;
- One Romanian Orthodox cemetery; and,
- One Greek Catholic cemetery.

In Gura Cornei there is:

- One cemetery belonging to Abrud Town; and,
- One Baptist cemetery.

RMGC is in active discussion with the congregations, local religious ministers and regional and national church authorities regarding the future of these churches, prayer houses and cemeteries.

The churches and cemeteries in the Protected Area will remain intact and unaffected by project operations and will remain accessible through the proposed duration of the mine and related activity, with the exception of the Orthodox Church and its cemetery, and the Greek Catholic Church at Corna. The latter has not been used for religious services in recent years. RMGC has recognized, however, that people who move from the area as part of the resettlement and relocation programme may be disadvantaged by being unable in future to visit and tend the graves of relatives with the same ease and frequency as previously. Accordingly, under the terms of relocation or resettlement, affected people may request the transfer of the remains of buried family members to a cemetery closer to their new homes. RMGC will cover costs and organize transfer of such remains, with full respect to religious rites and in close co-operation with the relevant religious authorities and in strict accordance with legislation. RMGC will also fund the transfer and re-erection of headstones and grave furniture, or the erection of a new headstone, as may be requested.

For the affected churches and prayer houses outside the Protected Area, various options are under consideration, including reconstruction of a new building at a different site, moving of contents and features of significance, and the payment of compensation. Plans for the new resettlement sites at Piatra Alba and Alba Iulia, include provision for the construction of new religious centres.

RMGC has prepared detailed inventories of the burial sites in the impacted area. Cemeteries that will be directly affected by operations will be emptied and the remains removed to a new cemetery site at Piatra Alba, at the cost of RMGC and with full respect for religious observance and compliance with legislation, unless specific requests are made by family members for alternative arrangements.

2.2.1.4 Social Initiatives

Exploration activities determined that many financially viable ore zones were located under portions of the residential areas of Roşia Montană. The only cost-effective way to mine the ore is by open pit mining, which requires resettlement or relocation businesses presently located within the footprint of the operations and the designated industrial zone.

RMGC has developed a policy for managing land acquisition and the displacement of project-affected people in accordance with Romanian Law, and also to meet the requirements of *Operational Directive OD 4.30 (Involuntary Resettlement)* of the World Bank Group, widely regarded as representing international best practice for resettlement activities. The *Resettlement & Relocation Action Plan (RRAP)*, and its subsequent revision, has been widely published with wide dissemination through the Project website and the Roşia Montană Public Information Centre.

From early 2001 consultations were undertaken by the company with local authorities and with project-affected people, regarding the process of property acquisition, options available to those whose property, accommodation and/or livelihood would be affected by the project and potential sites in which displaced people could be resettled. RMGC has issued Gazettes and held focus groups, meetings, and discussions with local leaders, and most of the inhabitants of the community.

The *RRAP* defined a number of principles upon which planning and the initial stages of implementation have proceeded:

- Project-Affected People are offered a choice between:
  - Resettlement, which is the receipt of a new parcel of land at one of two locations (one in the territory of the *comuna* of Roşia Montană and one in Albă Iulia) with a new home, which may be one chosen from a range of models developed by RMGC or, at the resettlement site in the *comuna* of Roşia Montană, a self-built house (an option in Abrud was also proposed, but insufficient interest was expressed in this option to justify proceeding with this); or
  - Relocation, which is the receipt of monetary compensation for their current property and the ability to move wherever they choose.
- The community infrastructure and public facilities of Roşia Montană will be re-established with a new town centre for Roşia Montană at the Piatra Albă resettlement site located within the territory of the *comuna;*
- Compensation for affected properties is at replacement value;
- The design of the resettlement sites takes into consideration the need for most people to practice small scale agriculture as a complementary source of livelihood;
- Assistance and training will be provided for affected people to help them restore their livelihoods; and,
- Processes will be transparent and consulted upon and an effective grievance handling mechanism has been set up.

RMGC initiated negotiations with people affected by the project in late April 2002 and started compensation payments in June 2002. Due to the fact that the vast majority of the property titles were unclear, the Community Relations Department commenced a property titles clarification process in parallel with the negotiations process. This process involved court cases undertaken at RMGC's expense on behalf of the property owners, technical clarification, and other various administrative and legal procedures.

As part of the process of obtaining additional project financing, RMGC was required to take its existing resettlement and relocation plans and incorporate these documents into a report format that meets internationally recognized requirements. The Company, after consultation with the relevant government agencies and local communities, interrupted relocation payments in September 2003 while the *RRAP* underwent revision. During this period, RMGC secured options to purchase properties by signing pre-contracts with the owners that were willing to commit, while at the same time, there was no interruption to the processes of ownership title clarification and negotiation. The *RRAP* is undergoing further refinement and update.

RMGC is implementing social programmes to help the displaced persons and families to reintegrate in their new host community, to restore the family income, to assist them in their livelihood restoration efforts, as well as to sustain the general development of the host communities.

The social programmes are:

- Site selection and preparation for resettlement;
- Relocation schedule and assistance;
- Replacement of services and enterprises for the resettlement sites;
- Restoration of livelihood;
- Management of cultural heritage; and,
- Special assistance for women and vulnerable groups.

Site Selection and Preparation

Information on options for resettlement and relocation has been widely disseminated to the public through direct meetings, by visits to the future site locations, by the construction of a model house in Roşia Montană which is open for visitors, and by exhibiting site maps and a scale model of the sites and houses. The new Piatra Albă site will have a location and infrastructure that reflects the preferences of the affected population in order to provide the best opportunities for timely restoration of livelihoods. The preservation of the original community fabric is a primary concern in the negotiation process. It is expected that the living standards at the new site will be higher than in the impacted affected area and will be in compliance with the legal requirements in Romania covering access roads, piped water supply, electricity, lighting, drainage and waste management.

The company has hired a team of trained negotiators who undertake several meetings with each owner before concluding the negotiations and property acquisition process; the owner then has a final option for relocation or resettlement. The owners of properties in the Project-Impacted Area are provided with free juridical/legal assistance for the process of clarification of legal title of land and houses. Lawyers from either the RMGC, or from independent law companies with accreditation to represent the owners' cases in Court, are responsible for providing this assistance.

Relocation Schedule and Assistance

The relocation process allows affected people to receive cash compensation at replacement value for their physical assets owned in the Project-Impacted area, on voluntary willing buyer/willing seller basis, as well as cash compensation for revenue and income (from crops, business, handicrafts etc) lost after physical displacement, whether these losses are temporary or permanent.

The relocation process will be scheduled for the convenience of the relocatees based on the completion of their new house, the house's state of readiness for occupation, and the signature of the sales agreement for the relinquished property.

For physical relocation the company provides assistance with relocation expenses (moving allowances, transportation of displaced persons and their belongings to the new site). The relocation process will be scheduled for the convenience of the relocates based on the completion of their new house, the house's state of readiness for occupation, and the signature of the sales agreement for the relinquished property. A Special section of RMGC arranges the movement of affected people to their new houses. Partial salvage of house materials during demolition is assisted along with its transportation to the new location. Full assistance is being provided for transportation of people and their effects to the new site.

Restoration of Livelihood of Displaced People

Programmes are being developed to assist displaced families to reintegrate easily in their new host community, to restore the family income and to assist them in rebuilding a normal life.

With regard to income restoration, *Operational Procedure 4.1.2* (p.1) of the World Bank Group states that "displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least restore them, in real terms, to pre-displacement levels, or to levels prevailing prior to the beginning of project implementation, whichever is higher".

The *RRAP* encompasses a programme to assist affected people with skills development and management of financial resources for business creation and development.

Small Business Enhancement Assistance

A loans programme is being implemented to provide micro-finance and small business development through loans that will be arranged for approved proposals. The loans programme is designed to assist income restoration and economic growth for eligible people displaced by the project who wish to create new businesses or to develop existing businesses.

As part of the resettlement programme, these assistance measures will provide sufficient resources to help displaced persons to start a business, or develop an existing one in the new location area, or access larger funds from local and international financial markets. Assistance given to the resettled community will be directed to improve former levels of production, income earning capacity and living standards, or at least to restore them to the levels they would have been at without the project. In this respect, the Company has set aside a one million USD fund that will be available for micro loans financing through a revolving credit scheme, to be made available for small business development by persons displaced from the Project-Impacted Area. The lending programme will be supported by training in managing credits, for running small businesses, and for learning to access larger grants and loans from financial institutions. The programme will also provide business advocacy and financial consultancy.

RMGC's Small Business Enhancement Programme is being designed in a way that seeks to integrate it closely with opportunities for local businesses to supply outsourced goods and services directly to RMGC during plant building and mine development and operation. The availability of financial support for small business activity is a primary component of the proposed resettlement plan and adheres to the following principal goals:

1. Implementation of a loans program to:
    - Facilitate the creation of new small businesses in the new community and neighbouring areas (cleaning and laundering, car maintenance, car wash, hair dressing and barber shop, couture, fast food shops, restaurants, mini markets, carpets manufacturing, agro tourism, small souvenir production, vegetables and animal farms, milk and meat processing, bakeries, etc.);
    - Assist already existing small businesses to be relocated, modernized, and developed; and,
    - Integrate intensive business support services for relocated businesses as an enterprise development strategy that includes assistance in covering the cost of feasibility studies and supports proposals to access larger funds for rural or community development (e.g., from the European Community, IFC, Romanian Government or other internal and external sources).
2. Integration into the RMGC operations strategy of an outsourcing system for many goods and services (such as car and equipment maintenance, electrical maintenance, security, food supply, cleaning, accommodation, entertainment, etc.) that could be provided by new small businesses started with the technical and financial assistance programme.

Skills Enhancement Assistance

RMGC has created a Skills Enhancement Fund, as part of an education and training programme for displaced people from the Project-Impacted Area. This fund will help the restoration of livelihood for relocated persons whose productive skills may be less applicable and will demonstrate compliance with the World Bank Group relocation guidelines. The Skills Enhancement Fund, together with the Small Business Enhancement Fund, include safeguards to address and mitigate impoverishment risks after relocation or resettlement, and are designed to assist these project-affected people in their efforts to improve their livelihoods and standards of living. The objectives of the RMGC Skills Enhancement Fund are to provide affected household members with education and training support to improve their socio-economic opportunities, help them participate in RMGC's small business finance fund, and to improve vocational skills. Examples of such training programmes include: mobile equipment operations, machine operations and maintenance, information technologies, and instrumentation and automation systems.

To increase the opportunities for local people to be selected for employment in the new plant and mine, the company has organised free open courses for computer skills and English language training for inhabitants of the Project-Impacted Area who are interested in improving their knowledge in these fields. Attendees of the computer skills training course will receive a certificate that is consistent with certification demands of certain employers.

RMGC has assigned to each relocated or resettled household, an amount of up to a maximum 1,000 USD towards the cost of one or more designated family members undertaking an education or vocational training course of their choice. The above training and grant programmes are designed to be a stimulus to relocatees and resettled persons to undertake small business enhancement and to benefit from the RMGC financial programme designed for this purpose.

Hiring Policy

RMGC pre-construction activities have created several hundred new jobs, for which the majority of employees are from the local area. During the warmer summer months there is additional temporary employment related to the seasonal work programmes in the Archaeology Department and for other contracted work. Particular attention is directed to members of displaced households and to vulnerable people from the Project-Impacted Area to offer work opportunities in the period prior to relocation or resettlement. RMGC has developed a hiring policy that is to be implemented as a transparent, fair and equitable hiring and procurement process.

A programme has been implemented to notify local inhabitants of employment opportunities and procedures to apply for such posts. In addition, this programme aims to inform persons in the Project-Impacted Area, and any already displaced persons, about job opportunities, the required qualifications for such posts, and the applications procedures, as they arise in the new host communities. Businesses and labour offices are regularly contacted in Albă Iulia, Cluj, Sibiu, Hunedoara, Deva, and Tirgu Mures.

Special Assistance for Vulnerable Groups

RMGC has a policy to assist vulnerable people or households at risk of further impoverishment or greater vulnerability resulting from displacement from the Project-Impacted Area. This aims to complement the provisions of Romanian legislation and the responsibilities of the Local Councils of Roşia Montană and Abrud. Local provision in this respect is effectively non-existent or is inadequate. The policy will apply to individuals who reside within the Project-Impacted Area and will include assistance for provision of social housing and access to employment.

A list of potentially affected vulnerable persons and households has been obtained from the mayors of the *comuna* Roşia Montană and of town of Abrud. The list includes all persons and families living in national housing, persons or families who are receiving the Minimum Guaranteed Income, and handicapped people.

<u>Replacement of Services and Enterprises</u>

The new resettlement site at Piatra Alba will have social services such as health clinics, schools, shops, and other service providers and community services. This will ensure that there is continuity in the provision of social services provided by government agencies at the resettlement sites.

In order to better develop and implement the above-mentioned social programmes, RMGC has identified and developed a process to make a major contribution to safeguarding the general development of the community through the following activities:

- Assistance to Community Local Councils to access external funds for local development (EC-Phare, SAPARD, etc);
- Assistance to build the capacity of Community Local Councils to plan and participate in sustainable socio-economic development;
- Promotion of strategic local and regional linkages with the company socio-economic policies and programmes;
- Reduction of community dependence on the project for socio-economic well-being over time;
- Minimising any social disruption of the community due to the project and specifically to assist improvement of current levels of local and regional unemployment; and,
- Cooperation with NGOs involved in rural development to act jointly in implementing general community initiatives.

People who have been, or will be affected by the project, and who may relocate to anywhere in the country, will be monitored on a regular basis throughout the life of the mine-related operations. Monitoring will be conducted by means of visits by RMGC's Socio-economic Unit staff and will be aimed at monitoring, and when necessary, further assisting relocated persons in their efforts to integrate into their new host community. Relocated persons have filled out detailed questionnaires that contain particular reference to their options and proposals to access funds, or to get assistance to develop businesses. Wherever appropriate, their initiative will be supported by the income and livelihood restoration plan.

RMGC has publicly committed to support and foster beneficial projects and management measures for the key host communities. In line with its commitment to the Equator Principles, RMGC has initiated the development of a formal and comprehensive *Public Consultation and Disclosure Plan (PCDP).* The commitment to good practice with regard to addressing the social dimensions of the Roşia Montană Gold project also recognises the need to integrate project-related activities into supporting community development and regional development plans. The Company is undertaking the preparation of a strategy for a *Social/Economic Development Plan,* which would be operative through the life of the project with the aim of instigating sustainable social development not only in the immediately impacted project area, but in the wider community in the area of influence of the project.

By the end of 2003, approximately 25 million USD had been spent on the resettlement programme activities. The final investment is forecast to be 60 million USD.

2.2.1.5 Workforce

During the pre-construction period, and specifically since the commencement of the archaeological field investigations in 2001, the RMGC workforce has fluctuated between ~200 and ~800 people. The higher number has applied to warmer months during the summer and autumn months, when conditions allowed excavation activities associated with the cultural and archaeological programme. Fewer people are employed during the winter months when winter conditions preclude archaeological activities.

2.2.1.6 Environmental Monitoring

As part of pre-construction activities, RMGC has put in place an extensive water-monitoring programme. The programme includes monitoring the flow rates in the water catchments areas within which the project lies and some adjacent areas, as well as monitoring the quality of surface water and groundwater. A database has been constructed for management of monitoring records at all regular sampling points and forms the basis for future management of monitoring through the life of the project, allowing incorporation of new sample locations as required by project activities. Baseline sampling of biological characteristics and of stream sediment samples has also been performed in the pre-construction period.

The programme has confirmed that surface water in the area has been impacted by the natural geological environment and the effects of historic intensive mining activities. Sulphide-rich rock characteristic of the mineralised zones of Roşia Montană oxidizes when in contact with air and water, resulting in the release of acidic flows. The acidic water in turn leaches heavy metals from the rocks. As a result, many area watercourses do not support aquatic life and are not fit for drinking water. The red colour of area watercourses is a visible sign of the elevated levels of iron.

Baseline sampling of air quality and noise has been performed with regards to the mining and other site activities, unrelated to the current development plans, which have continued during the pre-construction phase. This sampling forms a basis for predictive modelling for the EIA process.

2.2.2 Project Description for Construction Period

2.2.2.1 General

The proposed construction period for development of the Project is approximately 24 to 36 months. Activities will commence with the establishment of site offices, site construction facilities, and the mobilization of principal contractors. The primary Project activities during this period are as follows:

- Continuation of construction of the resettlement infrastructure (housing, churches, commercial premises, municipal and county administrative offices) using Romanian contractors and suppliers to the maximum extent feasible;
- Preparation of existing and future mine areas;
- Development of quarries for construction materials (La Piriul Porcului Sandstone Quarry; Sulei Andesite Quarry);
- Working with Minvest on redevelopment and permanent and temporary closure activities;
- HV power line diversion;
- Construction of water supply pipeline from Aries River;
- Construction of the access road to the process facilities;
- Construction of the process facilities;
- Construction of a new access road to Roşia Poieni;
- Construction of TMF, including initial starter dam and secondary containment dams;
- Development of the temporary accommodation necessary for the construction workers;
- Construction of infrastructure; and,
- Construction of other water control containment structures and channels.

Detailed lists of jobs and job descriptions are being developed. An inventory of skills available in the surrounding communities throughout the region is also being developed. The RMGC Human Resources Department will, based on the results of the survey, identify and train local people as well as implementing hiring policies with preference being given to local persons in cases where their attributes are equal. During the construction and operational life of the Project, when special skills are unavailable locally and training is not practicable due to time constraints, suitably qualified personnel will be hired from outside the local area.

It is planned that appropriate regional suppliers and fabricators of structural steel, suppliers of concrete and reinforcing steel, and suppliers of construction consumables (such as fuel and lube oils) will be employed during the construction phase of the project. Specialised equipment for plant construction will be sourced internationally due to the specialised technology that is required in its design and manufacture. Local resources will be used for in-country transportation and delivery. Moreover, the local labour force will be a prime source of labour for Romanian and international contractors contracted by RMGC to supply the craft disciplines for the construction of the Project.

Construction will take place in the Roşia Montană and Corna Valleys. Temporary areas will be established for the interim storage and preparation of equipment and supplies. Receiving and warehousing requirements will be significant due to the volume of materials that will be required for completion of construction. Warehouse management will require a dedicated workforce of personnel, drawn in part from the local populace for organization in support of the construction activities.

Quality control for the Project will require the utilisation of local material testing laboratories for concrete placement, rock and soil based engineered structures, and other construction activities.

2.2.2.2 Construction-Related Facilities

Facilities in this phase are illustrated on *Exhibit 2.2 Facilities Related to the Construction Phase.*

Project planning envisages construction of accommodation for up to approximately 800 workers. The need for construction of accommodation is dictated by the lack of suitable alternatives in the local area. Adequate accommodation will be provided for supervisors and construction staff with living quarters and dining facilities for a male and female workforce.

The total workforce for construction of the Project is expected to peak at approximately 1,200 persons. The current camp plan comprises modular style temporary facilities that will be serviced by potable water, sewage collection and treatment, and solid waste disposal systems. The camp and associated servicing requirements will be reduced and may be eliminated by maximising, where possible, the use of existing housing (including those that are purchased by RMGC, but which do not have to be removed immediately) and local commercial and industrial lodging facilities. Camp management and maintenance will require dedicated management that will be hired through a concerted effort to use local personnel.

A number of additional temporary facilities will be provided to facilitate construction-related activities. These include the following:

- Temporary Power: Temporary power will be supplied by generators, available at the plant site, and used until permanent power is available. During development of on-site quarries, RMGC will provide temporary power to the quarry office/trailer;
- Construction Laydown Area: A steel fabrication and laydown area will be temporarily located on the north side of the process plant construction area. Additional temporary laydown areas will be located inside the process plant, as necessary, to support particular phases of construction. Laydown areas will include modular buildings or weatherproof containers for the storage of tools, welding consumables, compressed gases, paint, and other materials. Covered storage will be provided for insulation, electric motors and machinery, wood, and other materials or equipment requiring a measure of protection from precipitation prior to installation. Open storage areas will be used for steel beams, piping, sheathing and roofing materials, and other materials not requiring protection from precipitation;
- Batch Concrete Production Plant: This will be installed in the vicinity of the process plant construction area**.** Aggregate for the batch process will be provided from onsite quarries; a

small stockpile will be maintained at the batch plant site. Power will be provided by a portable diesel generator until completion of the relocation of the main transmission line and plant substation, at which time a temporary distribution line and transformer will be provided to service the batch plant. The batch plant will be decommissioned and removed from the site at the completion of the construction phase of the project;

- Temporary Water Supply and Distribution: It is foreseeable that construction will commence before the permanent water supply pipeline from the Aries River is in operation; in this interim period the existing water supply to Gura Rosiei will be used to the extent possible, dependent on other competing demands. Provision will be made to cover additional requirements by means of truck transportation of water from nearby towns, which will be stored in temporary, insulated steel tanks. Water will be provided for potable and industrial use at the plant site and construction camp. Water for fire protection will also be provided;
- Sewage Collection and Treatment: Sewage collection and treatment will be provided to service the camp and will meet regulatory discharge requirements. In addition, portable toilet facilities will be located in outlying field areas;
- Temporary Buildings: A number of temporary buildings will be constructed to support construction including construction management offices, warehouse, maintenance shop, material laboratory, medical-aid clinic, field washrooms, TMF field office, quarry field office, temporary guardhouse and security fencing, temporary enclosure for generators, telephones; and,
- Waste Disposal Site: Non-hazardous waste and any hazardous material will be disposed of in accordance with RMGC's waste management policies, which will comply with Romanian regulations and recognised good practices. Waste disposal activities will be directed toward defined containment and management within the project boundary and the development of upgraded local facilities. The existing local facilities that are not in compliance with regulations will not be used by RMGC.

A number of potential quarry sites have been investigated as sources of aggregate for construction of the TMF dam and water management dams as well as for earthworks and concrete preparation. Two quarry sites *(Exhibit 2.2)* are planned for development unless alternatives can be secured at an equal or more favourable price: La Piriul Porcului Valley sandstone quarry (353946E, 535924N) and the Sulei andesite quarry (357499E, 535485N). It is expected that some material suitable for construction will be obtained from the pre-strip excavation for the Cetate and Cîrnic open pits. Initial estimates indicate that in order to supply the necessary quantities of aggregate an estimated area of 10 ha must be cleared and grubbed; in addition, over 1 km of access roads must be constructed from existing roads.

Several roads must be provided to facilitate Roşia construction activities. During the initial construction phase the road access to the plant site will be constructed on the south side of the Roşia Valley, as shown on *Exhibit 2.3 Haul and Access Roads*. A number of other existing roads require upgrading for use during the construction period. Site access, roads, and transportation are described further in *Section 2.2.3.5.1*.

An office will be maintained in Albă Iulia throughout the duration of the development of the Project in order to facilitate co-ordination efforts with Albă County authorities and other project stakeholders and service providers. There will also be a small office in Bucharest to deal with import/export, shipping etc.

2.2.3 Project Description for Operation Period

2.2.3.1 General Mine Plan

The proposed mining activities at Roşia Montană are based on conventional open-pit mining techniques that incorporate the unit operations of drilling, blasting, loading by hydraulic shovels, and hauling by rigid frame haul trucks. Sufficient mine support equipment will be provided to ensure safe and efficient operations. Advance site investigations will be undertaken for grade control and location of archaeological assets.

The current pit design, mine plan, and schedule are based on the resource model developed in December 2002 and the mine plan developed in February 2003 and updated in 2004. The purpose of the plan is to maximise returns, while assuring practical and efficient mine operations. The mine plan delivers the nominal 13 Mt/a ore to the process plant for 17 years, with total material movement of approximately 35 Mt/a during peak production. During the first six years of operation, low grade ore will be stockpiled and will be reclaimed to the process plant during years 14 through 17.

A preliminary schedule of the mining programme is presented in *Table 2.3 Mine Schedule by Pit Areas.* In addition, the site location plans for Project years 0, 7, 14 and 17, are given in *Exhibits 2.4, 2.5, 2.6* and *2.7,* respectively.

As indicated in the table, four open pits, the Cetate, Cîrnic, Orlea, and Jig pits, will be mined. The four pit areas are areas within a single mine operation, which will feed ore to the process plant. Mining at Cetate and Cîrnic will start simultaneously. In Year 10, mining will be complete in Cîrnic pit, while mining of Cetate will continue through the remaining mine life. Mining at Orlea and Jig will be initiated in Year 8. The final layout is shown in *Exhibit 2.7.*

Table 2.3 Mine Schedule by Pit Areas (Mt)

Year	Cetate Pit		Cîrnic Pit		Orlea Pit		Jig Pit		Total	
	Ore	Waste	Ore	Waste	Ore	Waste	Ore	Waste	Ore	Waste
0	1.3	7.0	0.3	0.1	-	-	-	-	**1.6**	**7.1**
1	4.3	6.1	15.0	7.2	-	-	-	-	**19.2**	**14.5**
2	3.2	6.2	17.2	8.5	-	-	-	-	**20.4**	**14.6**
3	5.0	6.4	13.5	10.1	-	-	-	-	**18.5**	**16.5**
4	11.0	9.9	4.9	9.2	-	-	-	-	**15.9**	**19.1**
5	0.5	0.2	15.3	19.0	-	-	-	-	**15.8**	**19.2**
6	-	-	14.5	20.5	-	-	-	-	**14.5**	**20.5**
7	-	-	13.1	21.9	-	-	-	-	**13.1**	**21.9**
8	1.0	6.0	5.3	7.1	4.1	2.2	3.2	6.3	**13.5**	**21.5**
9	1.5	6.3	11.1	16.2	-	-	-	-	**12.5**	**22.5**
10	2.7	15.2	3.5	2.1	3.4	0.3	4.3	3.6	**13.9**	**21.1**
11	11.9	15.3	-	-	0.2	5.9	0.8	0.8	**12.9**	**22.1**
12	2.3	2.9	-	-	13.1	14.1	-	-	**15.4**	**17.0**
13	4.1	3.3	-	-	11.4	4.3	-	-	**15.6**	**7.6**
14	15.1	16.2	-	-	-	-	-	-	**15.1**	**16.2**
Total	**63.9**	**102.0**	**113.6**	**121.9**	**32.2**	**26.8**	**8.3**	**10.7**	**218.0**	**261.5**

Note: Totals may not add exactly due to rounding

An exploration database and resource model was developed for the Roşia Montană Project. Based on available data, a mineable ore reserve for a 13 Mt/a operation was developed and is presented in *Table 2.4 Mineable Reserves.*

Table 2.4 Mineable Reserves						
Deposit	Ore Mt	Ore Grades		In-situ Metal		Strip Ratio
		Au g/t	Ag g/t	Au t	Ag t	
Cetate	63.9	1.49	5.66	95.1	361.7	1.60
Cîrnic	113.6	1.62	9.74	184.0	1,106.5	1.07
Orlea	32.2	1.18	2.23	38.0	71.8	0.83
Jig	8.3	1.62	10.65	13.4	88.4	1.29
Total	**218.0**	**1.52**	**7.47**	**330.5**	**1,628.4**	**1.20**

As indicated in the table, the Roşia Montană ore deposits contain approximately 218.0 Mt of ore, with average ore grades of 1.52 g/t gold and 7.47 g/t silver. This is equivalent to 330.5t (10.6 Moz) of in-situ gold and 1,628.4t (52.3 Moz) of in-situ silver.

2.2.3.2 Mining

2.2.3.2.1 Open Pit Design

Following detailed geotechnical investigation and pit slope design recommendations, and taking int account the planned size of the mining equipment selected, the following base parameters have been adopted for the pit design:

- Ramp width of 27 m, including berms and ditches;
- Ramp gradient of 8% with occasional use of 10%, where prudent;
- Bench height of 10 m; and,
- Inter-ramp slope angles planned not to exceed 42° overall; lower angles may apply within vent breccias.

The open pits will extend to maximum depths ranging from approximately 220 m to 260 m below the actual topographic surface. The slope designs for the four open pits were based on the selection of appropriate design sectors, allowable inter-ramp slope angles, appropriate bench face angles, and minimum safety catch bench widths. The pit slope design factors were selected based on the pit perimeter geometry and the geotechnical characteristics.

Preparation of the site for mining will begin with logging of merchantable timber and firewood from the site including the footprint of the open pits, stockpiles, plant site area and roads. Timber and firewood will be sold or otherwise utilised in accordance with Government forestry regulations. Remaining vegetation (tree stumps) will be grubbed out and the topsoil/organics will be removed and stockpiled for use in the progressive rehabilitation and during site decommissioning activities.

2.2.3.2.2 Mining Method

Mining operations at Roşia Montană will employ conventional open-pit mining techniques for drilling and blasting, loading and haulage operations, utilising blast-hole drills, hydraulic shovels, front-end-loaders and off-road dump trucks.

Drill and Blast

The pits will be deepened throughout the operations phase by the mining of a series of benches using drilling, blasting, and heavy excavation equipment. A general description follows:

- Production drilling will be performed by two drills capable of drilling 10 m benches in a single pass;

- A blast-hole pattern of approximately 8 m by 8 m will be used to produce blasted material meeting the required material size specifications for the primary crusher;
- ANFO (Ammonium Nitrate-Fuel Oil mixture) will be the primary blasting agent, supplemented by the use of emulsion (slurry) type explosives; and,
- Charges will be detonated with delays, in such a manner as to minimize noise and vibration.

It is estimated that 0.25 kg of explosives will be consumed for each tonne of rock blasted. Due to the numerous underground adits and workings below the pit footprint, added precautions will be taken to prevent unexpected cave-ins and ensure that worker safety is maximised, and also that any archaeological remains are recorded and recovered.

Load and Haul

Hydraulic shovels and haul trucks will be the primary equipment used for loading and hauling. The ore will be transported on haul roads to a primary crusher located adjacent to the process plant, or to storage on the low grade stockpiles and waste will be transported to dumps.

2.2.3.2.3 Waste Rock and Low-grade Ore Stockpiles

Approximately 262 Mt of waste are contained within the pit designs with a waste to ore strip ratio of 1.2:1. Quarried rock and pre-stripped waste rock will be utilised as appropriate for construction of the Corna Valley TMF embankments and other impoundments. If not required for construction, waste rock will be hauled to the Cetate and/or Cîrnic stockpiles for the first nine years of mine life (see *Exhibit 2.5*). Starting in Year 10, the Cîrnic pit will be backfilled with mine waste from the late pushbacks of the Cetate, Orlea, and Jig pits (see *Exhibit 2.6*).

Prior to the placement of any waste in the designated waste rock areas, the surface area to be covered will be stripped of topsoil; scarification and compaction of the exposed colluvial and/or weathered bedrock materials will provide a semi-impervious layer under the waste rock disposal sites. Topsoil will be stockpiled for later rehabilitation of waste rock piles. Waste rock material will be categorised in terms of its potential to generate acid drainage and will be disposed of within the designated sites to minimise ARD potential. Diversion channels around the waste rock piles will capture potential surface waste run-on and divert it around the piles. Run-off from the waste rock piles reports to the water management system and will be collected within the TMF or one of the water management dams, which will allow pumping to the wastewater treatment plant or the process plant.

Low-grade ore will be stockpiled near the plant. The location and disposition of stockpiled material will be such that any potential acid rock drainage that is generated from these materials will be captured and pumped directly to the wastewater treatment plant.

2.2.3.2.4 Mine Dewatering

As a result of drainage provided by the old underground workings, mine dewatering requirements will be negligible down to an elevation of approximately 720 metres above sea level (mASL). Current investigation and interpretation indicates that there are no significant aquifers within the mining area. However, impounded bodies of water may be encountered in old underground workings. Below 720 mASL, a dewatering requirement has been assumed. The dewatering system will consist of vertical dewatering wells and sub-horizontal gravity drains. Conventional practice will be employed using in-pit sumps to collect these gravity drains. Water pumped out of the open pits will be discharged to the Cetate Waste Rock and Mine Drainage Pond. Water collected in this pond will be directed to the treatment plant so that the water can be treated to discharge standards before release into local rivers. Drainage channels will be constructed to control surface water and run-off and to direct clean surface water away from potential contaminating materials in the pits.

2.2.3.2.5 Mine Haul Roads

Primary surface haul roads will be constructed from the mining locations to all waste or ore destinations. Main surface haul roads will be constructed to a minimum of 27 m wide to allow for safe dual lane operation for the open-pit haul trucks. The design and construction of the roads will, wherever possible, use cut and fill techniques, with any additional backfill required coming from quarry material. The roads will be surfaced with crushed gravel and maintained by watering and grading to a high standard to reduce rolling resistance, increase tire life, maximise haul truck productivity, and control dust.

2.2.3.2.6 Mine Mobile Plant

Table 2.5 Mobile Mining Equipment Requirement presents the preliminary list of mobile mine equipment required during Year 1 of Operations.

Table 2.5 Mobile Mining Equipment Requirement

Type of Equipment	No. of Units	Class / Capacity (preliminary – subject to change)
Major Equipment		
Rotary Blast hole drills	3	9-11 inch diameter
Hydraulic Shovels	3	19.5 m^3
Wheel loader	1	22 t
Haul trucks	14	150 t
Track dozers	3	354kW/474hp
Wheel dozers	2	392kW/525hp
Motor graders	2	198kW/265hp
Water Trucks	2	70,000 l capacity
Wheel loader	1	350-400kW, 6-7 m^3 bucket
Haul truck	1	60 t
Rock drill	1	107kW/144hp
Excavator	1	140kW/188hp
Support Equipment		
Fuel truck	1	10 t
Lube truck	1	10 t
ANFO truck	1	
Tyre handler	1	
Welding/mechanics truck	1	
Mobile crane	1	~80 t
All terrain crane	1	~30 t
Boom truck	1	~12 – 18 t
Rough terrain forklift	1	
Equipment trailer/tractor	1	
Flatbed truck	1	
Pickups	14	4x4 twin cab
Semi mobile crushing plant	1	
Portable light towers	6	

2.2.3.3 Proposed Ore Preparation and Processing Methods

2.2.3.3.1 The Process Plant Site

The process plant will be located on the side of a ridge between the Salistei Valley and the Roşia Montană Valley. This location was chosen for its proximity to the Cîrnic and Cetate pits, which provide the majority of the proven and probable reserves, as well as its proximity to the TMF to be situated in the Corna Valley. The process plant will be winterised to enable continuous operation throughout the year. The location of the processing plant is provided on the illustrations of site layout and the construction and operations phases of the mine (*Exhibits 2.4, 2.5, 2.6 and 2.7).*

2.2.3.3.2 Summary of Process Flowsheet

Exhibit 2.8 Processing Plant Site illustrates the proposed ore preparation and processing facilities. After the ore is transported to the processing plant, it will be reduced to the appropriate size for the chemical-based gold and silver recovery process. The proposed ore preparation and processing methods incorporate the following, principal elements:

- Single stage crushing of Run of Mine (ROM) ore by means of a gyratory crusher;
- Stockpiling of crushed ore;
- Reclaim of crushed ore and wet grinding using a Semi-Autogenous Grinding (SAG) mill followed by two ball mills in a parallel configuration;
- Cyanide leaching, commencing in the grinding circuit, from which a classified fine product passes to the CIL tanks to undergo agitation and continued cyanide leach;
- Adsorption of extracted gold and silver onto activated carbon within the CIL tanks followed by separation of the loaded carbon and elution of the gold and silver from the activated carbon in pressure vessels;
- Electro-winning to recover gold and silver stripped from the activated carbon, as a precious metals sludge, and smelting of this sludge to produce gold and silver ingots;
- Thickening of the tailings;
- Cyanide detoxification before the tailings leave the process plant containment zone;
- Placing of treated tailings into the TMF;
- Water reclamation from the TMF for recycling and re-use;
- Freshwater supply from the Aries River.

The crushed ore stockpile, carbon-in-leach (CIL) cyanidation tanks, cyanide detoxification tanks and thickeners will be located outdoors, while most other facilities will be located inside specially designed buildings. A flow sheet of the above process is presented in *Exhibit 2.9 Simplified Overall Process Flow Diagram*.

2.2.3.3.3 Primary Crushing and Crushed Ore Stockpile

The crushing section incorporates an area for a small ROM surge pile, the ore dump hopper, a primary gyratory crusher, and conveying system feeding onto the stockpile feed conveyor (*Exhibit 2.10 Ore Receiving, Crushing and Stockpile Process Flow Diagram*).

ROM ore will be fed to the primary crusher by direct dumping from the mine haul trucks. The crusher can also be fed by a front-end loader from the ROM surge pile. Level detectors in the dump hopper control signals will indicate to the truck drivers when tipping of ore should take place.

Under normal conditions, the crushing plant will operate continuously. The crusher will have a design capacity of approximately 3,100 tonnes per hour. Discharge from the crusher will be transported by conveyor to the coarse ore stockpile, which will provide a live capacity of approximately one day of operation when full. Magnets shall be strategically placed to remove metal from the feed before it is discharged onto the coarse ore stockpile. A crusher control station will be located adjacent to the crusher. From this location the crusher operator will control the dump rate to the crusher and the feed rate to the coarse ore stockpile.

Reclaim Feeders

Reclaim feeders will be located in a tunnel under the open conical crushed ore stockpile. They will reclaim the material and feed the SAG mill feed conveyor. Each feeder flow rate will be adjustable by means of a variable speed drive that regulates the feed to the mill feed conveyor according to the SAG mill requirement.

2.2.3.3.4 Grinding and Classification

The grinding circuit for the Roşia Montană project will consist of a single SAG mill followed by two ball mills, operating in parallel, as indicated in *Exhibit 2.11 Grinding Circuit.*

Prior to grinding, dry lime will be added to the crushed ore ahead of grinding in order to ensure a protective alkalinity in the milling circuit and to create an appropriate pH in the CIL circuit. The overall grinding circuit will have an average throughput rate of 1,625 t/h new feed.

SAG Mill

Crushed ore from the stockpile will be fed at a constant rate to the SAG mill. The SAG mill will have a nominal rated capacity of 13 Mt/a of new feed and will be driven by a 15MW variable speed wrap around electric drive. The SAG mill grates will be equipped with pebble ports to relieve potential build up of the pebbles in the mill. The SAG mill discharge will be classified with a trommel, from which the undersize will be directed into a cyclone feed pump box. The oversize mill discharge and pebbles will be directed to the pebble crushing plant as described below.

The variable speed SAG mill will be controlled remotely from the central control room. The operator will provide a set point to a controller that will adjust mill power to correspond to any variation in the ore feed as required. Feed into the mill from the conveyor will be mixed with aqueous mill solution, containing cyanide, which has been recovered as overflow from the CIL tailings thickener. Grinding balls will be added as required to the SAG mill to maintain efficient grinding.

The plant will operate 365 days per year, with continuous service of 24 hours per day, seven days per week.

Pebble Crushing Unit

The SAG mill oversize discharge comprising rock pebbles will be conveyed to the pebble crusher. Prior to feeding the crusher a magnet will remove metals, such as remnants of grinding balls, to prevent damage to the crusher. A metal detector will provide protection from non ferrous metals. The pebble crusher reduces the pebbles and the crushed material is returned to the SAG mill feed conveyor. The plant will operate on an as required basis.

Classification of Ball Mill Feed

The SAG mill discharge is screened via a trommel to remove coarse particles that report to the pebble crusher. The trommel undersize flows by gravity to the cyclone feed pump box from where it is then pumped to the two sets of classifying cyclone clusters, which separate the slurry into two streams:

- Cyclone overflow, which is the fine material suitable for processing in the CIL; and,
- Cyclone underflow, which is the coarse material that reports as feed to the ball mills for further grinding.

Ball Mills

Two ball mills will be controlled remotely from the central control room. The ball mills will operate 365 days per year, 24 hours per day, seven days per week. Each ball mill is driven by two fixed speed 10.0 MW wound rotor motors.

The ball mills discharge over trommel screens designed to scalp out remnant balls and unground material. The scalped ball mill discharges into a concrete bunker where it can be removed by front-end-loader.

During operation the ball load in each of the mills will be measured through power draw readings and grinding balls will be added as required.

2.2.3.3.5 Carbon in Leach (CIL) Circuit

The most effective and economic process for the recovery of gold and silver from ores of the type occurring at Roşia Montană is that of whole ore cyanidation. There are numerous examples worldwide of similar ore types that utilise cyanidation to effectively extract the precious metals. This safe and proven technology will be employed at Roșia Montană by employing the carbon-in-leach (CIL) technique. The CIL technique is a common and proven method for effecting cyanidation.

A comprehensive *Cyanide Management Plan* will be developed. Cyanide Management for the project is being developed in accordance with the UNEP-sponsored International Cyanide Management Code.

The *Cyanide Management Plan* will be used as the basis for the development of applicable operational procedures for the Project. This plan will be reviewed by an independent team of internationally recognised experts to ensure that the plan identifies and addresses all possible cyanide related hazards, including transportation, storage, handling, use, and final detoxification.

Cyanide will be delivered in especially designed and constructed bulk containers as a dry solid. The scope of the EIA requires description and assessment of alternative options and will address potential rail/truck routes. The cyanide will be dissolved in the containers with a caustic solution circulating from a mix tank. The mix tank will be designed to hold the entire contents of one bulk transportation container. Once the contents of the container are dissolved, the contents of the mix tank will be transferred to a bulk liquid storage tank.

The flow sheet of the CIL circuit is illustrated on *Exhibit 2.12 Leaching/Adsorption Process Flow Diagram.* The fine crushed ore is delivered as overflow from the cyclones, containing approximately 45% solids by weight. After passing over the trash screens that scalp out trash and mis-reporting particles, the ground ore reports to the CIL feed pump box. The ground ore is then transferred to the CIL feed box, into which cyanide is added along with slaked lime slurry as required for pH adjustment.

The CIL feed slurry is leached in two parallel trains into each of seven agitated tanks. Dilute sodium cyanide solution is added as required to the first four tanks of each train of CIL tanks in order to maintain the required cyanide concentration in the circuit.

The main process for gold/silver extraction is performed in the CIL circuit. The main equations for describing that process are:

Bollander's equation

$$2Au + 4CN^- + O_2 + 2H_2O \Leftrightarrow 2Au(CN)_2^- + H_2O_2 + 2OH^- \qquad (1)$$

Elsener's equation

$$4Au + 8CN^- + O_2 + 2H_2O \Leftrightarrow 4Au(CN)_2^- + 4OH^- \qquad (2)$$

During the reaction the gold forms a gold cyanide complex (equation 1) in alkaline solution. Both equations emphasize the importance of the free cyanide ion and hence the need for a high pH value (greater than 10).

As CN^- is the active ion in the gold complexation process (equations 1 and 2); it is important that the cyanide is stabilized by the maintenance of a sufficiently high pH. This is achieved through the addition of hydrated lime slurry to the CIL feed and as required to CIL tanks. Equations 3, 4 and the equilibrium constant (equation 5) describe the pH dependency of the formation of hydrocyanic acid. At a pH value of about 10, approximately 90% of the cyanide is present as the CN^- ion, with more and more becoming protonated (i.e., bound with hydrogen ions) as the solution pH falls.

$CN^- + H_2O \Leftrightarrow HCN(aq) + OH^-$ (3)

$CN^- + H^+ \Leftrightarrow HCN(aq)$ (4)

$HCN(aq) \Leftrightarrow HCN(g)$ (5)

(aq) = aqueous

(g) = gaseous

The CIL slurry discharge gravity feeds to the carbon safety screens and then flows into the tailings thickener. The carbon safety screens capture any activated carbon that has bypassed the internal carbon retaining screens in the CIL tankage.

This slurry is mixed with flocculants in the feedwell of the thickener to assist in settling of the solids. The thickener provides a method to increase the solids content of the underflow slurry and will generate a relatively clear overflow. Water (overflow) from the thickener will report back to the milling circuit for re-use and recovery of contained cyanide values.

The thickened tailings will then be pumped to a SO_2/air cyanide detoxification circuit where the Weak Acid Dissociable cyanide level (WAD Cyanide) in the thickener underflow will be reduced to levels below applicable EU standards. The treated tailings will then be delivered to the TMF. This process is described in more detail below.

2.2.3.3.6 Acid Wash, Elution and Carbon Regeneration Circuit

Exhibit 2.12 Leaching/Adsorption Process Flow Diagram illustrates the carbon recovery process from the CIL circuit whilst the process of elution of carbon and its reactivation for re-use in the CIL process is illustrated in *Exhibit 2.13 Desorption Process Flow Diagram*.

The CIL tanks are fed with activated carbon particles that adsorb the precious metals leached by the cyanide. Each tank will have internal screens to prevent the activated carbon particles from discharging from the tank with the residue. The apertures in the internal screens are sized such that the slurry can pass through the screen to the next tank; however, the aperture is too fine to allow the passage of the activated carbon. In this way, the carbon can be contained and managed.

Barren carbon is placed in the last CIL tank where it starts to scavenge precious metal values from the leach residue slurry. As the carbon loads with these precious metals it will be periodically pumped counter-current to the leached residue flow to the next upstream tank. The most highly loaded carbon in the first cyanidation tank will be pumped with the residue to one of two loaded carbon recovery screens. The screen underflow residue will be returned to the cyanidation tank from where it originated and the loaded carbon will drop by gravity to one of two acid-wash columns, where it will be washed in a dilute acid solution to remove calcium deposits. This process is described by equation 7.

$Ca(OH)_2 + 2HCl = CaCl_2 + 2H_2O$ (7)

The acid-washed carbon will be neutralised by rinsing with dilute caustic solution, as equation 8.

$HCl + NaOH = NaCl + H_2O$ (8)

and then transferred to one of two parallel elution columns where a hot cyanide-caustic solution [Anglo American Research Laboratory (AARL) process] will be used to strip the precious metals from the carbon.

The stripped carbon from each elution column will be pumped to a dewatering screen. The transfer water will flow by gravity from the dewatering screen to a tank to be reused. The carbon from each dewatering screen will drop by gravity into a surge tank feeding a carbon reactivation kiln. Reactivated carbon will be pumped to a sizing screen to remove fine carbon particles. Coarse-sized carbon will drop by gravity into a holding tank and be returned to the last tank of the cyanidation circuit for recovery of precious metals.

Fine carbon will be collected in a carbon fines tank as a dilute residue and periodically processed through the carbon fines filter. Although elution is done on a batch basis, reactivation will be on a continuous basis. Feed hoppers are used to provide surge between elution and reactivation for continuous operation.

The CIL circuit will operate 365 days per year, 24 hours per day and will be shut down periodically to perform maintenance on major process equipment.

2.2.3.3.7 Gold Recovery

The two elution columns strip the precious metals from the activated carbon producing a pregnant eluate containing the gold and silver in solution. The gold and silver in pregnant solution is then recovered by electro-winning and then washed from the cathodes with the resulting dilute sludge collected in the sludge filter. The flow diagram of the elution process is illustrated on *Exhibit 2.13 Elution/Regeneration Process Flow Diagram.* The flow diagram for electro-winning and gold smelting is illustrated on *Exhibit 2.14 Electro-winning and Smelting Process Flow Diagram.*

The gold sludge may contain a small amount of mercury that will be removed in a mercury retort. Procedures for the safe handling, storage and transport of the mercury will be included in the *Emergency Preparedness and Spill Contingency Plan*. The dried retorted sludge will then be smelted in an induction furnace and cast into ingots. The gold and silver doré will be stored in a secure vault until shipment to precious metal refineries.

Electro-winning Cells

The pregnant eluate will be stored in an eluate tank and pumped to the electro-winning cells in which the gold and silver is plated onto stainless steel cathodes. Carbon elution and electro-winning will operate in batch mode and will be started and stopped one to two times per day depending on the quantities of the metal to be processed.

The gold is deposited at the cathode, as equation 9.

$$Au(CN)_2^- + e^- \rightarrow Au + 2CN^- \qquad (9)$$

Silver is similarly deposited. The electrowinning of gold is accompanied by the cyanide detoxification at the anode, as equations 10 and 11.

$$CN^- + 2OH^- \rightarrow CNO^- + H_2O + 2e^- \qquad (10)$$

$$2CNO^- + 4OH^- \rightarrow CO_2 + N_2 + 2H_2O + 6e^- \qquad (11)$$

The second reaction does not generally occur due to the cyanide hydrolysis as equation 12.

$$CNO^- + 2H_2O \rightarrow NH_4^+ + CO_3^{2-} \qquad (12)$$

Cathode frames will be designed to slide within the tank, allowing systematic removal of loaded cathodes and insertion of fresh cathodes. The bottom of the cell tanks will slope to a drain allowing periodic flushing of gold sludge from the cell bottom.

Gold Sludge Filter

The gold and silver deposited on the cathodes will be removed as a sludge using high-pressure water sprays. The sludge will be filtered and dewatered in a sludge filter press. The sludge filter will operate in batch mode and will be started and stopped one or more times per day.

Mercury Retort

Precious metals sludge from the filter press will then be loaded into charge containers (boats) on mobile carts. The boats will be inserted into the mercury retorts without manual precipitate handling. Mercury will be volatilized and pulled from each retort with a vacuum pump with the gas/vapour directed to flow through a condenser, and carbon column. The carbon tower is filled with sulphur-impregnated carbon to specifically capture any mercury vapours not condensed due to process upsets.

The mercury and sulphur react as equation 13.

$$Hg(v) + S(s) \rightarrow HgS(s) \quad (13)$$

Condensed mercury will be captured in the charge tank and stored. The retorted precious metal sludge is then fluxed and melted in an induction furnace.

Induction Furnace

The furnace will operate on a batch campaign basis in association with emptying and filtering of electro-winning cells and retorting. Doré will be cast into 25 kg ingots in a cascade mould. Anticipated operation is three batches per shift to the furnace, with five to 12 shifts per week. Off-gases from the induction furnaces will be drawn through a scrubber to capture any precious metal or other dusts emitted from the furnace.

2.2.3.3.8 Cyanide Detoxification

The Project will use the Best Available Technique for cyanide detoxification through the employment of the Inco SO_2/air detoxification process on the tailings discharge residue. This is a proven technology that has been adopted in more than 90 mines worldwide. CyPlus GmbH, the key specialist for the Inco SO_2/air process technology, will design the detoxification system. This section describes the proposed cyanide detoxification methods to be employed, based on engineering studies completed prior to submission of this Project Presentation Report.

The chemistry of the cyanide detoxification process is presented in *Section 3.1.3.3 Cyanide Detoxification Process.* The flow sheet of the thickening and cyanide detoxification process is illustrated on *Exhibit 2.15 Thickening & Cyanide Detoxification Process Flow Diagram.*

The CIL tailings thickener underflow, which represents the entire process facility tailings stream will be subject to cyanide detoxification. Thickener overflow containing residual cyanide will be returned to the process circuit as mill solution.

The use of the CIL tailings thickener has an economic benefit as well as technical merit. Recycling thickener overflow enables free cyanide to be available for further leaching, thus reducing overall cyanide consumption. The use of a thickener reduces the cyanide load in the thickened underflow going to the detoxification stage thereby reducing the quantity of cyanide to be detoxified and reagent demands.

WAD cyanide concentrations will be reduced using the SO_2/air process to levels that comply with EU standards, before the treated tailings leave the confines of the process plant. The SO_2/air process is one of the most effective and reliable technologies available for cyanide detoxification associated with gold mining processes. The detoxification of cyanide using the SO_2/air technology will involve a continuous process where cyanide is oxidized using SO_2 and oxygen as oxidizing agents and minor amounts of copper sulphate as a catalyst. SO_2 is supplied in the form of sodium metabisulphite liquor and air is sparged to provide the necessary oxygen. Lime will be added to neutralise the sulphuric acid generated as a reaction product.

There are a number of elements incorporated in the design to ensure safe operation of the system. The pH control system employs duplicated pH probes with error checking to ensure accurate pH control. pH alarms will be able to initiate advisory shut-down procedures for the operations personnel should pH control be lost. An ion selective oxidation-reduction probe will be used in each reactor to evaluate the oxidation potential of the detoxified slurry and ensure no free cyanide remains. This same probe can be used as a control element in the basic automated control system employed. Reagent dosing will be controlled using ratio dosing based on the mass flow of both thickener underflow and the contained cyanide to ensure consistent discharge quality. The operators will routinely monitor the quality of the reactor effluent to confirm the instrumentation outputs and ensure that permit requirements are met. Analytical procedures will provide the operators with quick and accurate cyanide measurements, which will allow for set-point adjustment as required to maintain process control.

2.2.3.3.9 Auxiliary Facilities and Processes

There will be various auxiliary facilities and processes associated with the overall processing operations, as summarised below.

Addition of Lime

Lime will be used in the gold ore processing plant. The ore will be crushed, wet ground, and leached in a series of agitated CIL tanks using a dilute cyanide solution. Dry lime will be added to the SAG mill feed conveyor and slaked lime will be added to the agitated CIL tanks for pH control. Slaked lime is also dosed to the detoxification reactors to maintain pH control if required.

Reagent Storage and Handling

There will be a number of chemicals and reagents required for the project. Each of these chemicals and reagents will be stored on site in varying quantities. The storage and handling areas will be designed and constructed to reduce possible health impacts to the workers and environs. Emergency management/spill contingency plans will be developed and enforced to further reduce the potential impacts to humans and the environment.

The following lists various reagents and chemicals that will be required:

- Sodium cyanide;
- Flocculant;
- Sodium hydroxide;
- Hydrochloric acid;
- Sodium metabisulphite;
- Copper sulphate;
- Smelting fluxes including silica, potassium nitrate, soda ash and borax;
- Lime;
- Activated carbon; and,
- Carbon dioxide.

2.2.3.3.10 Water Circuits

The management of water in the process plant is designed to maximise recycling of process water and to minimise process water effluent beyond the plant boundary with an aim to minimise demand for fresh water. There will be a continuing demand for fresh water for:

- Reagent mixing;
- Gland seal water of process pumps;
- The elution circuit;
- Electro-winning; and,
- Site facilities, especially potable water and for fire fighting.

The grinding circuit will receive a limited stream of fresh water as dust suppression spray on the new ore feed, however the primary supply of water to the SAG mill will be from the mill solution tank. The mill solution tank is supplied with the recycled overflow from the CIL tailings thickener, and therefore contains recycled cyanide from the CIL process. The mill solution tank will also have a make-up supply from the process water circuit to cater for any shortfall in supply.

Additional water supplied to the grinding circuit (cyclone feed pump box and ball mill feed water) will be drawn from the process water tank. The process water tank and the distribution circuit is supplied primarily by water recycled from the decant pond of the TMF. Make-up water to the process water circuit can be sourced from the freshwater circuit if no other sources are available.

Process water will also be supplied to the CIL circuit and to the CIL tailings thickener as flocculant dilution to affect some washing of cyanide from the tailings. The tailings thickener underflow requires controlled dilution prior to entering the cyanide detoxification process and this too is achieved by addition of process water.

ARD water, pit water and site run-off are processed in a wastewater treatment facility. At certain times of the year this treated water will be used as a make-up water source in certain areas of the plant. The treated water will be used as dilution water to the cyanide detoxification facility in place of process water when available or as a make-up to the process water circuit by having it report to the TMF. From here it will be reclaimed and directed to the process water tank along with any other decant liquor. Treated domestic wastewater and all other process site-impacted water reports to the decant ponds of the TMF, from where it enters the process water circuit for recycling, effectively minimising fresh water demands.

2.2.3.3.11 Process Control

A modern computerised control system will be used for the majority of process control, drive control, data collection and start-up and shutdown sequences. Each cyclone overflow stream will be sampled for metallurgical accounting and to provide samples for grind size analysis. An on-line cyanide analyser will sample and analyse cyanide concentrations in the first CIL tank. Data from the control system and other analyses will be automatically transferred to a data recording system.

2.2.3.4 Tailings Management Facility (TMF)

This section describes the proposed tailings management methods based upon engineering studies completed at the time of writing.

The operation of the Roşia Montană Project will generate tailings at a rate of approximately 13 Mt/a for approximately 17 years, producing a total of approximately 218 Mt of treated tailings.

The proposed mining and processing operation will require the construction and operation of a TMF to be located in the Corna Valley and situated immediately to the south of the plant site (*Exhibit 2.16 Tailings Management Facility Initial Dam* and *Exhibit 2.17 Tailings Management Facility Final Dam*). The site for the TMF was selected from several alternatives considering a broad range of technical, social, economic and environmental issues. An optimisation study has been performed to select the optimum dam alignment in the Corna Valley for the purpose of minimising dam fill material while maximising storage capacity and stability in line with best practice applied to the specific site characteristics. The scope of the EIA requires description and analysis of significant alternative options, including alternative sites for the TMF.

The TMF will be designed as a depository for the treated tailings residue. The Corna Valley TMF site provides the required design storage capacity for the life of the mine, plus an additional contingency capacity. In addition it has the advantage of being close to the process plant and open pit sites, thus minimising the project footprint. The following design components will be included in the proposed TMF:

- A rock fill embankment (dam) to retain the treated tailings;
- An impoundment to store treated tailings, upstream of the embankment;
- A treated tailings delivery and water reclaim system;
- Secondary containment and seepage water pumpback system with a pilot scale water treatment system downstream of the embankment;

- Analysis of alternatives in the EIA will address the benefit of water treatment at this point and release to Corna stream or a re-circulation system (impervious dam, pumps, containment pond and monitoring system) to return all collected water to the TMF decant pond;
- Cofferdam and surface water runoff diversion channels;
- A comprehensive geotechnical monitoring system; and,
- Service roads.

The TMF will contain a starter dam and a cofferdam that will be contained within the main rockfill embankment dam. In addition, the TMF will contain a secondary containment dam downstream of the main rockfill embankment dam. All of the dams will be constructed of materials from the following primary sources:

- Dedicated quarries containing rock including breccia, andesite, dacite and rock from the mine pre-stripping activities; and,
- Clay overburden from dam foundation preparation, quarry pre-stripping, and/or borrow areas within the TMF basin.

Exhibit 2.16 and *Exhibit 2.17* present drawings of the initial and final TMF dam. Cross-sectional views are shown in *Exhibit 2.18 Tailings Management Facility Schematic* and *Exhibit 2.19 Tailings Management Facility and Secondary Containment Dam Cross Sections.*

2.2.3.4.1 Design Considerations

The TMF is being rigorously designed to Romanian and international standards to provide a facility for the safe and environmentally acceptable storage of the treated tailings. The design will also take into account closure requirements to be implemented at the end of the mine life. The design concept is illustrated on *Exhibit 2.18 Tailings Management Facility Schematic.*

Foundation Conditions

The Corna Valley contains a floodplain with a width that varies between 50 m and 100 m. It is vegetated with occasional stands of trees and is underlain with colluvial material on the sides of the valley and alluvial material in the centre of the valley due to the stream running through the valley. Based on seventeen boreholes drilled in the area, this alluvial deposit is found to be up to 12 m in depth and consists of a wide range of soil types from silty clay to clean sand and gravel. Several springs are evident on the valley slopes. Site investigation work indicates that both the overburden and underlying Cretaceous sediments are low permeability. The alluvial soils are higher permeability, however they will be excavated and removed as part of the construction of the TMF dams.

The colluvial/residual soils of the valley slopes have a thickness generally in the range of 2 to 7 m. The soils have a matrix of silty clay and clayey silt, but also have a moderate percentage of sand, gravel and cobble size cemented sandstone and shale material. The matrix of the colluvial/residual soils typically is of medium plasticity (plasticity index = 15 to 25) and low hydraulic conductivity (of the order of 10^{-6} cm/sec).

The bedrock across the Corna Valley at the tailings dam site is a sequence of competent and incompetent foliated shale dipping south, towards the left bank, with intercalation of sandstone, breccia and generally fresh, black foliated shale. The interbedding of sandstone layers is generally more prominent below a depth of 50 m. The characterization of the overburden and bedrock material beneath the TMF dam and impoundment indicates that they are generally low permeability materials and thus will provide a high degree of containment.

During detailed engineering and construction of the tailings basin, the actual conditions on the area will be investigated and inspected. It is possible that at some limited locations within the tailings basin, higher permeability materials will need to be excavated and replaced with a moisture conditioned and compacted low permeability clay material.

Tailings Impoundment Capacity

After construction of the starter dam, the main tailings dam will be developed in stages over the operating life of the mine using a modified-centreline and centreline method of construction. The ultimate crest elevation of the main dam will be approximately 840 m above sea level and is designed to provide a maximum capacity of 224 Mt of treated tailings, which incorporates approximately 6 Mt of contingency. Before commencement of ore processing, the initial stage of the TMF embankment (main starter dam) will be constructed to an approximate elevation of 741 m above sea level (78 m above ground surface). This starter dam will provide a maximum water storage capacity of 2,500,000 m^3 for mill plant start-up and tailings storage for the first 15 months of operations. The initial rate of rise of the embankment will be 20 m in the first year, reducing to about 5 m in the final year. The final height of the embankment will be approximately 185 m. The elevation of each stage of the facility is determined as the sum of the design volume required to:

- Store process water and tailings for the maximum normal operation volume of tailings and the average decant pond volume (volume assessed from the predicted monthly water balance);
- Store run-off from the probable maximum flood (PMF) storm event. The PMF volume has been estimated for both a winter and summer event. Both cases were considered to determine the most critical event; and,
- Provide freeboard for wave protection to the tailings volume at each stage during operations. A conservative freeboard criterion is based on the PMF plus 1 metre of wave run-up.

Romanian guidelines dictate that the TMF must store a 1:10,000 year storm event, which corresponds to 227 mm of rainfall/snowmelt within a 24-hour period. This compares with the Probable Maximum Precipitation (PMP) event of 450 mm for a summer event and 440 mm for a winter event with snowmelt. To be conservative, the more stringent PMP event has been selected as the design criteria for the TMF. An emergency spillway for the dam will be constructed in the unlikely event that pumps fail due to malfunction or power interruption at the same time as the PMP event.

Embankment Slope Stability

For static loading conditions the main tailings embankment will be designed with a minimum factor of safety of 1.3 during starter dam construction, 1.5 during subsequent dam raising construction and 1.5 for closure. A factor of safety of 1.3 is used during construction, since no tailings or water are behind the dam. Once tailings are impounded, a factor of safety of 1.5 will be achieved. A minimum factor of 1.1 will be used for consideration of seismic loadings.

Seismic Design Criteria

Although the Roşia Montană mine is located in an area of very low seismic activity, the TMF design incorporates seismic design parameters that include the following:

- Operating Basis Earthquake (OBE) taken as the 1 in 475 year return period event corresponding to a maximum bedrock acceleration of 0.082 g for a magnitude 8.0 earthquake; and;
- Maximum Design Earthquake (MDE) taken as equal to the Maximum Credible Earthquake (MCE) with a maximum bedrock acceleration of 0.14g, and an earthquake magnitude of 8.0.

These seismic design parameters meet or exceed Romanian and European standards for tailings facility design.

2.2.3.4.2 Initial Starter Dam Cross-section

The initial starter dam cross-section, as shown in *Exhibit 2.19*, is typical of the majority of zoned earth water dams used throughout the world. This type of dam cross section is being used because of the volume of process water that needs to be stored during start-up operations. The starter dam will be made up of six separate zones of different material types, which are as follows:

- Zone 1 - This zone is the low permeability core of the dam, which will minimise seepage through the embankment. In addition, this material will be placed over the upstream face of the cofferdam up to elevation 690 m. The material will be obtained from excavated clay overburden at the dam site, access roads, or from waste material within the mine pre-strip area and open pit. Zone 1 material will be placed in suitable horizontal lifts compacted at the appropriate moisture content and density to minimise permeability;
- Zone 2 - This material will be placed as a filter downstream of the low permeability core and above and below the blanket drain over the downstream footprint of the embankment;
- Zone 3 - This material will be installed upstream of Zone 1 in the upstream half of the embankment. In addition, it will be placed downstream and on top of the Zone 2 material in the downstream half of the embankment. This material will act as a transition/filter layer between the Zone 2 and Zone 4 materials. It will be produced from crushed rock obtained either from the open pits or from an off-site quarry;
- Zone 4 - This zone will comprise the majority of the downstream portions of the embankment and a limited portion of the upstream slope. The material will be made up of durable dacite run-of-mine waste rock or run-of-mine quarry rock;
- Zone 4B – This zone will comprise the majority of the upstream portions of the embankment. Since this zone of the embankment is not critical for stability, it will consist of substandard dacite or mixed breccia mine rock or quarry rock; and,
- Zone 5 - This zone will be installed as a coarse blanket drain over the downstream half of the embankment footprint. This coarse blanket drain will be sandwiched in between Zone 2 material, which acts as a drain material and filter layer for the coarse Zone 5 drain. This material will be manufactured by crushing andesite or sandstone rock from the identified quarries.

Preparation of the starter dam footprint will involve removing trees, vegetation, other organic material and topsoil; excavating a cut-off trench into relatively solid weathered rock; and covering the surface of the weathered rock at the base of the cut-off trench with a concrete mat. Topsoil will be stockpiled and retained for mine reclamation activities. The rock beneath the cut-off trench will be grouted to a depth sufficient to ensure a positive seal between the bedrock and the core zone. On completion of the grouting, the cut-off trench will be backfilled with dam core material.

The next step will entail construction of the various zones previously described. These zones will be brought up simultaneously to their final elevation. The final elevation of the starter dam crest will be 741 m.

2.2.3.4.3 Tailings Dam (Main Embankment)

The main TMF dam will be a zoned rockfill dam. The following describes the proposed design concept for the dam. During detailed design, development improvements to the design may be performed to optimise safety and operation.

The TMF dam will be constructed in stages with the starter dam being the first stage. As noted previously, the central low permeability zone will act as a water retention structure for the initial construction of the starter dam. Subsequently, the dam will be raised based on storage requirements, while at all times respecting the pervious dam concept to ensure dam safety and minimise environmental risk. The dam downstream slope will be designed with benched slopes approximately every 40 metres to permit access, and to provide erosion control. The extension of the tailings dam will consist of constructing two downstream raises above the starter dam and then raising the dam solely with centreline raises. The downstream construction method will be utilised to construct the initial two raises for the TMF embankment. This method provides for increased dam safety during early operating years, as the beach development along the embankment to support centreline construction will not be well established due to the rapid raise rate requirements. For both the downstream raise and the centreline raise, the material will consist of the following:

- Zone 2 – This zone will be extended vertically near the dam centreline and be extended horizontally over the downstream dam footprint;
- Zone 3 or 3A(1) –This zone will also be extended vertically near the dam centreline and horizontally over the downstream footprint. At the centreline of the dam, the Zone 3A material will be placed upstream of the Zone 2 material to act as a transition layer between the tailings and Zone 2 material, and downstream of the Zone 2 material to act as a transition layer between the Zone 2 material and the dam shell;
- Zone 4A(1) - The majority of the dam fill material placed during construction of the ultimate embankment will be Zone 4A material. This material will form the majority of the downstream half of the embankment; and,
- Zone 5 – This material will be extended horizontally over the entire downstream portion of the embankment and daylight at the downstream toe.

Note 1: the "A" designation indicates that the material may be acid-generating.

Similar materials and construction installation methods will be used for the main embankment as those described previously for the starter dam.

The main embankment will be constructed in a series of raises over the course of the mine life. *Exhibits 2.18* and *2.19* show the cross-section of the embankment.

2.2.3.4.4 Secondary Containment System

Minor seepage through the main dam is expected, is normal for any dam, and is a design feature that contributes to progressive dewatering of tailings within and behind the dam structure, which results in increases in stability with time. Seepage through the dam will be collected directly in the secondary containment system (SCS), located at the final downstream toe of the embankment *(Exhibit 2.19)*. For design purposes, seepage is estimated at approximately 9 m^3/hr to 45 m^3/hr for the starter dam and final tailings dam, respectively. The SCS will consist of a 10 to 15 m deep sump excavated into weathered rock in conjunction with a zoned rockfill dam and pumping system to pump water over the TMF embankment and back into the tailings impoundment.

The secondary containment dam will be approximately 10 m high and will be a zoned rockfill dam, similar to the starter dam. However, for the secondary containment dam:

- Dam materials will be selected to minimise their chance of leaching metals that could contaminate any seepage/climatic water; and,
- The base of the cut-off will have a cut-off trench to prevent the escape of collected seepage water from the sump.

The materials that will be used to construct the secondary containment system will consist of:

- Zone 1 - This zone is the low permeability core of the dam that will minimise seepage through the embankment. The material will be obtained from excavated clay overburden at the plant site, along access roads, or in the embankment footprint or impoundment. Zone 1 material will be placed in suitable horizontal lifts and compacted to 95% of the Standard Proctor at the appropriate moisture content;
- Zone 2 - This material will be placed both upstream and downstream of the clay core. In addition, Zone 2 material will be placed as a blanket over the downstream half of the embankment;

- Zone 4 –This material will make up the bulk of the upstream and downstream portion of the embankment. The material will be made up of durable dacite run-of-mine waste rock; and,
- Zone 5 – This zone will be installed as a coarse blanket drain over this downstream half of the embankment footprint. This material will be manufactured by crushing andesite or sandstone rock.

The material types and methods used for construction of the SCS are virtually identical to those of the tailings embankment. The biggest difference between the materials is that the material used to construct the SCS will be chemically inert, and non-acid generating.

The seismic design inputs used for the SCS are identical to those used for the TMF. For static loading conditions, the main tailings embankment will be designed with a minimum factor of 1.5. A minimum factor of 1.1 will be used for consideration of seismic loading.

Additional components of the Secondary Containment System will include the option to route water through a treatment system, and a groundwater monitoring system that can be modified for groundwater recovery. The treatment system would initially be a pilot system based on passive or semi-passive technologies. After development and testing, this system may become a permanent component of the Secondary Containment System. However, with both the pilot and final treatment system, the ability to pump water back to the TMF will be maintained when the facility is operational. The groundwater monitoring system will include an alignment of wells across the valley. These wells will be constructed so they can be converted into secondary recovery wells if TMF contaminants are detected in the groundwater. Recovered water from these wells would be pumped to the secondary containment sumps, where it would be subsequently pumped to the TMF reclaim pond.

2.2.3.4.5 TMF Diversion Works

In order to minimise the volume of water entering the TMF, diversion channels will be constructed to collect and route clean runoff water before it drains to the TMF and discharge it downstream of the SCS (*Exhibits 2.4, 2.5, 2.6 and 2.7*). The left bank Corna Diversion Channel will be constructed on the south hillside of the TMF to collect and route surface water to the downstream toe of the SCS. A similar channel will be constructed on the northern hillside above the final level of the TMF. Both channels are sized to pass the 24-hour, 25-year storm event. Additional diversion channels may be employed for the management of surface runoff.

2.2.3.4.6 Instrumentation and Monitoring

Both the tailings dam and the secondary containment dam will be instrumented. The different types of instruments that are currently planned include the following:

- Vibrating wire piezometer;
- Hydraulic piezometer;
- Slope indicators (inclinometers);
- Deformation monitoring stations;
- Piezometer nests for groundwater monitoring; and,
- A V-notch weir for flow measurements.

A total of six vibrating wire piezometers are planned for installation in each of the three elevation locations within the central core of the starter dam section. In addition, two vibrating wire piezometers are planned at two elevations within the foundation, immediately downstream of the central grout curtain. Two vibrating wire piezometers are proposed at two locations in the downstream shell to determine if there is an unexpected rise in the line of saturation for this area. These piezometers will monitor the under-drainage system.

Nine hydraulic piezometers will be installed in the upstream tailings beach. The piezometers will tentatively be located about 200 m apart from each other across the valley. Five piezometers will be located 100 m upstream of the dam centreline and three piezometers will be located 200 m further out on the beach with one planned closer to the right abutment. The hydraulic piezometers will be installed from the beach and will be raised in advance of the tailings beach. The purpose of the piezometers is to determine the line of saturation in the tailings and to determine the rate of water level drop after spigotting of tailings is moved to another area.

Two temporary slope indicators are planned for installation on the downstream slope of the starter dam and on a lower berm of the final dam. The purpose of the slope indicators is to check for possible downstream shear deformation at shallow depth in the bedrock.

A permanent nest of piezometers will be provided on each ridge of the Corna Valley, upstream of the tailings dam, for monitoring groundwater levels and quality. An existing nest on the left ridge will be used for this purpose and a new nest will be installed on the right ridge.

A V-notch weir will be provided in the valley channel just upstream of the sump. During sustained dry periods, the flow at this weir should be indicative of the seepage rate through and under the tailings dam.

Two sets of vibrating wire piezometers will be located in the secondary containment dam, both upstream and downstream of the grout curtain. These piezometers will assess the hydraulic containment of the secondary containment dam. Survey deformation stations will be established on the dam to monitor any potential movements.

Downstream of the dam, it is planned to monitor groundwater levels and quality from the existing piezometer nest.

2.2.3.4.7 TMF Operations

At all times, there will be adequate storage in the TMF to contain the runoff from a PMP event. During snow melt and after storm events, water in excess of process requirements will be stored in the TMF for later use in the process or treatment in the lagoon system and discharge in the Corna Valley. The construction schedule for embankment and impoundment stage construction will be monitored and revised, as required, to ensure PMP storage requirements are available.

For normal operations water will be recycled from the TMF to the mill via a floating pump barge located at the northeast end of the impoundment. The barge will pump water to the process water tank located at the plant site, from where the recycled water will be used in the milling process.

Tailings will be treated to reduce WAD cyanide concentrations to comply with EU standards and the International Cyanide Management Code prior to discharge to the TMF. The treated tailings will be delivered from the mill via a pipeline to various points on the impoundment perimeter. A distribution mainline pipe will be located along the northwestern edge of the impoundment and across the embankment. The discharge points for the treated tailings will be managed to keep the tailings supernatant pond centred around the reclaim barge and, to the maximum extent possible, to keep the pond away from the embankment.

A technical seminar for Romanian experts was held in Bucharest in November 2002, and in Albă Iulia in January 2003, to review the design, construction, and operation aspects of the TMF.

2.2.3.4.8 Emergency Response

It is good practice and a regulatory requirement to prepare an emergency response plan in the unlikely event of a dam failure. A major-accident response plan will be detailed as part of the operational *Emergency Preparedness and Spill Contingency Plan*, based upon Romanian and international protocols.

Consultation on the proposed *Emergency Preparedness and Spill Contingency Plan* will take place with populations residing near the TMF and the relevant emergency response services of the Government of Romania. Once finalised, a separate, independent team of experts will review the plan to ensure the design has identified and mitigated potential hazards. The *Emergency Preparedness and Spill Contingency Plan* will be released for further public review and input.

A comprehensive *Tailings Facility Management Plan* will also be developed during the EIA process. It will then be reviewed by an independent team of internationally recognised experts, to ensure that the plan identifies and addresses potential issues related to the design, construction and operation, reclamation and final closure of these facilities.

2.2.3.5 Mine Infrastructure

2.2.3.5.1 Roads/Transport

Access to the site via the national road system is shown in *Exhibit 2.20 Major Transport Routes*. Only minor road building is required to link the plant site to the national road system, which is reasonably well developed and in good condition. The access roads are suitable for servicing the Project, providing access from the major commercial and residential areas in the region.

The proposed new access roads comprise access to the plant area along the Roşia Valley and a new access road to Roşia Poieni following a route to the north of the Roşia Valley. The plant access road will commence in Gura Rosei and climb to the east to follow the track-bed of the existing Rosiamin rail track on the southern side of the Roşia Valley and then will turn to the south to climb to plant site; this represents new road construction of 3.4 km. Two alternatives are being considered for the access road to Roşia Poieni, one is at the north end of the site and is on the north flank of the Roşia Valley. This is generally referred to as the 'Northern bypass' road and is shown in *Exhibit 2.3*. This alternative will start from the Roşia Valley road, also near Balmoşeşti, and will climb gently northeastwards across the northern valley slopes of the Roşia Valley, to join an existing access road to Roşia Poieni, a total of 5.9 km of new construction. The second alternative is referred to as the 'Southern bypass' road and is located at the southern end of the site. The road starts in the Bucium Valley and climbs to the ridgeline on the southern end of the Corna Valley where it connects up to the existing road to Roşia Poieni. This alternative will require approximately 6.6 km of road construction.

The scope of the EIA for evaluation of significant project alternative will require more detailed evaluation in the EIA process to select the preferred route.

The development proposal anticipates that the by-pass access road to Roşia Poieni will be paved along its length and the plant access route will be gravel surfaced for the greater part of its length.

Internal roads include:

- Process plant site roads;
- Service roads to the tailings pipeline, explosives storage area, water supply line and overhead power line; and,
- Haul roads to transport ore and waste rock from the open pits (Cetate, Cîrnic, Jig and Orlea) to the processing plant and Cetate and Cîrnic Waste Rock Disposal Sites.

Internal mine roads will be routinely augmented with aggregate material and graded, as part of road maintenance and operation activities.

Vehicles and support equipment required for the project include the following:

- Forklifts;
- Skid steer loader;
- Articulated dump truck;

- Ambulance;
- Pick-up trucks;
- Mini buses;
- Bus;
- Fire truck;
- Rough terrain crane;
- Telescopic loader;
- Backhoe loader;
- Integrated tool handler;
- Articulated boom work platform; and,
- Water trucks.

2.2.3.5.2 Electricity Power Line and Transformer Station

An existing 110 kV overhead power line from Zlatna to Roşia Poieni operated by S.C. Electrica S.A. bisects the project site, running from the south to the north. This line has the capacity to meet the existing demand in the region plus the anticipated Project needs. The existing line will be relocated around the western side of the Project site (to avoid crossing mine haul roads and mine waste rock disposal sites) and a new spur line will connect to the primary substation building at the plant site (see *Exhibits 2.4 – 2.7*)**.** Electrical power at the plant site will be based on a primary 20 kV voltage. Electric power will be distributed around the site at 20 kV (standard Romanian voltage), mostly via overhead lines, but with buried cables when appropriate.

Stand-by power generation will be provided locally for emergency operations of critical systems.

2.2.3.5.3 Plant Site – Offices, Mill and Ancillary Buildings / Facilities

Based on the current results of Basic Engineering, the following buildings/facilities and plant infrastructure will be constructed as an integral part of the mine development (*Exhibit 2.8)*:

- Administration building and parking area;
  - Office space (for plant, administration, and mine management personnel) equipped with data network and telephone connections;
  - Meeting and training facilities; and,
  - First aid room.
- Mine workers' changing facilities (mine dry);
- Metallurgical laboratory and office facilities;
- Warehouse facilities with modern inventory control and management features;
- Fuel and lubricant storage tanks and fuel station area; the plant site fuel storage facility will include one above-ground storage tank (~ 800,000 litres) for diesel fuel and one above ground storage tank (~ 20,000 litres) for gasoline surrounded by a containment berm with capacity to hold 110 % of the volume of the largest tank;
- Truck wash: a fully equipped vehicle wash down facility with oil separator;
- Plant maintenance facility;
- Explosives magazine;
- Electrical sub-station buildings;

- Gate house; and,
- Weighbridge.

2.2.3.5.4 Communication and Information Technology

A fibre optic link will be extended from the current termination at Gura Rosiei up to the plant site to become the primary method of communication for the Roșia Montană Project.

Hardware and wiring will be provided for a local area network connecting all workstations throughout the Roşia Montană site with up-to-date technologies. Business systems, including mine planning, maintenance, inventory control, and accounting will be provided. A telephone system will provide for on site voice communication along with radios and cell phones. A public address system will be provided with call points strategically located throughout plant areas, the workshop, and warehouse.

Either a programmable logic controller (PLC) or a distributed control system (DCS) automated control system will be installed in the process plant to control primary and auxiliary processes from a central location.

2.2.3.5.5 Security

Access to the mine and plant areas will be restricted. The process plant area will be securely fenced with a manned gatehouse at the main entrance. Security staff will be provided on a continuous basis for overall site security as well as to provide protection during gold pours. Doré will be stored in a permanently secured and guarded vault until shipped off site.

The pump stations for the Cetate Mine and Waste Drainage Pond and the Secondary Containment Dam will be securely fenced and locked and will be subject to daily inspection.

All vehicular and footpath access routes which approach or give access to areas permitted for mining and site activity under the planning consents will be equipped with locked barriers and will be adequately signed with warnings to alert potential trespassers of physical dangers within the operations site and of site security for the protection of site equipment and machinery. Regular security patrols will take place during each working shift throughout the operations sites, including inspection of the integrity of all barriers to access and continued visibility of adequate warning signs.

2.2.3.5.6 Fire Protection

The fire prevention system will consist of sprinkler systems, detection devices, manually operated local alarm points, and alarm bells located in strategic locations. A central alarm panel will be located in the process plant control room, (which will be manned 24 hours per day).

Sprinkler systems will be provided in the following areas:

- Electrical substations;
- Refinery areas;
- Compressor rooms;
- Control rooms;
- Storage areas, warehouses and maintenance shops;
- Laboratories;
- Offices and washrooms;
- Dry complex;
- Reagent mixing areas;
- Hydraulic lubrication units; and,
- Reclaim tunnel and conveyors.

Firewater will be drawn from the fresh water tank. The Project area will be serviced with a fire main and hydrants. In addition, fire hose cabinets will be located so that all interior areas of buildings are within reach of a fire hose stream. Portable hand-held fire extinguishers will be provided throughout these areas and near exits.

2.2.3.5.7 Off Site Facilities

It is anticipated that the majority of Romanian employees will live in nearby existing communities and will not require housing, only transport to and from the mine at shift change. Housing for certain senior operations personnel is likely to be needed. The need to support the upgrading of medical facilities in Abrud is under discussion with the council and will support the additional needs of the company.

2.2.3.6 Water Management

2.2.3.6.1 Introduction

Water management is a key component of the Project, which, if properly implemented, will allow the mine site to operate efficiently while minimising the environmental impacts to water resources. The management of water for the Project considers the natural hydrology, as well as the influences of past human activity. The Project is located within a region that is subjected to substantial seasonal variation in precipitation and run-off. In addition, the hydrologic balance is positive, meaning that more water falls on the site than will evaporate. The Project is also located within a region where mining has been carried out over some 2,000 years resulting in modifications to the natural hydrology and hydrogeology, and significant contamination of watercourses in the Project area.

Three fundamental water management strategies will serve to reduce potential impacts associated with mine operations:

- Drainage control that will capture contaminated water associated within the Project area and divert water not significantly impacted by mining activities (Project Drainage Control);
- Reuse and recycling of treated and untreated site water to reduce the need for fresh water and the need to discharge treated water (Project Water Processing); and,
- Continual maintenance of the site water balance to help ensure that sufficient water is available for project process use while preventing an excessive build-up of water in the storage facilities (Project Water Balance).
- The Project water management is illustrated in a schematic flow balance for site-wide water management presented as *Exhibit 2.21.*

2.2.3.6.2 Project Drainage Control

The proposed Project has the following site drainage objectives:

- To the extent practicable, divert run-off water not significantly impacted by mining activities away from areas where it may co-mingle with mining-impacted water and reduce the available water storage volume in site water control facilities;
- To protect structures, stockpiles and active areas (e.g., plant yard, offices, pits, etc.) from flood flows; and,
- To intercept and store contaminated run-off water for recycling within the mine process or for treatment for discharge into downstream surface water, of equal or better quality than set by regulatory consents.

Wherever practicable, diversion ditches will be constructed to minimise the volume of surface water entering the site and the water containment systems. These diversion ditches will be intended to convey water that is not significantly impacted by historical or proposed mining activities. The ditches will reduce the volume of clean water mixing with water requiring treatment, thus reducing the wastewater storage and treatment requirements. In addition, the diversion ditch water will help maintain the biological base flows in the creeks downstream of the Project.

Another function of the diversion ditches is to reduce the potential flooding of site facilities. The Project is located within hilly terrain and the proposed ditches around the pits, stockpiles, plant, and waste disposal areas will provide control of surface runoff except under extreme events. For the plant site, surface runoff will be directed to the plant storm water pond that will also act as a secondary containment system for the plant facilities.

The TMF is designed for total containment under all expected operational conditions. There is sufficient storage for extreme precipitation events in the TMF (i.e., Probable Maximum Precipitation event), and throughout most of its operational life there is enough available storage for multiple extreme events. Other water storage facilities are designed to store appropriate volumes of water under normal storm conditions with spillways designed to prevent facility failure under extreme events.

The TMF forms the largest containment and drainage control structure on site. Water draining from much of the impoundment catchments will be collected and contained in the tailings decant pond. This will provide the major source of water for ore processing. Diversion channels in the upper portion of the basin will be constructed to collect and route un-impacted runoff water around the TMF as indicated in *Section 2.2.3.4.*

Other smaller water management impoundments will be constructed to manage site water. These include the following:

- Cetate Waste Rock and Mine Drainage Pond Dam (353,399E, 535,669N, *Exhibits 2.4 – 2.7*): The Cetate Dam will collect and impound acid rock drainage from the current site features, as well as possible new acid rock drainage runoff and seepage water from the Roşia Montană stream catchments. Much of the water collected by the impoundment will be drainage from historic underground mine workings via the 714 adit. During the later portions of the mine life when the bases of the pits are below the elevation of the 714 adit, the storage capacity will be used to store water pumped from the mine pits.
- The water impounded behind the Cetate Dam will be pumped to the wastewater treatment plant. A possible addition to this system may include installation of a valved plug in the 714 adit. This plug would allow for controlled release of water in the underground mine workings, or to prevent water impounded behind the Cetate Dam from backing up into the open-pits when these are developed below the 714-adit level.
- Roşia Montană Diversion Channel and Diversion Channel Dike (354,000E, 535,620N; *Exhibits 2.4 – 2.7*): Diversion works will be constructed to direct water, unimpacted by the project, around the Cetate Waste Rock and Mine Drainage Pond to downstream of the Project area. These diversion works will divert the Roşia Montană Stream and unaffected runoff water from the north slope of the Roşia Valley to downstream of the Cetate dam.
- The Cîrnic Waste Rock Drainage Pond (356,040E, 534,081N; *Exhibits 2.4 - 2.7*) will be constructed upstream of the tailings impoundment, immediately downstream from the Cîrnic Waste Rock Disposal Site. The facility will be designed to collect possibly acidic runoff from the waste rock and pump it to the wastewater treatment plant. This will prevent the water from mixing with the tailings pond water and impacting the reclaim water required for processing. This dam will be constructed at the onset of impacted drainage from the disposal site. Runoff collection ditches will be constructed on the downstream side of the waste rock disposal site to collect seepage and runoff and route it into the drainage pond. Diversion ditches will be constructed on the upstream side of the Cîrnic Waste Rock to divert water that has not contacted the waste rock around the facility. A spillway will be constructed in the containment pond embankment that will control the discharges from large storm events that will flow into the TMF Reclaim Pond.

2.2.3.6.3 Project Water Processing

Water treatment will be required at the site in order to reuse and discharge site-impacted water to the environment. In addition, a substantial portion of the water treatment capacity will be used to treat water impacted by the previous mining activities. Treatment will be required for the existing and new sources of ARD and to treat residual cyanide concentrations from the ore processing. These sources and the associated treatment technologies are key components of water management at the site and are described here. The sources and outflows from the wastewater treatment process are illustrated as *Exhibit 2.22.*

ARD Sources

A wastewater treatment plant will be constructed to treat acidic drainage associated with previous and future mining activities. The treatment plant is being designed to treat ARD runoff water from the previous mining operations within the Project area, the future mine pits, site run-off, and drainage from the proposed Cetate and Cîrnic Waste Rock Disposal Sites. The potential ARD runoff will be collected in two catchment ponds, the Cetate Pond and the Cîrnic Waste Rock Drainage Pond. It will then be pumped to the wastewater plant for treatment. Treated water, following a lime neutralisation/precipitation process, will be reclaimed for use in the mill or other uses as needed.

At present, ARD issues from old mines working in the Roşia Montană area, including old mine adits and dumps, and the mine pit associated with the current operation. This water is characterised by low pH, and concentrations of heavy metals (copper, iron, manganese, nickel, and zinc) and sulphate higher than that normally observed in the environment. This is due to the oxidation of sulphur bearing minerals primarily in the ore resource, but also to a lesser extent present in the host rock. This oxidation of the sulphur (sulphide) minerals and subsequent chemical reactions produce the ARD.

Based on laboratory Acid Base Accounting (ABA) and kinetic tests, quality of the composite runoff and seepage from the planned new waste rock disposal sites is expected to be neutral and low in dissolved metals, during the initial years of operation. However, localised areas or periods of time may occur where new waste rock will produce ARD. Runoff and seepage from the low-grade ore stockpile is expected to generate ARD. In addition, runoff from the existing waste rock piles and drainage from the 714 adit will result in ARD. Therefore, water collected from all the waste rock disposal sites and mine drainage will be collected and routinely monitored and pumped to the wastewater treatment plant. The water collected in the Cîrnic Waste Rock Drainage Pond can be released to the TMF for reuse in the ore process if the water quality is suitable without treatment. Any water discharged from these facilities to the environment will be compliant or of better quality than with applicable discharge criteria and requirements. The treatment and monitoring process has been designed to help ensure that any water leaving the site perimeter will meet discharge requirements.

Process Summary

The wastewater plant will be designed specifically to reduce dissolved metal concentrations and to meet quality parameters to permit the following uses of the treated water:

- As a contributing supply to process plant water; and,
- For discharge to the Corna and/or Roşia streams to support adequate flow levels for biological needs.

Discharge of treated water directly to the environment in the Corna and/or Roşia valleys will meet standards established in accordance with Romanian legislation and specified as part of the project water management and environmental endorsements.

The plant will comprise an ARD treatment process using the lime neutralisation/precipitation method, which includes the following unit operations:

- Air oxidation;
- Lime neutralisation/precipitation and pH control;

- pH adjustment with carbon dioxide (CO_2);
- Flocculation with solids recycle; and,
- Solids / liquid separation by settling in a clarifier.

Slaked lime will be added to the feed solution of a continuously stirred tank reactor to raise the pH to about 7.2. In addition, air will be added to the reactor tank to oxidize ferrous iron to ferric iron, which will then precipitate as ferric hydroxide. Flow from the neutralisation reactor will cascade to a second reactor tank of equal size to the first tank, referred to as the oxidation/precipitation tank. Lime slurry will be added to raise the pH to about 11 and air will be added to continue the oxidation process and to purge free carbon dioxide from solution. At elevated pH levels and oxidizing conditions, iron and other heavy metals such as copper, manganese, nickel, and zinc, will precipitate as hydroxides. Calcium ions disassociated from the lime will combine with sulphate ions to form aqueous calcium sulphate, and the quantity that exceeds the solubility level will precipitate as solid calcium sulphate. Suspended solids in the oxidation/precipitation reactor tank, therefore, will consist of metal hydroxides, calcium sulphate minerals (e.g., gypsum), and some unreacted lime.

Following the neutralisation and oxidation/precipitation steps, the solution will be discharged by gravity to the clarifier for solids - liquid separation. A flocculant will be added to the clarifier feed tank to aid the settling characteristics of the solids in the clarifier. Clarifier underflow solids will be recirculated to the neutralisation reactor to catalyse the precipitation of calcium sulphate, minimise scaling, and improve the quality of the precipitate which will be pumped as a slurry to the tailings pump box where it will be pumped to the TMF with the tailings. The pH of the water discharged from the treatment plant will be adjusted to a near-neutral pH. A more detailed description of the process technology and chemistry for treatment of ARD is presented in *Section 3.1.3.2.*

Water quality data collected from the Roşia Montană site indicate that, in addition to existing elevated levels of metals, drainage from the existing mine area and historic waste dumps contains elevated levels of sulphate ions. In addition, testing of waste rock from future mining areas indicated that a portion of the water discharge from future waste rock areas would have elevated sulphate levels but neutral pH and generally low metals concentration of similar character to neutralised ARD. RMGC will continue to monitor sulphate concentrations.

The capacity of the wastewater treatment plant has been selected on the basis of site water balance modelling, in which a primary constraint is the requirement of the wastewater treatment plant to control and maintain the levels of impounded acid and mine impacted waters in the Cetate and Cîrnic ponds. The plant capacity of 400 m^3/hr has been designed for the first seven years of site operation with the option for upgrading for additional capacity, if needed in the future.

<u>Releases from the Wastewater Treatment Plant</u>

When the wastewater plant is operating, discharges from the plant will be used primarily for dust suppression and in the process plant for dilution in the cyanide detoxification process. Clarification underflow residue from the ARD treatment process will report to the Tailings Tank for placement with the tailings in the TMF. Some discharge water may be used to maintain biological baseflows in the Roşia Valley Creek and excess quantities of treated water, that are in compliance with water quality requirements, will be discharged to the Roşia Valley stream.

<u>Process Water Management</u>

A schematic flow diagram of water management in the process plant operations is presented as *Exhibit 2.21*.

The proposed Roşia Montană processing plant will require a constant and reliable water supply. Processing and delivery of the tailings to the TMF will require approximately 1 tonne of water per tonne of ore. Approximately half of the water will report to the reclaim pond where it will be recycled back to the plant. It should be noted that the requirement per tonne of ore processed could be expected to vary in practice due to the variation in the hardness of ore, the moisture content, and ore mineralogy through the course of operations. However, in practise the withdrawal of water from the

TMF will be governed by actual rainfall amounts within the catchment basin of the TMF. In addition, there is a need to help ensure that there is never less than a minimum acceptable volume in the decant pond to ensure that there is sufficient water to float the pump barge and keep the pump intakes clear of sediment. There is also the need to ensure that the maximum volume of the decant pond is never surpassed.

The milling process will require relatively small amounts of both fresh water and treated water from the wastewater treatment plant. The fresh water demand is largely determined by a consistent requirement for reagent mixing, which is proportional to tonnage throughput, plus a variable requirement for make-up water to the process. The supply of water to the process from the wastewater treatment plant is anticipated to be variable, being dependent on variable inflow of impacted and acid waters, reflecting precipitation and storm events, demands to maintain an ecologically acceptable base flow of treated water in the Roşia and Corna Valleys and the requirements of the process plant with respect to the availability of water from other sources.

The water supply to the process plant, expressed as average flow rate over the life of the project, may be summarised as follows in *Table 2.6 Water Supply to the Process Plant*.

Table 2.6 Water Supply to the Process Plant

Origin	Average m^3/hr (estimated over life of project)
Recycled water from the TMF	1,270
Outflow from the wastewater treatment plant to the process	130
Fresh water supply to the process plant	224

The total water requirement for the operations area has been estimated based on the annual tonnage of the mined ore. The plant will operate 24 hours per day, seven days per week.

<u>Water Management in the TMF</u>

Within the TMF, management of tailings discharge will create and maintain a decant pond at the northern (upstream) end of the tailings impoundment area. The TMF will receive water inflows from the following sources:

- Supernatant water released from the discharged tailings;
- Precipitation on the decant pond, tailings beach and undisturbed peripheral areas;
- Pump back from the Secondary Containment System;
- Discharge and residue from the wastewater treatment plant;
- Discharge from the domestic wastewater treatment plant; and,
- Any seepage or direct storm-event overflow from the Cîrnic Waste Rock Drainage Pond and related diversion channels, including unimpacted water.

The reclaim water from the decant pond is an important component to meet the demand for process water. After the water recycled within the process system (internal plant recycling from the CIL thickener overflow returned via the Mill Solution Tank to the grinding circuit), the TMF reclaim water is the next largest source of process water. Through the life of the project, the TMF reclaim system will supply approximately 90% of all external water supply to the process plant. The balance will come from precipitation, the wastewater treatment plant, and fresh water supply.

Water will be reclaimed from the TMF by vertical turbine pumps mounted on a barge located on the TMF decant pond. Reclaim water will be pumped through a combination steel (with liner) and HDPE pipeline to the Process Water Tank, located within the processing plant. The estimated initial pipeline length will be 5.1 km. The pipeline length will gradually reduce as the tailings impoundment fills and the decant pond moves closer to the plant.

TMF Secondary Containment System

Maximum seepage through the TMF dam is anticipated as approximately 9 m^3/hr (2.5 l/s) at the beginning of operations, increasing to approximately 45 m^3/hr (12.5 l/s) when the TMF reaches its final height. The seepage will be captured within the Secondary Containment System and pumped back to the TMF decant pond, or treated and discharged. The collected seepage will be contained in a sump that will be maintained at a level lower than the natural ground level. The pumping station will pump through a 1.2 km long pumping main to the TMF decant pond. This configuration is designed to result in a reverse groundwater flow from the surrounding area (i.e., the groundwater will seep to the sump at a rate estimated as 0.2 – 0.5 m^3/hr).

Moderate storm events will be contained behind the small dam constructed for this Secondary Containment System. Modelling has been used to evaluate exceptional conditions when, due to heavy precipitation, inflow may exceed the pumping capacity of the Secondary Containment System and the pond level may temporarily rise. Under such exceptional circumstances, seepage out of the Secondary Containment System may increase for a short period of time. In addition, under extreme event a storm water release from the system will be required through a designed spillway. The spillway will be designed to control the discharges from a 1,000-year, 24-hour rainfall event. In both cases of increased seepage or a release associated with a storm event, the event will be short-term and mixing with unimpacted waters will result in a significant reduction in concentrations of any potential contaminants.

Additional components of the Secondary Containment System, which will include the option to route water through a treatment system, and a groundwater monitoring system that can be modified for groundwater recovery, are summarised in Section 2.2.3.4.4.

Fresh Water Supply

Fresh water is required for supply of potable water for domestic and sanitary use, fire protection and reagent mixing and, on rare occasions when process water supply from the TMF decant pond may be insufficient, for make-up water for processing or maintaining baseflows in the Roşia or Corna streams. The primary supply of potable quality fresh water will be a piped supply from the Aries River. Where possible, where water quality requirements permit, the demand for fresh water in the operations and process plant will be met by discharge water from the wastewater treatment plant, in order to minimise pumping from the Aries River.

The proposed fresh water supply to the project is from the Aries River and the supply infrastructure is proposed as:

1. Water intake at the Aries River, upstream of its confluence with the Abrud River;
2. A pumping station located at the right bank of the Aries River, equipped with pumps capable of lifting the required flow rate over 420 m elevation difference to a Fresh Water Supply Tank in the vicinity of the processing plant; and,
3. A pipeline laid along the Abrud River to Gura Rosiei, and then along the existing mine railway and the new access road to the processing plant, a distance of 11.2 km.

The distribution and use of fresh water for the project is illustrated schematically on *Exhibit 2.22*. A simplified water balance and estimated fresh water flows are presented on *Exhibit 2.21*. The average demand for fresh water from the Aries River is estimated as approximately 224 m^3/hr over the life of the project. This demand has been estimated to comprise allowance for:

- A requirement, as yet unspecified in detail, for domestic potable water supply to residential accommodation in the Roşia Valley, either for impacted properties or for worker accommodation outside the perimeter of the processing plant, to a total of approximately 8 m^3/hr;

- Maintaining a fresh water storage tank on site, which will provide 3-day storage of site demand and will provide stored capacity for fire-fighting if required; maintenance of this storage capacity is estimated to require a sustained average supply of 224 m^3/hr, to meet the following demands:
  - Supply from the fresh water storage tank for potable water at the processing plant for domestic and sanitary use;
  - Supply from the fresh water storage tank for reagent mixing both for the processing plant and the wastewater treatment plant;
  - Supply from the fresh water storage tank for process and make-up water in the processing plant (carbon stripping, electro-winning, replacement of evaporative losses); and
  - Supply from the fresh water storage tank for a minor amount of fresh water in the operation of the wastewater treatment process.

The fresh water demand for domestic and sanitary use, both within the site perimeter and allowance for any other residential demand in the Roşia Valley, is subject to review in the context of conditions that may be imposed under the Water Management Endorsement or other planning agreement. Evaluation of alternatives for situating accommodation for the workforce, both in the construction and operations phases, forms part of the EIA process. The proposed water use quantities have taken into account the Romanian standards for the estimation of water use for the industrial workforce, (determination of drinking water supply quantities for settlement: Romanian Standard SR1343-1, September 1995 – 30 l/day per worker and 85 l/day for those workers taking a shower at shift changes), ensuring adequate capacity over maximum envisaged demand.

Water Distribution and Collection Systems

A summary of proposed major water distribution and collection systems is shown in *Table 2.7*. All pipelines will be buried below the freezing depth, with a possible exception of the tailings delivery pipeline, which could be installed above ground due to the anticipated raised temperature of the effluent slurry after cyanide detoxification.

Design flows have been established with a margin above currently anticipated maximum demand and estimated average flows.

Table 2.7 Summary of Distribution and Collection Pipelines

Pipeline	**Purpose**	**Average Design Flows (*)** m^3/h	**Pipe Length** (m)
Fresh Water Supply Pipeline from Aries River	Provides fresh water for the project.	224	11,200
Cetate Wastewater Pipeline	Transports the water from the Cetate Drainage Pond to wastewater treatment plant	378	1,805
Cîrnic Wastewater Delivery	Transports the water from the Cîrnic pond to the wastewater treatment plant	48	2,120
Treated water release to Roşia Valley (pipeline or open channel from wastewater treatment)	Releases treated water from the wastewater treatment plant to augment base flows in the Roşia stream.	314	2,080
Treated water release to Corna Valley (pipeline from wastewater treatment to downstream of the secondary containment dam)	Releases treated water from the wastewater treatment plant to augment base flows in the Corna stream.	20	4,900
Tailings Delivery Pipeline	Transports residue from Process Facility to Tailings Pond	2,274	5,200

Pipeline	Purpose	Average Design Flows (*) m^3/h	Pipe Length (m)
Reclaim Water Pipeline	Transports water from TMF to the Process Water Tank at the plant	1,516	5,100
Secondary Containment Pond to the TMF	Pumps back the seepage from the TMF	114	1,200

Table 2.7 Summary of Distribution and Collection Pipelines

(*) All flows are averages and assume a design factor of 1.2, i.e., 8,000-hour annual operation.

Characteristics of the principal collection and distribution systems are summarised below.

Cetate Wastewater Pipeline

Acid runoff from historical operation (including the Adit 714 runoff) and the new mine will be captured in the Cetate drainage pond. The base flow in the Roşia stream will be maintained primarily by constructing a diversion canal that will collect and divert water not impacted by the new mining operations around the Cetate dam and discharge it into Roşia Creek. Initially, the 3.9 km diversion canal will drain an area of about 7.5 km^2, which has not been impacted by recent mining. This represents about 70% of the Cetate pond catchment. Hence, initially the base flows of the Roşia Stream downstream of the Cetate dam will only be affected to a minor extent by the construction of the dam.

The acid water captured in the pond will be pumped to the wastewater treatment plant, located in the processing plant. Due to the expected oscillations in the pond levels, the pumping station is anticipated to be located on a floating barge. The 300-mm pipeline will be buried along the access road to the plant, parallel with the fresh water supply pipeline.

Treated Water Discharge Conduits

Baseflow in Roşia and Corna Streams will be supplemented by release of treated water from the wastewater treatment plant or from the fresh water supply system when necessary. The release points will be downstream of the Cetate Dam and the TMF Secondary Containment System. Baseflows have been estimated to be 18 l/s in the Roşia Valley and 7 l/s in the Corna Valley, and these minima will be maintained by the diversion channels, release of treated water from the wastewater treatment plant, or from the fresh water supply system. The releases from the wastewater treatment plant will be increased as required to dispose of the project surplus water and the design capacity of the conduits leading to the Roşia Stream will be increased accordingly. Pipelines will be constructed to feed treated water discharge into graded conduits, which will be maintained by gravity flow from the discharge point from the wastewater treatment plant. Under extreme dry conditions, fresh water may be used to supplement the Roşia and Corna stream flow to maintain the biological baseflow.

Tailings Delivery Pipeline

Tailings from the processing plant will be pumped from the tailings pump box located at the processing plant to several discharge points at the TMF. The 5.2 km-long pipeline will be 800-900 mm in diameter and will generally follow the mine roads leading to the TMF. Suitable containment will be provided to control any occurrences of spillage. The solids content of the tailings being transferred to the TMF will be approximately 49%.

2.2.3.6.4 Project Water Balance

The development of a comprehensive water balance model for a complex project such as the Roşia Montană Gold Project is inevitably an iterative process, which progressively approximates to reality as definitive decisions are reached on project design, as the project moves towards the definitive detailed design stage. Modelling performed at the feasibility level of definition (this Project

Presentation Report) will be refined progressively in later stages of the project design. The EIA submission will include a more detailed *Site Water Balance Report*.

To date the water balance for the Roşia Montană project site including the Corna Valley TMF has been developed using a computer-based model. The model offers a predictive tool to assess and develop operational management plans in response to annual variations of precipitation and fluctuating demand in response to project operations.

The current model operates through the preparation of individual water balances developed separately for each water control feature. The separate balances are linked to reflect interaction between the various facilities.

The preliminary water balance estimates are solved on a monthly time step. All inflows and outflows are calculated per month for each of the water control features and resultant end of month volumes are calculated. The modelled year runs from May 1 to April 30.

The input data includes precipitation and evaporation data for the site and baseflow for Roşia, Corna and Salistei streams and the 714 Adit. Precipitation data was modified to account for snowfall during the winter months; snow pack accumulates between December and February and melts in March and April for all weather scenarios.

<u>Operations</u>

The operations area utilises water from the TMF, wastewater treatment plant, fresh water supply and the process water tank. Primary outflows from this area go to the Mill Solution Tank and to the TMF (as tailings).

The total water requirement for the operations area is calculated based on the annual tonnage of ore mined. The plant was assumed to run 24 hours per day, seven days per week. Water inputs into the processing plant are considered to be drawn on a priority basis as follows:

- Initial moisture content of the ore;
- Freshwater feed for reagent mixing (minimum freshwater requirement);
- Water entrained with ore feed, derived from the Mill Solution Tank (recycled from tailings thickener based on previous month's production);
- Water from TMF, delivered via the Process Water Tank, required to prevent TMF from reaching maximum volume;
- Water from the wastewater treatment plant;
- Water from the TMF until minimum decant pond volume is reached; and,
- Freshwater make-up water.

Water from the operations area is discharged either back to the Mill Solution Tank for re-use in the operations area or sent to the TMF as part of the tailings. Excess water from the tailings thickener that is not required as process water is discharged to the TMF.

The balance for the additional water requirement between that sourced from the wastewater treatment plant and that from the freshwater supply will be dictated by decisions still to be finalized on the installed capacity for the wastewater treatment plant. Design of the wastewater treatment plant will be refined to reflect design options to construct a modular plant and the plant capacity that will be needed through the life of the project to ensure an adequate drawdown from the Cetate and Cîrnic water containment facilities to maintain impounded water levels below the maximum volumes for each facility.

<u>Cîrnic Waste Rock Drainage Pond</u>

Runoff and seepage from the Cîrnic Waste Rock Disposal Site is collected in the Cîrnic Waste Rock Drainage Pond. Water collected in the pond is pumped to the wastewater treatment plant.

Water sources to the Cîrnic Waste Rock Disposal Site include initial moisture in the waste rock and direct precipitation on the disposal site and on the pond. A runoff coefficient is used for runoff from the undisturbed area that is directed around the waste rock disposal site. It is assumed that all areas in the Cîrnic Waste Rock Disposal Site area not covered by waste rock are to be diverted. Drainage channels collecting runoff water have been assumed to lose a third of all flows by seepage to the TMF; this is a conservative assumption that in practice will be minimised by the lining of drainage channels.

Infiltration into the waste rock disposal site results in an increase of the moisture content of the waste rock to the maximum moisture content. Available water storage in the waste rock is calculated from annual tonnage of waste rock added to the disposal site based on an average daily value. Any infiltration in excess of the available storage in the waste rock reports as seepage to the Cîrnic Waste Rock Drainage Pond.

Outflows from the Cîrnic Waste Rock Disposal Site and pond include seepage from the pond to the TMF, evaporation from the pond, seepage from the diversion channels to the TMF, storage in the waste rock and pumping of pond water to the wastewater treatment plant. The pumping rate for the Cîrnic Waste Rock Drainage Pond is controlled by the available treatment capacity at the wastewater treatment plant.

Cetate Dam

The Cetate Waste Rock and Mine Drainage Pond collects water from the Cetate Waste Rock Disposal Site, the mine pits, low-grade ore stockpile, historic ARD sources and the 714 Adit. It is assumed that non-contact water in the Roşia Valley will be diverted around the pond by means of a diversion channel.

Runoff diversion structures for areas not impacted around the pond have been estimated to carry 100 percent of the flow around the pond, as these will be permanent lined ditches. Infiltration into the waste rock disposal site results in an increase of the moisture content of the waste rock to the maximum moisture content. Available water storage in the waste rock is calculated from annual tonnage of waste rock added to the disposal site based on an average daily value. Any infiltration in excess of the available storage in the waste rock reports as seepage to the drainage pond.

Precipitation into the pits is multiplied by a runoff coefficient. Infiltrating water from the mine pits reports to the pond by way of the 714 Adit. Current flow from the 714 Adit is assumed to stay constant through the life of the mine. Precipitation on the historic ARD sources is multiplied by a runoff coefficient to determine volume reporting to the pond.

Runoff from the Cetate Waste Rock and Mine Drainage Pond collection area that is not directly impacted by mine-related facilities (i.e., pits, waste rock disposal sites, plant site, etc.) would be diverted around the Cetate pond. Losses of water from the Cetate Waste Rock and Mine Drainage collection area include:

- Storage in the waste rock disposal site;
- Evaporation from the drainage pond; and,
- Pumping to the wastewater treatment plant.

The pump rate from the Cetate Waste Rock and Mine Drainage Pond is controlled by the available treatment capacity at the wastewater treatment plant.

Plant Site

Inflows into the Plant Site Storm/Spill Containment Ponds include runoff from the plant site area, calculated using a runoff coefficient and direct precipitation onto the pond. Losses from the plant stormwater pond consist of evaporation from the pond surface and, dependent on the quality of the water, pond water pumped to the wastewater treatment plant and/or the TMF.

Acid Rock Drainage Treatment

The wastewater treatment plant used to treat ARD receives water pumped from the Cîrnic Waste Rock Drainage Pond, the Cetate Waste Rock and Mine Drainage Pond and the Plant Storm/Spill Containment Pond.

Treated water will be used as required, directly on site for dust control, environmental base flows in Roşia and Corna streams and in the processing plant, primarily as dilution water for the cyanide detoxification process. The balance of treated water passes to the tailings tank for disposal in the TMF, through which it is recycled to the process. Excess not required for any of these purposes will be discharged to the Roşia Valley.

The final design capacity and the timing of initial commissioning of the plant and possible subsequent modular increases to the plant are the subject of detailed review. The primary controlling factor on treatment capacity is the need to manage the levels of impounded acid waters to within the pond capacities of the Cetate and Cîrnic ponds. A secondary controlling factor for timing of the introduction of the treatment plant is the need for treated water to maintain environmental flows in the Roşia and Corna streams and the requirement for treated water for site and process plant use, thereby reducing project demand for freshwater.

The modelling process is the means to evaluate optimal strategies for ARD treatment and the construction of the wastewater treatment plant. Modelling options have recognised and evaluated strategies for water management when the wastewater treatment plant is not operational. The modelling has indicated that initially the wastewater treatment plant will need to be sized for approximately 400 m^3/hr. At this treatment rate, the water levels in the Cetate Drainage Pond will remain below maximum levels and will allow for some non-operational periods where long-term plant maintenance can occur. Longer term modelling indicates that additional treatment capacity will be required after Year 7 of the mine life, because the drainage basin reporting to the Cetate Drainage Pond increases to include the Orlea and Jig pit areas. The wastewater treatment plant will have the capacity to be expanded to handle an increased treatment rate.

Tailings Management Facility (TMF)

The TMF worksheet includes flows through both the TMF and for the Secondary Containment System, which captures all seepage from the TMF.

The TMF receives flows from the following sources:

- Rainfall and snow;
- Water in tailings;
- Precipitation on the decant pond, tailings beach and undisturbed areas;
- Seepage from the Cîrnic Waste Rock diversion channels (clean water and impacted water);
- Seepage from the Cîrnic Waste Rock Drainage Pond;
- Pumpback from the Secondary Containment System;
- Water retained in underflow residue from the wastewater treatment plant; and,
- Outflow from the domestic wastewater treatment plant.

Inflows into the Secondary Containment System include the following:

- Precipitation on the tailings dam face and on the pond; and,
- Seepage from the TMF and clean water diversion structures.

All runoff values were determined by use of a runoff coefficient multiplied against precipitation. Diversion channels above the TMF will be unlined and have been assumed to lose a third of flow to seepage that would report to the TMF.

The tailings were distributed to the TMF at a specified percentage of solids by weight. Placed tailings have been assigned a dry unit weight based on the year placed. The difference in water volume between the tailings and the placed tailings is added to the decant pond volume. The dry unit weight increases over the operational life of the TMF. Once placed, the dry unit weight is assumed to be constant (water released during consolidation of the tailings is not calculated). Therefore, unit weight for the tailings over the average life of the mine has been used.

Outflows from the TMF and from within the water balance include the following:

- Final moisture content in settled tailings;
- Evaporation from the pond and the tailing beach;
- Seepage from the TMF to the Secondary Containment System; and,
- Reclaim water to the operations area.

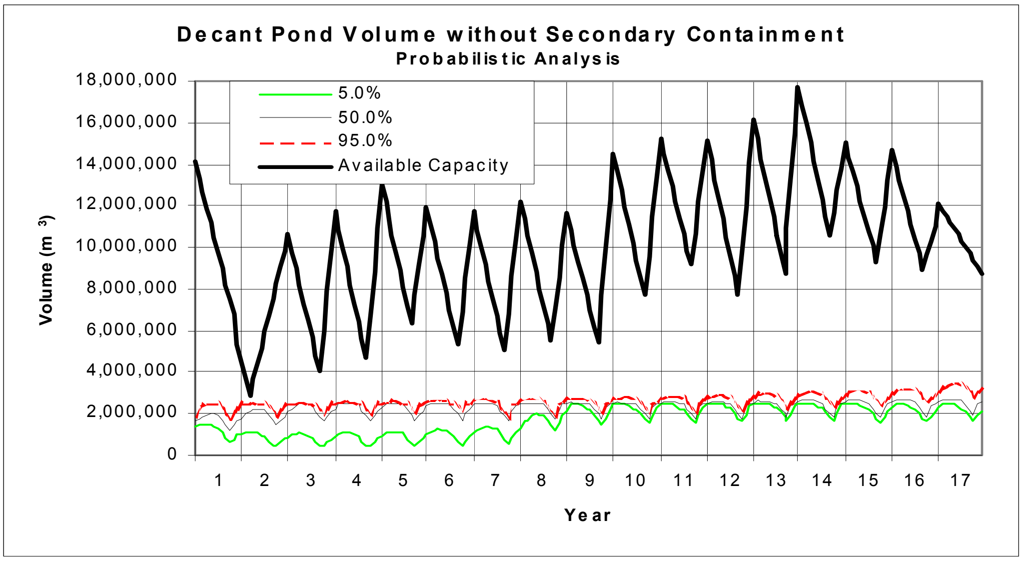
Outflows from the Secondary Containment System comprise the following:

- Evaporation from the pond; and,
- Pumpback from the pond to the TMF or discharge to Corna Creek.

The TMF is designed so that it can be operated without discharge during normal operations. However, during wet periods or extreme rainfall events, water from the reclaim pond can be discharged to Corna Creek, provided it meets water quality criteria, or can be treated to meet water quality criteria. Seepage from the Secondary Containment System is controlled and all water captured in the containment sump is returned to the TMF. In addition, an option to recover groundwater is available if TMF constituents are detected.

The current modelling exercise has addressed potential volumes reporting to the TMF and the planned capacity of the TMF decant pond to accommodate such volumes under various precipitation conditions, including requirements to handle the probable maximum flood (PMF) runoff and freeboard.

Text Figure 2.1 - Evolution of Decant Pond Volume over the Life of Project illustrates the change in the decant pond capacity and anticipated volumes of water impoundment under a range of potential precipitation conditions. In summary the TMF facility has significant excess capacity for retention of the reclaim pond volume plus PMF runoff and allowance for free board.



Notes

1. Avaliable TMF capacity, including required PMF storage volume of 2.75 Mm3
2. Percentiles (5.0%, 50.0% and 95.0%) indicate extreme dry, average, and extreme wet conditions, respecitively, for rainfall and resultant pond volumes over the mine life.
3. Available pond volumes indicate capacity after completion of each dam raise. Therefore, increase capacity only taken as point value.

Text Figure 2.1 - Evolution of Decant Pond Volume over the Life of Project

2.2.3.6.5 Summary of Site Water Management Strategy

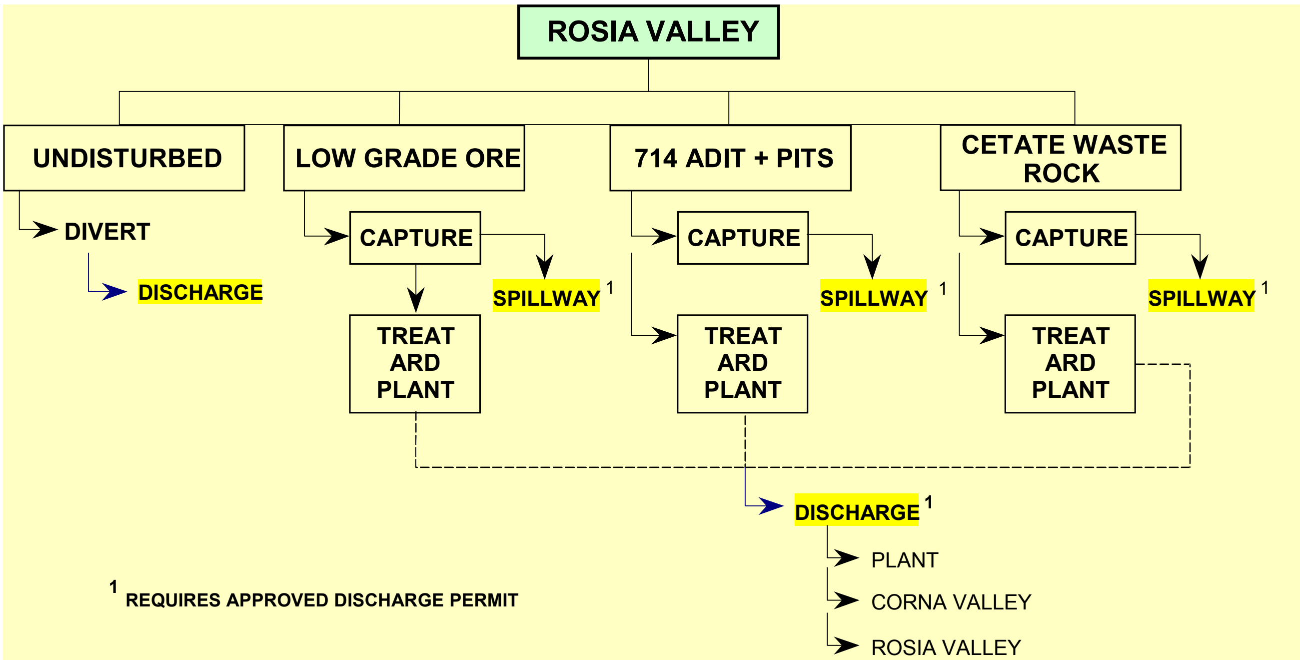
The overall water management strategy contains all of the components previously discussed in this Water Management Section. The two watersheds, the Roşia Valley and Corna Valley watersheds were considered, along with operations during storm conditions and abnormally dry periods.

Roşia Montană Valley Watershed

The Roşia Montană Valley watershed will contain most of the mining operation. *Text Figure 2.2 - Roşia Valley Water Management During Operation*, illustrates the primary components of the water management strategy in the Roşia Montană Valley during operation. During normal operation water from undisturbed areas will be routed around the mining facilities and discharged to Roşia Creek. This will assist in maintaining biological base flows in Roşia Creek and reduce the water that has to be actively managed by the Project. As the mining expands in the Roşia Valley, the location of the diversion ditches will be adjusted so that flows from active mining areas are excluded.

Flows from the low-grade ore stockpile, Cetate waste rock area, 714 adit, and mine pits will be captured behind the Cetate Waste Rock and Mine Drainage Pond Dam. The water from this pond will be pumped to the wastewater treatment plant and treated. The plant effluent will be used to supply much of the water required for the mineral processing. Alternatively, the effluent from the wastewater treatment plant may be used to supplement flows in the Corna or Roşia Valleys. This treated water discharge will require permitting. As mining expands it may be necessary to expand the wastewater treatment plant in about Year 7 of the project, as less water is diverted around the mining areas.

Permits will also be required to allow for the discharge of excess storm water from the Cetate Waste Rock and Mine Drainage Pond Dam. This impoundment will be used to collect ARD from the previously mentioned facilities in the Roşia Montană Valley.



TEXT FIGURE 2.2 – ROSIA VALLEY WATER MANAGEMENT DURING OPERATION

The pond will have a designed capacity for a 1-day, 100-year storm event above which a discharge will be allowed to protect the impoundment dam. The spillway structure on the dam will be constructed for a 1,000-year storm event in accordance with Romanian regulations. Any such discharge will occur during large storm events with a high capacity to dilute the contents of the pond.

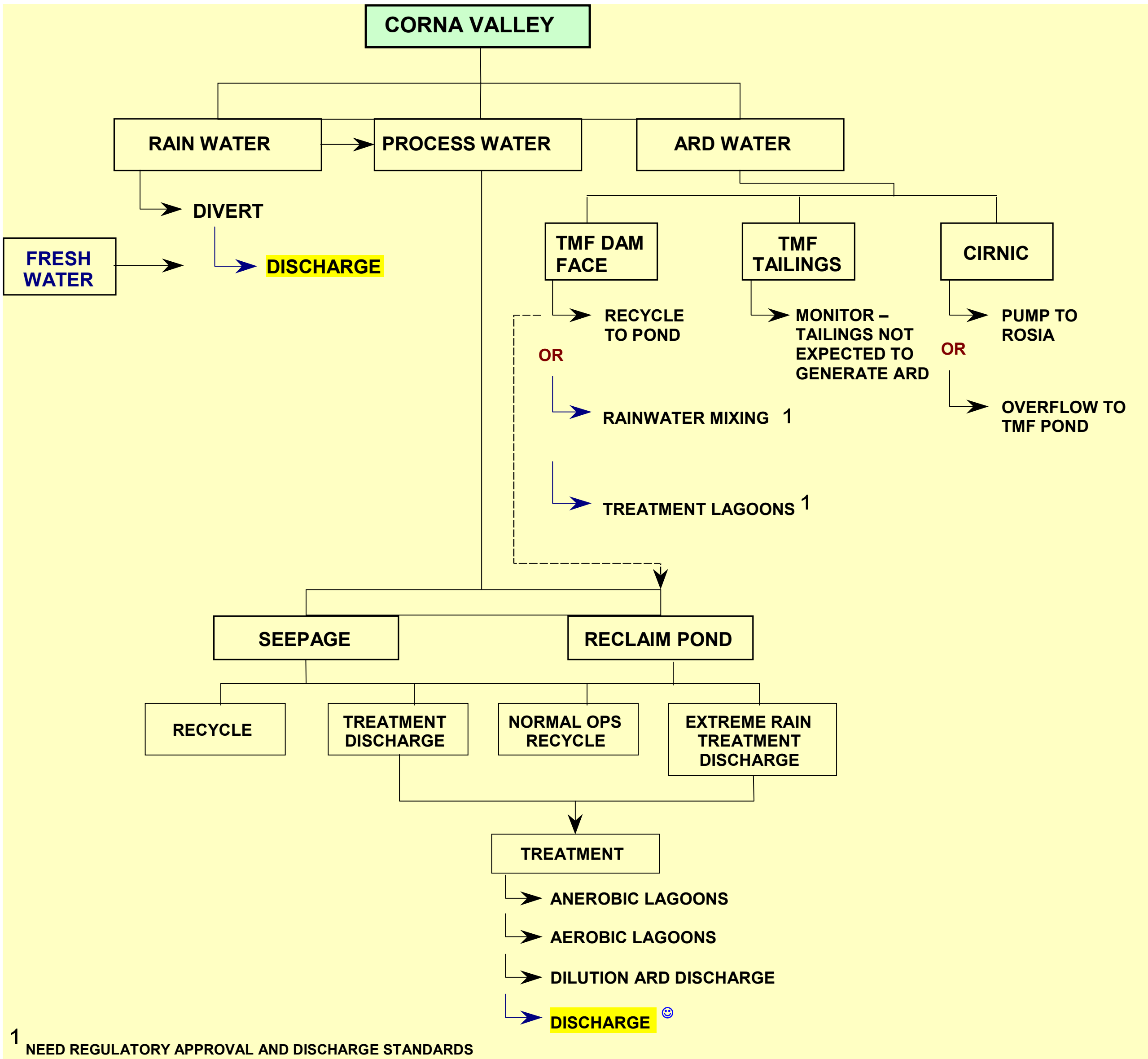
The primary difference during dry weather operation is that water from the diversion system may be used to supplement the flow to the processing plant. This water would be directed to the Cetate Waste Rock and Mine Drainage Pond Dam impoundment. From there it would be pumped to the wastewater treatment plant or directly to the processing plant if it is of suitable water quality. Freshwater pumped from the Aries River may be required to meet the biological base flow needs in the Roşia Valley.

Corna Valley Watershed

The general water management strategy during operations for the Corna Valley is presented in *Text Figure 2.3 – Corna Valley Water Management During Operations*. Similar to the strategy for the Roşia Valley, water from the non-mine areas will be diverted around the mine facilities. In the Corna Valley these facilities will largely consist of the Cîrnic Waste Rock area and the Tailings Management Facility. The flow from the diversion channel will likely not be sufficient to supply the biological baseflow for the Corna Creek. Therefore, freshwater from the freshwater supply system may need to be periodically discharged to the Corna Valley.

During operation the process water in the tailings decant pond, possibly containing residual cyanide concentrations, will be recycled back to the processing plant for reuse. Two scenarios are available for the process water seepage from the TMF. It is expected that for a period of time the seepage water may be relatively fresh groundwater, similar to existing spring discharge. This water could be allowed to discharge to the Corna Valley. Once TMF contaminants are detected in the seepage above permitted discharge levels, then this water would be collected in the secondary containment system. This captured water could then be recycled back to the TMF. However, this water may also be used for pilot testing of a seepage treatment system, and if the pilot system discharge meets permitted limits it could be discharged to the Corna Valley and become a permanent component of the water management system. If it does not meet permit requirements, it could be recycled back to the TMF during system development. Development of a treatment system for the tailings seepage water is a key component to the long-term management of TMF water. This system will be an important component at closure and also for managing storm water accumulations in the TMF.

Three potential sources of ARD are present in the Corna Valley. These include the Cîrnic Waste Rock Pile, the tailings in the TMF, and the waste rock used in the TMF dam construction. The Cîrnic Waste Rock seepage will typically be pumped to the Roşia Montană Valley wastewater treatment system. However, if the water does not contain significant ARD, it may be discharged to the TMF decant pond. Because of how the TMF will be operated, weathering of the TMF tailings will be limited and should not generate any significant ARD. Saturated tailings will be placed at a rate that will limit the opportunity for oxidation. What little ARD that may be produced will be contained and recycled with the process water. The TMF dam will be constructed to the extent practical with waste rock with low ARD potential. If some ARD is generated it will be contained in the Secondary Containment System and either recycled to the TMF, or discharged through the pilot treatment system, if permit limits are met.



TEXT FIGURE 2.3 – CORNA VALLEY WATER MANAGEMENT DURING OPERATIONS

During large storm events, the water falling in the TMF watershed will be retained in the decant pond. The TMF has the ability to store a PMF event, and indeed multiple events during much of its operation. With the high amount of dilution associated with a large storm event, and the associated acceleration in cyanide degradation, the water quality may quickly become acceptable for discharge with concentrations below permit limits. The option then exists to discharge this water to maintain the planned TMF storage capacity. If concentrations remain above permit limits then the excess water may be handled by treating a portion in the downstream treatment system for seepage (the system can be designed for excess capacity) and by consumption in the ore processing. A portion of the wastewater treatment plant discharge would typically be used for the ore processing. To help consume the excess storm water, all of the water from the wastewater plant would be discharged.

Impoundments that are part of the TMF Secondary Containment System and Cîrnic Waste Rock seepage collection system will be designed to discharge during events exceeding a 1-day, 100-year storm event. The Cîrnic collection pond would discharge to the TMF. The Secondary Containment System would discharge to Corna Valley and would need to be permitted for this discharge.

Water management for the TMF during periods of prolonged dry conditions will consist of diverting storm water into the TMF reclaim pond, pumping back all seepage, and discharging all of the wastewater treatment plant water to the TMF. During these periods, the fresh water supply system would be required to maintain the biological base flow in Corna Valley.

2.2.3.7 Material Use and Waste Management

2.2.3.7.1 Data of Raw Materials

Sources for Materials

Any synthetic liners (plant storm water pond), chemical reagents and cyanide materials will be shipped to the mine site from external certified suppliers. Open pit equipment supplies, such as tyres for haul trucks and explosives (ammonium nitrate), will be purchased from outside suppliers. Material Safety Data Sheets (MSDS) will be obtained for all chemicals and will be made available for review at the site office.

The following tables, *Table 2.8a* and *Table 2.8b,* provide available information regarding energy resources, raw materials and chemical substances anticipated to be used in the initial phase of site operations. These tables are based on preliminary engineering data and are subject to change as the engineering design is developed and refined.

Table 2.8a Energy Resources Used to Attain Production

Name[1,2]	Annual Quantity	Supplier
Electricity	397,835 MW-hr (1)	Romanian source TBD
Gasoline	TBD	Romanian source TBD
Diesel	16,600,000 l	Romanian source TBD

Notes:

1. Resources shown are for the process plant and administrative facilities only
2. Information on raw materials and chemical substances or solutions is included in Table 2.8b.

Table 2.8b Information on Raw Materials and Chemical Substances or Solutions		
Raw Material, Chemical Substance or Solution	**Approximate Annual Quantity (tonnes)(1)**	**Hazard Classification**
Activated Carbon	400	Non-hazardous
Flocculant	500	Dependent of type selected
32% HCl	2,300	Hazardous
90% CaO(2)	54,000	Hazardous
Sodium Cyanide	12,000	Hazardous
50% NaOH	2,000	Hazardous
Copper Sulphate	860	Hazardous
Sodium Metabisulphite	12,600	Hazardous
Ammonium Nitrate	8,100	Hazardous
Carbon Dioxide	60	Non-hazardous

Notes:
1. Annual quantities have been averaged over the life of the project
2. Pebble lime is included in the reagent estimate for 90% CaO; tonnage based upon two lime silos with 600-tonne capacity for pebble lime

2.2.3.7.2 Solid Waste and Residues

This section describes the proposed solid waste and residues sources and proposed handling methods. The following discussion identifies the types of solid waste that will be generated from the Project, including scheduled discharges and outputs (e.g., deposition of tailings within the impoundment). A summary of potential sources of, and disposal routes for, solid wastes and residues are provided in *Table 2.9 Solid Wastes and Residues.*

Table 2.9 Solid Wastes and Residues		
Activity		**Solid Waste Products**
Mining Operations		Waste rock, topsoil and overburden will be generated as part of the mining operations. Waste rock and overburden is to be used for construction of tailings dam and other structures; excess waste rock and/or overburden to be deposited in designated, engineered waste rock disposal sites. Topsoil will be stripped from all disturbance areas for use during closure. The topsoil materials will be stockpiled at pre-determined locations.
Processing	Crushing & milling	Dust recycled to process; trash and tramp steel collected either for disposal to off-site landfill or for site recycling/re-use in an approved manner.
	Gold recovery	CIL process tailings to Corna Valley TMF.
	Carbon regeneration and smelting	Carbon fines to third parties for reuse. Mercury recovery from retorts collected in sealed containers.
	Reagent use	Used storage containers disposed of or returned to suppliers in an approved manner.
Acid rock drainage treatment		By-product to TMF impoundment. Clear water outflow to Corna or Roşia Valley as base flow or recycled as process water.
Mine and plant facilities		Construction camp waste such as scrap metal/wood, to inert waste and landfill in waste rock stockpiles. Residues from filters on dust extraction systems recycled; laboratory solid wastes recycled to process or disposal to off-site landfill. Sewage waste to domestic wastewater treatment plant, and solid waste to agricultural use or site rehabilitation.
Other		Small quantities of hazardous and non-hazardous materials will be generated from time to time. For example, spent reagents and solvents

Table 2.9 Solid Wastes and Residues	
	used in the assay laboratory will be generated which will be disposed of off-site at a certified disposal facility in accordance with applicable regulations.

Waste Rock

Waste rock produced during the operation of the mine will be comprised of ore body host rock lithologies (i.e. dacites and breccia). Rock hauled from the open pits may also be used for construction, principally the TMF dam. Excess waste rock not required for construction will be deposited in three waste rock disposal sites, the Cetate waste rock disposal site located adjacent to the main pit complex *(Exhibits 2.4, 2.5),* a second south of the Cîrnic open pit *(Exhibits 2.5, 2.6 and 2.7)* and a third in the Cîrnic open pit after mining is complete.

The Cetate waste rock disposal site will cover an estimated surface area of approximately 64 ha and will contain approximately 20 million m^3 of waste rock material. The proposed Cîrnic waste rock disposal site will have an approximate surface area of 150 ha and contain approximately 37 million m^3 of waste rock. The backfill in the Cîrnic pit will contain approximately 28 million m^3 of waste rock. The TMF dam will store approximately 26 million m^3 of waste rock.

Geochemical evaluation of waste rock indicates that it is potentially acid generating. However, based on the results of recent (and prolonged) kinetic tests, it appears that the generation of ARD may not occur in the short term. Any ARD generated by percolation and run-off from the waste rock disposal sites will be collected and treated at the wastewater treatment plant.

Topsoil

Topsoil will be stripped from beneath all disturbance areas prior to the start of construction. The topsoil will be stockpiled in one of four topsoil stockpiles. The locations of these stockpiles are shown in *Exhibit 2.2*. The topsoil will be recycled and re-used as part of the reclamation and closure operations.

Based on site-specific soils surveys across the site, the depth of topsoil is estimated to range between 0.1 to 0.3 metres. The total volume of topsoil that will be stripped and stockpiled is estimated to be 1.1 million m^3.

Process Tailings

The product of the mineral preparation and gold recovery process passes through to the tailings thickener, which separates process water, still containing cyanide, from solids underflow that then passes to the cyanide detoxification process.

The solids passing through the CIL process comprise crushed ore at 80% passing 150 micrometers. Lime is added as an acidity adjuster within the milling circuit, and slaked lime is added in the CIL circuit; lime is also an integral element of the cyanide detoxification process. Other added reagents are copper sulphate and sodium metabisulphite. The quantities of reagent in the detoxification process are largely dependent upon the specific characteristics of the ore mineralogy and additional testwork is currently in progress that will verify quantities.

The solid effluent from the cyanide detoxification comprises the process tailings and is primarily composed of finely ground solids. The granular material is within a slurry of hydrated calcium sulphate (gypsum) and undigested lime plus smaller quantities of metal hydroxides with some iron cyanide as an insoluble strongly complexed compound. Soluble cyanide will be at a reduced level that complies with EU standards, World Bank guidelines and international standards of good practise.

The recovery of gold and silver, and mercury as a segregated contaminant, represents only minimal impact on the mass of material throughput to the process, from the crusher through to cyanide detoxification. The process and detoxification stages also require significant addition of lime and other reagents to the materials throughput *(Table 2.8b)*. The mass of tailings produced will be essentially equivalent to the mass of corresponding input of ore, which can be expressed on average, through the project-operating period, as at 13 Mt/a.

Tailings will be placed within the Corna Valley TMF as described in *Section 2.2.3.4.*

Process Residue

Mercury is an ore contaminant captured in the gold recovery and carbon reactivation circuits, from which it is volatilised and condensed into the mercury retort in an estimated quantity of 0.5kg/day at a rate of 6 days per week. The mercury is collected in sealed containers for safe removal from the site.

The residue from the wastewater treatment plant will be discharged directly to the TMF impoundment via the tailings delivery pipeline.

Waste from Mine and Plant Facilities

Solid waste generated from the mine plant site, including ancillary buildings, will primarily be domestic and industrial non-hazardous waste. A comprehensive *Waste Management Action Plan* has been developed for the project. Solid waste will include:

- Refuse from construction (i.e., scrap wood, metal);
- Refuse from operations (i.e., empty drums, other packing materials or packaging waste);
- Used oils, tyres, batteries and accumulators; and,
- General domestic waste from offices, kitchen and ancillary buildings (i.e., paper, refuse food).

Recyclable construction debris will be sold to specialised waste management businesses (ferrous and non-ferrous waste) or to local persons (wood waste).

Packaging waste will be collected separately and either returned to purveyors or sold to businesses specialised in processing of packaging or packaging waste.

Used oils, tyres, batteries and accumulators will be either sold for energetic or material recovery or stored in special facilities using methods compliant with the *Waste Management National Strategy*.

Domestic solid waste will be placed in waste receptacles and containers which will be collected and processed at a central site, where it will be segregated for recycling prior to disposal/transfer to approved off-site waste facilities.

Solid waste for off-site disposal will be contracted out to approved/recognised local waste management businesses. Final disposal will be to facilities that are compliant to the requirements of the national and EU legislation.

Domestic Wastewater Treatment System Residues

Solid residues within a slurry effluent will be generated during operation of the domestic wastewater treatment plant, and will be sent off site for use as an agricultural supplement or used on site as part of the site re-vegetation programme.

2.2.3.8 Manpower Requirements for Project Implementation

Manpower requirements will fluctuate throughout the life of the mine project. During the operations phase of the mine the total number of employees will drop from over 600 staff during the first year of operation to under 400 staff in the final year of operation.

The manpower estimates anticipate that, particularly in the first three years of operation, there will be a requirement for a number of expatriate technical staff to assist start-up and commissioning and any design modifications that may be necessary. After Year 3 of operation, the estimated total number of expatriate staff will never exceed 3% of the total manpower.

2.2.4 Mine Closure and Reclamation Period

Romanian legislation stipulates that a mine closure plan must be developed for the proposed mine in advance of construction. (*Mining Law 85/2003, Government Decision No. 639 regarding approval of a Norm applying to Mining Law applications (1998);* and *Ministerial Order No. 273, regarding the approval of a Mine Closure Manual (2001)).* Rehabilitation strategies and measures that will be applied at the Roşia Montană site are outlined in *Table 2.10 Rehabilitation Measures Incorporated into the Mine Closure Plan.*

Table 2.10 Rehabilitation Measures Incorporated into the Mine Closure Plan

1.	All openings to portals of adits and declines shall be secured.
2.	A qualified professional engineer shall assess mine workings to determine their stability and any surface areas disturbed or likely to be disturbed by such workings shall be stabilized or made secure to prevent access.
3.	Buildings, power transmission lines, pipelines and other structures shall be dismantled and removed from the site to an extent that is consistent with the specified future use of the land.
4.	Machinery, equipment and storage tanks shall be removed from the site to an extent that is consistent with the specified future use of the land.
5.	Transportation corridors shall be closed off and re-vegetated to an extent that is consistent with the specified future use of the land.
6.	Concrete structures, foundations and slabs shall be removed or covered by overburden and re-vegetated.
7.	Petroleum products, chemicals and waste shall be disposed of safely on site or removed.
8.	Explosives shall be disposed of or removed from the site.
9.	Landfill sites and other waste management sites shall be rehabilitated.
10.	Soils in the vicinity of sites used for storing or transferring petroleum products, chemicals, ore, concentrates or waste during the life of the project shall be sampled and tested for contamination and, if contamination is found, a management plan consisting of a risk assessment and action plan for the contaminated soils shall be implemented.
11.	Tailings, waste rock piles and overburden piles shall be rehabilitated or treated to ensure permanent physical stability and effluent quality.
12.	Materials, or conditions created because of mining that produce or may produce acid rock drainage, or metal leaching, shall be dealt with in accordance with the management plan.
13.	Impoundment structures shall be certified by a qualified professional engineer with respect to their stability against static and dynamic loadings to which the structures are likely to be subjected, to ensure that the materials are completely contained and the specified land use maintained.
14.	Decant structures, other than dam spillways, shall be removed or left inoperable.
15.	Remaining on-site watercourses or drainage channels shall be left to minimise maintenance and shall be consistent with the specified future use of the land.
16.	Disturbed sites shall be re-vegetated, as appropriate.

The approach adopted in the Roşia Montană Mine Reclamation and Closure Plan (*MRCP)* recognises that mining, while permanently changing some surface topography, represents a temporary use of the land and that appropriate closure of the operations is in accordance with the sustainable use of mineral resources. The principal objective of the closure plan and design process is to ensure that the potential environmental, safety and health impacts associated with a decommissioned mine (together with their associated financial and legal liabilities) are identified at an early stage and thus minimised as a consequence of actions taken during planning, design and operational phases of the project.

The objectives of the Roşia Montană Project *MRCP* include the following:

- Continued protection of public health and safety following closure of the mine;
- Reduction or elimination of long-term environmental impacts;
- Rehabilitation, to the extent reasonably practicable and economic, of disturbed land and promotion of productive use;
- Minimisation to the extent possible of the sterilization of remaining mineral resource; and,
- Establishment of a financial guarantee to ensure funding of the mine closure plan and activities.

Detail of activities related to the site rehabilitation and closure phase are presented in this Project Presentation Report as *Section 4.0 Activities Related to the Site Rehabilitation/Closure*. Activities related to closure and decommissioning of the principal site facilities are summarised below, and anexpanded description can be found in *Section 4.0*.

<u>Tailings Management Facility</u>

The TMF will remain as a significant landform after mine closure. During the final years of operations, the preparatory work will include modification of the tailings disposal system to achieve the final landform and establishment of a water management and treatment system to handle long-term seepage from the facility.

Key elements of the closure plan are:

- Reduction and elimination of the final decant pond by pumping to the mine pits. The reclaim barge and associated pipelines will be retained for the purposes of pumping down the pond to sufficiently dry surface to support re-grading and emplacement of soil cover;
- Emplacement of a topsoil cover over the surface of the impoundment area in conjunction with engineered grading and drainage ditches to control and minimise infiltration of precipitation and to shed surface water towards a peripheral collection drain leading to a closure spillway off the surface of the impoundment;
- Dismantling and removal of the tailings delivery and distribution pipelines; these will be flushed with water and the wastewater directed to the TMF; pipelines will be cut up for recycling as scrap or disposed of in a landfill;
- Progressive rehabilitation of the terraced downstream slope of the main tailings dam during the final years of operations and after the completion of operations, with emplacement of a soil cover and re-vegetation of the slopes and benches near the toe of the dam;
- Construction of a graded spillway, with sediment control features, to discharge water from the top surface of the impoundment over the face of the dam. Maintenance of the secondary containment system, with treatment in semi-passive or passive treatment system designed and constructed during operation. Alternately, the seepage will be pumped to the mine pits until a treatment system is functional;
- After appropriate monitoring of seepage and collected water demonstrates that there is no further significant cyanide, cyanide degradation products, or acid-impacted water reporting to the secondary containment system, treatment and pumping will cease and rehabilitation measures will be undertaken in the area to establish a safe ecological habitat; and,
- Ongoing monitoring, instrumentation, and inspection of the tailings dam to ensure embankment integrity and stability are maintained consistent with statutory requirements.

Open Pits

The open pits will remain significant landforms after closure. Key elements of the closure plan are:

- The high elevation faces of the excavations will be characterized by benches with a height of 10 m and widths of 27 m; the benches may allow progressive establishment of natural vegetation;
- The construction of berms around the pit perimeters will be ongoing during operations and completed before the end of mining; the berms will be designed to ensure public safety, to control vehicle access to the pits and to minimise surface water runoff from entering the pits;
- The pit lake system will be allowed to flood naturally with the addition of water from the TMF facility, which will help reduce the potential for ARD from the walls of the final pit slopes;
- If it proves necessary due to continued ARD generation and accumulation in the mine pit lake system, an active onshore ARD treatment system will be utilized to achieve improvement of pit water quality; with time this will replace the current Wastewater Treatment Plant located at the plant site;
- When a discharge is required, controlled discharge can occur through a valved bulkhead in the 714 adit to a passive or semi-passive biologically based treatment system for water quality polishing; however, if the in-pit water quality treatment has not produced a water quality suitable for discharge to the passive or semi-passive system, the wastewater treatment plant is planned to remain available for active treatment; and,
- Long-term in-lake treatment and management so that a stable natural lake system may develop with sufficiently good water quality to allow for direct discharge to the environment.

Waste Rock Disposal Sites

Key elements of the closure plan are:

- The construction of the waste rock disposal sites during operations will be designed and undertaken to meet long term closure plans; each disposal site will be underlain by a drainage blanket of non-acid generating rock to maintain drained conditions within the waste rock;
- The slopes of the waste rock stockpiles will be constructed with 30 m-high lifts at an angle of 34º (1.5H:1V); each lift will be offset to form a 41-m-wide bench;
- Progressive re-grading of the lower parts of each waste rock disposal facility, emplacement of soil cover and re-vegetation will occur through the active mining operations;
- The regrading operation will result in a bench slope of 22º (2.5H:1V) and a bench width of 6 m, every 30 m vertical; this will result in an overall slope of 20º (2.7H:1V);
- At completion of mining operations, or earlier, when waste rock disposal to the site has ceased, the final areas of the site will be re-contoured to the final planned landform and soil cover will be emplaced in conjunction with re-vegetation to agreed specification;
- At closure, the surface of the Cîrnic Waste Rock Disposal Site outside of the Cîrnic Pit will be graded to direct run-off to peripheral collection drains leading to the drainage system constructed around the TMF; drainage reporting to the Cîrnic Waste Rock Drainage Pond will continue to be directed to treatment facilities for as long as the water quality does not meet applicable regulatory standards;
- The waste rock inside the Cîrnic Pit will be re-graded during placement to achieve the same overall slope configuration as the external Cîrnic waste rock stockpile; a soil cover will then be placed over the waste rock in conjunction with re-vegetation; and,

- At closure of the Cetate Waste Rock Disposal Site, the surface will be covered with a soil cover, vegetated and engineered to control run-off to a peripheral drainage collection system, initially directed to the Cetate Waste Rock and Mine Drainage Pond.

Water Management and Water Retention Structures

The site water management strategy throughout the initial, transitional period of decommissioning and closure is to minimise any potential for generating or releasing acid rock drainage. Surface water and groundwater monitoring will be conducted to ensure that potentially impacted waters are directed to the wastewater treatment systems and, correspondingly, waters that meet water quality discharge criteria are directed and maintained away from any potential source of contamination. The scope and timing of final closure strategies will be dependent on demonstrating that acid and mining impacted waters are not, nor are likely to be, released to the environment and, if required, effective long-term treatment systems are in place.

Key elements of the closure plan are:

- The wastewater treatment plant will remain at its existing plant site location during the early stages of closure.
- Run-off and seepage from the waste rock disposal sites, and possibly ARD water from the TMF secondary containment system will be pumped to the plant; this treatment facility will continue until a new system is in place near the Orlea pit lake;
- If necessary ann ARD treatment system may be constructed at the Orlea pit, which is the lowest in the pit lake system and will collect ARD produced at the site; this treatment system may also be used to provide a means to treat directly the pit lake system or treat pit water for discharge;
- Water from any site ARD retention systems, such as the Cetate Waste Rock and Mine Drainage Pond, will, if necessary, be directed or pumped to the pit lake system where it will be managed with the pit lake water and either retained or treated and discharged;
- The Cetate Waste Rock and Mine Drainage Dam will remain operational until it can be demonstrated that water collected in this facility can be discharged directly to the environment in compliance with regulatory consents, or the flow is so low that it can be effectively treated with a semi-passive bio-reactor constructed in the Roşia Valley; final closure strategy is subject to review and regulatory consent but an appropriate strategy would be to include a series of treatment lagoons and/or construction of a residual wet-land area; and,
- The Cîrnic Waste Rock Drainage Pond will remain operational as long as acid impacted waters report to this impoundment, which will either be pumped to the active treatment systems, or if flow is small enough, treated in a passive system located at the pond location; thereafter, natural silting and the establishment of vegetation will be allowed, with any residual seepage or outflow reporting to the drainage system on the restored TMF surface.

Processing Plant Site

Key elements of the closure plan are:

- With the exception of the wastewater plant, the fencing, buildings and structures at the plant site will be removed for salvage, or, if they are portable, retained for re-sale;
- Key components of the wastewater plant may be relocated to a plant site near the Orlea pit;
- The equipment will be removed for salvage and structures and foundations will be demolished to ground level, structural materials will be salvaged for re-use or re-sale where appropriate, waste materials will be removed and disposed of to an approved facility and any remaining inert material will be buried, covered with a soil layer and re-vegetated;

- Stationary process equipment, such as the crusher and mills, will be removed from their foundations and sold to appropriate salvage outlets;
- Careful inventory control will be implemented to minimise the contents of storage tanks during the final phases of operations; all storage tanks will be decommissioned in accordance with the applicable environmental and safety regulations; and,
- Structures which have been fabricated on site, including CIL tanks and thickener, will be cut up as scrap metal for removal; soils below the process plant footprint and specifically below storage tanks, will be sampled and tested to confirm there are no residual contaminants and, if such were the case, removal and/or decontamination of affected soil would be in accordance with approved international practice and national legislation.

2.2.5 Environmental and Social Management Plans

A series of social and environmental management and monitoring plans are considered an integral part of the Project as part of an Environmental and Social Management System, reported in the *Environmental and Social Management Plan.* Component plans will be presented as appendices to the EIA, and will be an important reference point for discussion of relevant activities within the structure of the EIA.

Implementation of these plans and the inter-relationship between the plans and the EIA will be described in the *Environmental and Social Management Plan*.

Exhibit 2.1 Surface Geology in Roşia Montană

Exhibit 2.2 Facilities Related to the Construction Phase

Exhibit 2.3 Haul and Access Roads

Exhibit 2.4 Site Conditions at Year 0

Exhibit 2.5 Site Conditions at Year 7

Exhibit 2.6 Site Conditions at Year 14

Exhibit 2.7 Site Conditions at Year 17

Exhibit 2.8 Processing Plant Site

Exhibit 2.9 Simplified Overall Process Flow Diagram

Exhibit 2.10 Primary Crushing and SAG Milling

Exhibit 2.11 Grinding Circuit

Exhibit 2.12 Leaching/Adsorption

Exhibit 2.13 Elution/Regeneration

Exhibit 2.14 Electrowinning and Smelting Process Flow Diagram

Exhibit 2.15 Thickening and Cyanide Detoxification Process Flow Diagram

Exhibit 2.16 Tailings Management Facility (TMF) Initial Dam

Exhibit 2.17 Tailings Management Facility (TMF) Final Dam

Exhibit 2.18 Tailings Management Facility (TMF) Schematic

Exhibit 2.19 Tailings Management Facility (TMF) and Starter Dam Cross Section

Exhibit 2.20 Major Transportation Routes

Exhibit 2.21 Simplified Water Balance

Exhibit 2.22 Detailed Water Balance

3 POLLUTION SOURCES AND ENVIRONMENTAL PROTECTION

This section of the Project Presentation Report outlines potential pollution sources and describes environmental management and protection strategies to be implemented throughout all stages of the project.

3.1 SOURCES OF WATER POLLUTION AND PROTECTION OF WATER QUALITY

The Roşia Montană Project has the potential to impact water quality in two drainage basins: the Corna and Roşia Valleys. These impacts may be positive in nature resulting in improvements in water quality, as well as potentially negative. Impacts from previous mining will be reduced by the Project due to both source removal and water treatment. Negative impacts could be caused by chemicals and chemical conditions associated with the Project. The potential sources for pollution, and control and treatment measures to mitigate these sources are discussed herein.

The proposed Project will result in facilities being constructed within the Roşia and Corna Valleys. On a year-round basis, the range of daily stream flows recorded in these valleys may be summarised as:

- Corna Valley: 3 to 642 l/sec; and,
- Roşia Valley: 16 to 1,150 l/sec.

The proposed project development plans include measures to protect the surface and groundwater resources by diversion of unimpacted water around and away from project operations. In addition, surface water impacted within the operations area will be collected for treatment or recycling within the operation.

The effluent from the wastewater treatment plant may be released from the site, after testing to ensure that it meets discharge standards for surface waters. All other waters, and periodically a portion of the treated water, will be retained within the site boundaries and will be recycled for use in the operations. The majority of water used at the site can be recycled. The primary surface water diversion and collection features through the period of operations are shown in the site layout plans (*Exhibits 2.4, 2.5, 2.6, 2.7*).

Additional details on the possible sources of pollution at the site, estimated flows within the site for each of the potential pollutants and treatment, and/or mitigation measures that are proposed to address each source are presented in the followings sections.

3.1.1 Potential Sources of Emissions to Water

Potential discharges to water are associated with several aspects of the mining operations and ore processing, as indicted in *Table 3.1 Potential Sources of Releases to Water.* Other potential releases of water are a part of the normal operation of the mine and are discussed in the following sections. These releases are generally managed by collection and recycling or treatment.

Runoff from the previous Roşia Montană operations, including existing mine adits, and mine water from the currently active pits, is characterized by low pH and higher than normal concentrations of heavy metals (copper, iron, manganese, nickel, and zinc) and sulphate ions. Runoff collected from the waste rock disposal sites and mine drainage will be continuously monitored, and either pumped to the wastewater treatment plant or released to the TMF for reuse in the ore treatment facility. The treatment and monitoring process has been designed to help ensure that water leaving the site perimeter will meet discharge requirements.

Table 3.1 Potential Sources of Releases to Water		
Operation	**Specific Activity / Location**	**Potential Environment Releases**
Mining Operations	Blasting, excavation	Discharge of collected rainwater in the operations area; release of acid water impounded in old workings; mine dewatering and drainage systems discharge
	Haulage	Run-off sediment/salt from mine roads; seepage to groundwater
Processing	Ore stockpile	ARD run-off; seepage to groundwater
	Soil stockpiles	Sediment run-off
	Crushing and milling	Release of recycle or process fluids
	Gold recovery	Accidental discharge/release of reagents to surface environment.
	Reagent transport and storage	Accidental discharge/release of reagents to surface environment.
Disposal to TMF	Tailings pipeline	Accidental discharge or rupture of pipe
	Impoundment	Abnormal/accidental release of fluids to the environment; seepage to groundwater
Waste rock haulage and disposal		Run-off from/through waste rock dump during wet periods; run-off from haul roads
Mine, plant and office facilities		Sewage pipeline rupture, possible chemical/fuel/oil spillage.
Transport of personnel		Spillage of fuel and oil.
Water supply		Spillage from pipeline, which is river water, but potential for contribution to site run-off containing suspended solids.

3.1.2 Water Pollution During the Phases of the Project

The potential categories of pollution to surface water and groundwater at the site must also be considered in terms of their impacts during the three phases of the project (construction, operations, and closure), summarised in *Table 3.2 Categories of Potential Water Pollution during Phases of the Project.*

Table 3.2 Categories of Potential Water Pollution during Phases of the Project				
Categories of Pollution	**Project Phases**			
	Existing	Construction	Operations	Closure
Acid Rock Drainage – old operations	X	X	X	X
Acid Rock Drainage – proposed operations			X	X
Domestic Wastewater from on- site facilities		X	X	
Miscellaneous Chemicals in Runoff from Plant Site			X	
Process Effluent (Including residual cyanide in closed TMF)			X	X
Soil Erosion from the Site	X	X	X	X

A comprehensive strategy for management of water during the life of the project and for control of erosion has been developed in the project *Water Management and Erosion Control Plan*, which forms part of the forthcoming EIA submission.

3.1.2.1 Existing Conditions

Existing Acid Rock Drainage

This includes the seepage from the existing waste rock piles at the site and the discharges from the 714 adit and other minor adits. Average flows from the 714 Adit are estimated to range between 10 to 18 l/sec. Flows from other minor adits are much less than the 714 adit, and flow rates from seepage from the existing waste rock areas have generally not been quantified.

Soil Erosion from Site

The current area of workings on the Cetate Massif has given rise to large areas of unconsolidated overburden and waste rock, much of which fringes the top of the massif overlooking the Roşia Valley, and rests at an angle of repose without any engineered contours or consolidation, nor with any control structures for runoff. During periods of precipitation this is extensive gullying into and silt transport into both the Roşia Valley and the Corna Valley.

3.1.2.2 Construction Period

Acid Rock Drainage from Existing Mine Workings and Waste Areas

In the Roşia Valley this will remain uncontrolled until construction of the Cetate Waste Rock and Mine Drainage Dam and the wastewater treatment plant. The Cetate Dam allows impoundment of acid waters from old workings, which report through the 714 adit, and seepage from existing waste rock piles. In the Corna Valley, completion of the construction of the TMF starter dam will provide impoundment of acid-impacted waters from existing mine waste and adit drainage.

Domestic Wastewater from On-site Facilities

A construction camp will be erected and operated through the construction period. It will be provided with an independent sanitary system with collection of all domestic wastewater for treatment within the project perimeter; release of treated domestic wastewater will be in compliance with national standards and consents. The construction camp is expected to be a temporary feature and the wastewater treatment facilities will reflect this; long-term domestic wastewater treatment will be provided for in the processing plant area during the operations period.

Soil Erosion from Site

The construction activities for the project will give rise to widespread movement of soil and rock, for construction of water retention and treatment facilities, access roads, construction of the processing plant and preparatory works for mining. The ground disturbance will give rise to a sediment source that can be mobilized by precipitation and run-off. The construction phase will include the construction of site drainage that will be designed with gradients and sediment traps to minimise uncontrolled gullying and erosion. The management of run-off over the site area is of primary importance for the management of mine-impacted water and the management of diversion channels that will maintain a flow of non-impacted waters in the Roşia and Corna Valleys.

3.1.2.3 Operations Period

Pre-existing Acid Rock Drainage

During the course of operations, a comprehensive system for the collection and treatment of known sources (714 adit and other adit discharge, and seepage from old waste rock dumps) will be in place. Design of the collection and treatment system has addressed negative impacts which may occur through inadequate collection and storage capacity, temporary failure of the wastewater treatment system, rupture of water transfer systems and foreseeable flood events. The extent, complexity and interconnection of old workings presents a risk that unforeseen areas of water impoundment may be released by operations or that impacted water may find previously unidentified drainage routes; the situating of the Cetate Waste Rock and Mine Drainage Dam in the Roşia Valley and the TMF in the Corna Valley are anticipated to provide adequate control measures.

Acid Rock Drainage from Project Operations

It is anticipated that additional ARD water may be generated from the:

- low-grade ore stockpile;
- waste rock piles;
- mine pit walls; and
- mill tailings.

The rock storage sites will include the Cetate waste rock disposal site, the Cîrnic waste rock disposal site, the Cîrnic pit waste rock backfill, low-grade ore stockpile, and the TMF shell, which will be constructed using some waste rock. Testing has indicated that ARD generation from site waste rock and the mine pit walls may be limited. However, because the testing indicates that the potential for ARD generation is highly variable, all waste rock and the pit walls will be managed as if they will generate ARD. The low-grade ore stockpile has a high potential to generate ARD, and water discharging from this facility will be managed as ARD. These sources will be present during operations and, with the exception of the low-grade ore pile, will expand throughout the operational period. The low-grade ore pile will be processed near the end of the Project; therefore, this source will be eventually removed. Drainage and seepage arising from waste rock and low-grade ore piles will be collected in drainage ditches feeding to drainage collection ponds from which collected water will be pumped to the wastewater treatment plant. Runoff from the mine pit walls will be managed with the 714 adit discharge. Any ARD runoff from the TMF exterior dam face will be collected and pumped to the TMF decant pond or possibly treated.

The mill tailings will have the potential to generate ARD. However, the rapid accumulation of tailings in the TMF will limit weathering and possible ARD generation, and the process water will be alkaline, further limiting ARD generation potential. It is not anticipated that during operations that any significant ARD will be generated. However, if limited ARD generation occurs, it would be captured by the decant pond, blended with the alkaline process water, and recycled to the processing plant. If some ARD infiltrated into the tailings, it would be neutralised by the tailings pore water and the neutralising capacity of the tailings.

Domestic Wastewater from On-site Facilities

Sanitary facilities will be provided in the main industrial area including all major buildings and offices. This will result in production of sanitary wastewater that is a potential pollutant. A domestic wastewater treatment plant will be constructed for the treatment of domestic wastewater arising within the industrial zone.

Miscellaneous Chemicals in Run-off from the Plant

The process plant is expected to use a variety of chemicals and reagents as part of the normal operations. Risk analysis recognises that there is a remote possibility of these being released accidentally and, therefore, they are treated as a potential pollutant. Detailed control and containment measures will be put in place; specifically, the process plant area will be designed to capture any spillage and precipitation run-off. The *Emergency Preparedness and Spill Contingency Plan,* which forms part of the EIA presentation, will address all foreseen eventualities.

Process Effluent (Cyanide and Associated Chemicals in Tailings)

Cyanide will be used in the gold recovery process. The tailings will be treated prior to transfer to the TMF, using an internationally recognised effective system for cyanide detoxification, which will help ensure that WAD cyanide is reduced to a level that complies with existing and currently proposed EU standards and World Bank guidelines. Natural degradation of the cyanide compounds in the tailings decant pond will further reduce any residual cyanide concentrations in the tailings water. Other constituents such as ammonia and nitrate, which are by-products of cyanide detoxification and degradation, and sulphate, may be present in concentrations that could be a concern. The concentrations of these constituents and others potential pollutants will be monitored in the tailings decant water and in the TMF seepage such that corrective actions could be implemented in the unlikely case that an environmental impact may occur. During normal operations, the TMF reclaim pond will be recycled back to the plant. Seepage water collected in the secondary containment dam may be pumped back to the reclaim pond or routed through a series of treatment lagoons prior to discharge to the Corna Stream. In addition, if excess water is collected in the reclaim pond from extreme rainfall events, the excess water could be treated in the lagoons to appropriate discharge standards before release to the Corna Stream.

Soil Erosion from the Site

Soil erosion on site during operations is perceived to be primarily related to erosion from areas of waste disposal or rock and soil storage (topsoil storage piles, waste rock disposal sites); these areas are generally under continuous construction, reclaim, profiling or rehabilitation during the course of operations. In addition, erosion may develop over and along the course of access routes and drainage channels. However, the operation of extractive mining will largely take place within the perimeter of the open-pits and should not generate any erosion outside the pit perimeters. The planning and design of rock and soil storage facilities will include the use of best management practises which will specifically address the management of run-off and drainage which may generate erosion; engineered gradients and final surfaces will be used in conjunction with soil cover and re-vegetation to control run-off over remaining rock disposal sites. Drainage ditches alongside access roads and selective lining of drainage collection systems will be designed to minimise erosion and sediment mobilization. Nonetheless, any sediment that is generated even with the implementation of best management practises will be captured behind the TMF dam or Cetate dam.

3.1.2.4 Closure Period

Acid Rock Drainage from Old Mine Workings and Closed Project Facilities

A benefit of the Project development is that it will contribute to the cleanup of long-term mining impacts during mining and at closure. Many of the current sources of ARD, including existing waste rock piles, and most areas of underground mine workings, currently have residual ore value and will be consumed by the Project. One of the perceived risks is that the scale of historic acid drainage from areas of ancient mining and its associated waste dumps may be such that this is more extensive than can be handled within the scope of the proposed Project excavations and water treatment systems. With the removal of many of these sources as the result of the Project and the water management plan for the site, this risk is not substantial.

An additional risk is that the excavations of the present project and the corresponding waste rock disposal and tailings disposal may themselves contribute acid rock drainage beyond site operations. Source controls implemented at closure will substantially reduce this risk, but residual seepage and ARD generation may occur after closure. Seepage will be collected and managed in conjunction with the pit lakes, which will contain any ARD generated from the mine pit walls.

Detailed investigation and water balance modelling have been used to determine the catchment area and capacity of the proposed wastewater treatment system and drainage collection systems (including the TMF secondary containment system). This will help to ensure that all foreseeable long-term risks have been addressed. A comprehensive surface and groundwater monitoring programme has been developed in the pre-construction period and will be operated throughout the operations period and, in compliance with conditions established with regulatory authorities, after closure. Investigation of groundwater indicates that there are no significant aquifers and limited lateral connectivity, such that no long-term impact of groundwater can be anticipated. In addition, in the Roşia Valley, the network of mine workings acts as a drain to collect the limited groundwater that does occur. The wastewater treatment plant will remain operational in the post-closure period for treatment of acidic and mining impacted surface water, subject to agreement on long-term rehabilitation plans to be agreed on with the regulatory authorities. Other forms of treatment may eventually be applied if more effective and appropriate for the level of treatment required and if they reduce the long-term care required for the Project. These measures may include semi-passive treatment lagoons to address acidic drainage in the Roşia Valley.

Residual TMF Seepage

Seepage of water from the TMF will occur during operation and after closure. A regenerated topsoil cover will be placed on the tailings to limit water infiltration into the tailings and limit long-term ARD generation. However, consolidation of the tailings mass will also result in the discharge of some water. This discharge rate will decrease as the tailings consolidate and become less permeable. The quality of the seepage will be dependent upon the water quality in the tailings impoundment throughout its operational history, and geochemical processes that occur along the seepage flow path. If this seepage water exceeds water quality standards for discharge then water treatment systems will be needed after closure, with a reducing need as time passes. Such treatment will need to be fashioned to the specific components that exceed standards. Because this treatment requirement will be identified during the operational period, an existing system will have been developed and will be in place at closure to meet this need. At this time, it is expected that the treatment system will consist of a series of semi-passive treatment lagoons that could address acidic water or CN concentrations. These would be constructed in the Corna Valley during the operational period and tested to confirm the design and operation

Soil Erosion from the Site

One effect of the mining operation, outside the perimeter of the open pits, is to reduce the gradients of surface areas within the industrial zone. Rehabilitation measures in the processing plant area will result in a low profile surface and the TMF impoundment area will have a generally flat surface. The drainage system established during operations will in general be retained, incorporating low profile drainage routes to the primary drainage systems for the Roşia and Corna Valleys. The proposed re-vegetation of affected surfaces will require soil retention structures to support the initial vegetation and, thereafter, the new vegetation will become a soil retention system.

Steep gradients will result only within the perimeters of the open-pits and on the slopes of the waste rock stockpile. The pit perimeters will be surrounded by protective berms, which will limit drainage and sediment transfer into the pits. Steep faces within the pits are mitigated by the mining system of benches, which normally trap water and sediment transfer. The waste rock stockpiles will be regraded to an overall slope of 20º (2.7H:1V).

3.1.3 Wastewater Treatment and Control of Pollution

3.1.3.1 Clean Surface Water Diversions

Surface water diversion channels are proposed within each drainage basin to collect and divert clean surface water around the proposed facilities. This water will be collected and fed by gravity to a location downstream of the disturbance areas and will then be discharged back into the existing stream channels. The flow in the diversion channels is intended to be a major source of the biological baseflow that will be maintained in each drainage basin. The primary surface water diversions are shown in *Exhibits 2.5, 2.6* and *2.7.*

3.1.3.2 Wastewater Treatment Plant

Overview

Acid Rock Drainage refers to the production of acidity that can occur when sulphide minerals are exposed to air and water. The rocks within the region generally and specifically in the project area, are known to have varying concentrations of sulphide minerals. Historically, these rock types have demonstrated their potential to generate ARD. The main factors influencing the oxidation of sulphide minerals are water availability for oxidation and transport, oxygen availability, physical characteristics of the materials and, to a lesser, degree temperature, pH, ferric/ferrous iron equilibrium and microbiological activity.

The potential for ARD generation from waste rock produced as part of the proposed project has been evaluated. It has been determined that most of the site mine wastes, pit walls and ore have the potential to generate ARD. However, waste rock and the mine pit walls may do so in only relatively limited quantities with substantial portions of the water discharging from these features being either non-ARD impacted or neutralised ARD.

ARD generation may occur in the waste rock piles limited to specific areas of the piles where ARD-generating material is placed. Because the piles are dynamic during operations, with new material continually added, the locations and magnitude of these areas may change through time. The mine pit walls may behave in a similar manner as the pits expand. At closure, covers will be placed on the waste rock, which will help retard any ongoing ARD generation. Control of ARD runoff from the pit walls at closure will be more limited, but the gross potential for the pit walls to generate ARD is less than the waste rock. This is because of more limited surface area associated with the intact rock. The data indicate that there is some potential to manage waste rock during operation in a way to limiting ARD run-off. This could include placing waste rock with a high ARD potential in the interior of a waste rock pile where contact with water and oxygen would be limited. Alternatively, waste rock with low or no ARD potential would be placed on the exterior of stockpiles. This may become especially useful in managing waste rock that is used in the TMF dam construction.

The wastewater treatment plant is being designed to treat ARD-contaminated runoff water from the previous mining operations within the project area, water reclaimed from the pits, site runoff and drainage from the proposed Cetate and Cîrnic waste rock disposal sites and the low-grade ore stockpile. Potential ARD runoff will be collected in two catchment ponds, the Cetate waste and mine drainage pond and the Cîrnic waste rock and mine drainage pond. It will then be pumped to the wastewater treatment plant processing. Some of the treated effluent will be reclaimed for use in the ore treatment facility.

Runoff from the previous Roşia Montană operations, including existing mine adits and mine water from the currently active pits, is characterized by low pH and higher than normal concentrations of heavy metals (copper, iron, manganese, nickel, and zinc) and sulphate ions. Runoff collected from the waste rock disposal sites and mine drainage will be continuously monitored, and either pumped to the wastewater treatment plant, or released to the TMF for reuse in the ore treatment facility. The treatment and monitoring process has been designed to help ensure that water leaving the site perimeter will meet discharge requirements.

3.1.3.2.1 Process Description

The ARD treatment process selected for this project will be based on the most commonly employed strategy for treatment of acid drainage, consisting of lime neutralisation/precipitation. The main unit operations of the treatment process will be the following:

- Air oxidation;
- Lime neutralisation/precipitation and pH control;
- Flocculation with solids recycle;
- Solids / liquid separation in a clarifier; and,
- pH adjustment with carbon dioxide (CO_2).

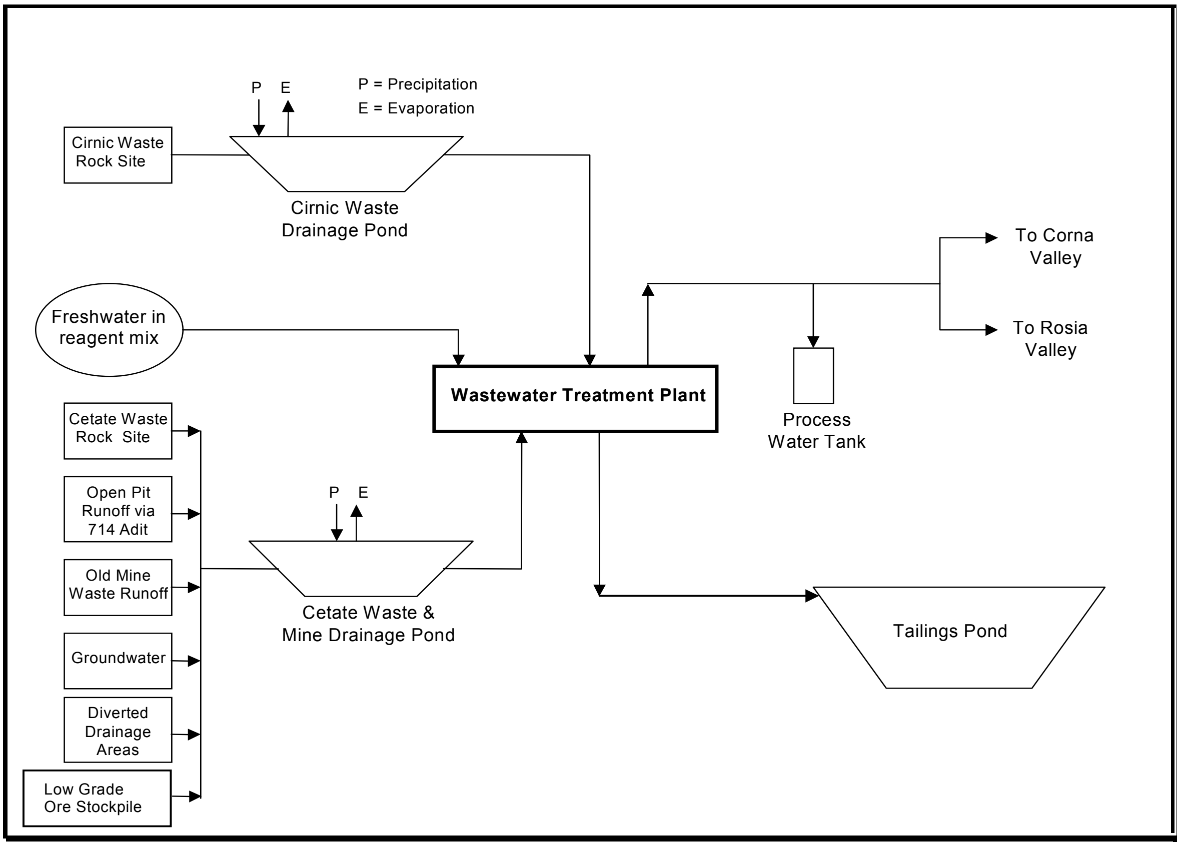
Drainage collected in the collection ponds will be pumped to the wastewater treatment plant. The wastewater enters the first of three agitated neutralisation tanks. The tanks are arranged in series such that each tank can overflow to the successive tank. Overflow from tank three passes to the clarifier feed tank.

Slaked lime slurry is mixed with recycled clarifier underflow in a recycle tank and then returned to the neutralisation tanks. The addition of the slaked lime is regulated by pH measurement in tank one. Compressed air is sparged into each tank to effect metals oxidation.

Diluted flocculant will be added to the clarifier feed tank to aid in settling of the solids produced. From the clarifier a portion of the overflow liqour will be pumped to the process water tank, the cyanide detoxification circuit as dilution or directed to the TMF for eventual recycle for use in the process plant. Excess overflow that cannot be used in the process plant will undergo pH adjustment before release into the environment. To effect the pH adjustment the overflow water is passed into the re-carbonation circuit, comprised of two tanks in series. Carbon dioxide is sparged into these tanks to reduce pH from 11 to 8.5, prior to discharge to either the Roşia or Corna Valleys. The clarifier underflow is a by-product and the greater part, some 94% of solids generated, is recycled back to the neutralisation circuit. This recycle stream is mixed with incoming lime slurry in the recycle tank for eventual dosing to the neutralisation tanks as described above. The balance of the clarifier underflow is discharged to the TMF via the tailings pump box.

Text Figure 3.1 presents the schematic balance for wastewater treatment.

Text Figure 3.1 - Schematic Balance for Wastewater Treatment



3.1.3.2.2 <u>Chemistry of ARD treatment</u>

The ARD treatment chemistry consists mainly of neutralisation/precipitation reactions as the pH increases, along with dissolved metals oxidation/precipitation and sulphate removal.

Slaked lime addition and air oxidation in the first phase of treatment results in the ferrous ions being oxidized to ferric ions, which are then precipitated as ferric hydroxide at a pH value of approximately 7.2 (equation 1).

$$4FeSO_4 + O_2 + 2H_2O + 4Ca(OH)_2 \rightarrow 4Fe(OH)_3 + 4CaSO_4 \qquad (1)$$

The second phase comprises increasing the pH to approximately 11 by a further addition of lime slurry and includes air sparging for oxidation. At elevated pH levels and oxidizing conditions, iron and other heavy metals such as copper, manganese, nickel, and zinc, will precipitate as hydroxides (equations 2 – 6).

$$CuSO_4 + Ca(OH)_2 \rightarrow Cu(OH)_2 + CaSO_4{**} \qquad (2)$$

$$Fe_2(SO_4)_3 + 3Ca(OH)_2 + 1\tfrac{1}{2}O_2 \rightarrow 2Fe(OH)_3 + 3CaSO_4{**} \qquad (3)$$

$$MnSO_4 + Ca(OH)_2 \rightarrow Mn(OH)_2 + CaSO_4{**} \qquad (4)$$

$$NiSO_4 + Ca(OH)_2 \rightarrow Ni(OH)_2 + CaSO_4{**} \qquad (5)$$

$$ZnSO_4 + Ca(OH)_2 \rightarrow Zn(OH)_2 + CaSO_4{**} \qquad (6)$$

** ignoring hydration effects

Calcium ions added with the lime slurry combine with sulphate ions to form aqueous calcium sulphate, and the quantity that exceeds the solubility level of about 3,200 mg/l at 20ºC precipitates as solid calcium sulphate (equation 7).

$$CaSO_{4\,(aq)} + 2H_2O \rightarrow CaSO_4 \cdot 2H_2O_{\,(s)} \text{ above solubility limit of } CaSO_4 \qquad (7)$$

(aq = aqueous, s = solid)

The unreacted lime is partially dissolved based on its solubility (equation 8)

$$Ca(OH)_{2\,(s)} \rightarrow Ca(OH)_{2\,(aq)} \text{ (to solubility limit)} \qquad (8)$$

Suspended solids resulting from the neutralisation/precipitation process consist of metal hydroxides, calcium sulphate and gypsum, and some unreacted lime.

The treated effluent with a pH of about 11 can be directly reclaimed as process water. The effluent that has to be discharged into surface water needs to be further treated to decrease the pH from 11 to 8.5. This is achieved by addition of gaseous carbon dioxide, which, depending on the pH value, reacts first with the excess of slaked lime (pH > 8.3) and afterwards with the resulting calcium carbonate (pH< 8.3) (equations 9 and 10).

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O \qquad (9)$$

$$CaCO_3 + CO_2 + H_2O \rightarrow Ca^{2+} + 2HCO_3^- \qquad (10)$$

Following the neutralisation and oxidation/precipitation steps, the solution is discharged by gravity to the clarifier for solids-liquid separation. Clarifier underflow solids are recirculated to the neutralisation reactor to catalyze the precipitation of gypsum, minimise scaling, and improve the quality of the settled precipitate. Water quality data collected from the Roşia Montană site indicate that, in addition to elevated levels of metals, drainage from the existing mine area and historic waste disposal sites contains high levels of sulphate ions. RMGC will continue to monitor sulphate concentrations and conduct pilot studies to determine the most effective process for sulphate reduction, should it be needed.

3.1.3.2.3 Releases from the Wastewater Treatment Plant

If treated water from the wastewater treatment plant is not required for the process plant, the water can be released to either the Corna or Roşia Valleys.

The treated effluent from the wastewater treatment plant will have reduced dissolved metal concentrations and other quality parameters that will meet discharge standards in accordance with Romanian legislation (harmonized with EU Directives) as defined by the Project Water Management Endorsement.

3.1.3.3 Cyanide Detoxification Process

3.1.3.3.1 Overview

The process plant will incorporate a cyanide detoxification technology that will ensure that WAD cyanide concentration is reduced below statutory levels in the tailings before leaving the confinement of the process plant facility. This is a proven technology that has been adopted in more than 90 mines worldwide. This section describes the proposed cyanide detoxification method to be employed.

Tailings from the CIL section of the process plant will be routed to the tailings thickener, where process water containing cyanide will be recovered in the tailings thickener overflow and returned to the grinding circuit for re-use. WAD cyanide concentrations will be reduced using the SO_2/air process, to the target discharge level. The SO_2/air process is one of the most effective and reliable technologies available for cyanide detoxification associated with gold mining processes and test work has been completed to verify that it is effective in the context of Roșia Montană ore mineralogy and process route.

The detoxification of cyanide will involve a continuous single stage process where cyanide is oxidized using SO_2 as an oxidizing agent, supplied in the form of sodium metabisulphite, oxygen supplied from air, and possibly minor amounts of copper sulphate as a catalyst. Lime will be added to neutralise the sulphuric acid generated.

Cyanide bound to iron as ferrocyanide, is precipitated as a base metal-iron insoluble salt. Other metals in the solution will be removed as hydroxides.

Test data predicts that, after the proposed cyanide detoxification process, the average WAD cyanide content in the TMR will be below standards proposed in the draft EU Directive concerning mining industry waste.

Continued reduction of WAD cyanide concentrations will occur in the tailings impoundment through natural processes. In addition, precipitation events will result in further pond dilution.

The cyanide detoxification will occur basically in two stages:

- Cyanide detoxification based on the SO_2/air process; and,
- Residual WAD cyanide natural degradation in the tailings pond.

3.1.3.3.2 Cyanide Detoxification

The cyanide detoxification facilities will consist of two tanks operating in parallel. Treated water or freshwater will be added to the cyanide detoxification feed header to dilute the underflow of tailings thickener from normally 60% solids to 50% solids. Water addition will be based on density and flow measurements of the thickener underflow. The resulting diluted thickener underflow will be directed to the two tanks of the cyanide detoxification facilities.

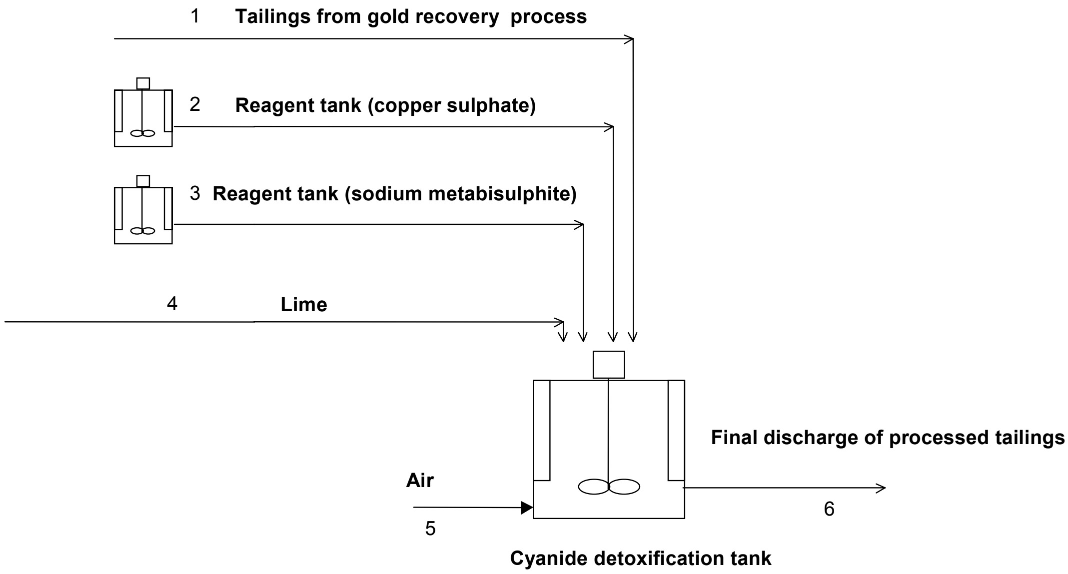
Compressed air, provided by four compressors discharging at a pressure of 250 kPa, will be added to each tank through a sparger. Airflow will be controlled at each tank through a rotameter.

The source of SO_2 is sodium metabisulphite – ($Na_2S_2O_5$) a solution that will be metered into each tank. The addition rate of SO_2 will be based on the concentration of WAD cyanide in the tailings stream and the tailings solution flow. The cyanide concentration will be determined by the plant operator and input to the control system. The detoxification reactor feed flow is measured and the mass flow of cyanide is calculated by the control system. The control system then adjusts the flow of the SO_2 to effect detoxification.

A copper sulphate ($CuSO_4$) solution will be metered into each tank to maintain a required concentration of copper ion in solution to catalyse the detoxification reaction. Because of the composition of the Roşia Montană ores and the resulting fluid chemistry, copper sulphate may not need to be routinely added to maintain the required copper concentration. Copper sulphate control is managed by the control system adjusting the dose rate based on the measures flow of solution into the detoxification reactors.

Lime slurry will be added to each tank via a ring main system to control the pH in the tanks at 8.5. A Cyanide Detoxification Flow Diagram is presented in *Text Figure 3.2.*

Text Figure 3.2 - Cyanide Detoxification Flow Diagram



3.1.3.3.3 Chemistry of Cyanide Detoxification Process

The basic chemistry of the SO_2/air process consists of primary and secondary reactions.

In the *primary reaction* WAD cyanide, which includes free cyanide and weakly complexed metal cyanides, is oxidized to produce cyanate (OCN^-) and sulphuric acid while releasing metals into solution. Stoichiometrically, the reactions require approximately 2.5 grams of SO_2 per gram of WAD CN to be oxidized.

$$\text{Free } CN^- + SO_2 + O_2 + H_2O \rightarrow OCN^- + H_2SO_4 \quad (1)$$

$$Me(CN)^{1-} + SO_2 + O_2 + H_2O \rightarrow OCN^- + H_2SO_4 + M^{2+} \quad (2)$$

$$M^{2+} = Zn^{2+}, Cu^{2+}, Ni^{2+}, Cd^{2+}, \text{etc.} \quad (3)$$

Reactions (1) and (2) require a small amount of copper in solution to serve as a catalyst.

The *secondary reactions* are related to the sulphuric acid neutralisation and metals precipitation.

Acid produced in the oxidation reactions is neutralised with lime at a controlled pH generally in the range of 8 to 10 with an optimum of 8.5.

$$2H^+ + SO_4^{2-} + Ca(OH)_2 \rightarrow CaSO_4. + 2H_2O \quad (4)$$

Iron cyanide, a strongly complexed metal cyanide, is precipitated as an insoluble salt in combination with the metals that are discharged during the oxidation reactions (particularly copper). This precipitate is stable within a wide range of pH. Excess metals in solution, including the spent copper catalyst, are precipitated as hydroxides.

$$2M^{2+} + Fe(CN)_6^{4-} \rightarrow Me_2Fe(CN)_6\,(s) \quad (5)$$

$$M^{2+} + Ca(OH)_2 \rightarrow Me(OH)_2\,(s) + Ca^{2+} \quad (6)$$

Cyanide disposal in the TMF

Cyanide detoxification will substantially reduce the concentration of cyanide in the discharge to the TMF. Most of the remaining cyanide will be discharged as lower toxicity metal complexed cyanide. A small amount of free cyanide will occur in the TMF as the result of chemical equilibrium reactions that cause metal complexed cyanide to break down until equilibrium is obtained with free cyanide as described in Equation 7, for example.

$$Zn(CN)_4^{2-} \Leftrightarrow Zn^{2+} + 4CN^- \qquad \text{Dissociation constant} = 1.3 \times 10^{-17} \quad (7)$$

The amount of free cyanide will be dependent upon the concentration of metal cyanide complexes and the strength of the complexes. With low concentrations of WAD metal cyanide complexes, the associated concentration of free cyanide may not even be measurable. Experience at other similar tailings sites has shown that a significant proportion of the free cyanide will volatilise and/or break down in the impoundment. This leads to a continual disequilibrium that will tend to keep the concentrations of free cyanide low and also eventually result in the complete degradation of the cyanide in the TMF after processing has ended. During operations, water reclaimed from the tailings pond will be pumped back to the mill for reuse in the process. The basic chemical processes within the TMF are presented below. The two main reactions that occur in the tailings pond in the shallow water layer are natural degradation by volatilisation and by oxidation.

Natural degradation by volatilization

As metal cyanide complexes dissociate, most of the free cyanide that is created is lost naturally by volatilisation to HCN gas. The volatilisation rate is dependent on a number of parameters, of which pH value is the most important. Equations 8 and 9 describe the pH dependency of the formation of hydrocyanic acid. At a pH value of about 10, approximately 90% of the free cyanide is present as the CN^- ion, with an increasing proportion becoming protonated (i.e., bound with hydrogen ions) as the solution pH falls.

$$CN^- + H_2O \Leftrightarrow HCN\,(aq) + OH^- \quad (8)$$

$$CN^- + H^+ \Leftrightarrow HCN\,(aq) \quad (9)$$

Equation (10) describes the loss of hydrocyanic acid from the aqueous phase to the gaseous phase as hydrogen cyanide gas through the process of volatilisation.

$$HCN\,(aq) \rightarrow HCN\,(g) \quad (10)$$

(g) = gaseous

Natural degradation by oxidation

Reactions that cause the oxidative loss of the free cyanide ion from alkaline solutions are described by the following equations whereby cyanide is degraded to cyanate and then ammonium ion:

$$CN^- + \tfrac{1}{2}\,O_2 \Leftrightarrow OCN^- \quad (11)$$

$$OCN^- + 3H_2O \Leftrightarrow NH_4^+ + HCO_3^- + OH^- \quad (12)$$

Biological systems degrade cyanide to the ammonium ion (equations 11 and 12), which is then converted to nitrate. The non-biological oxidation of cyanide to cyanate (equation 11) is enhanced by adsorption of cyanide on organic materials and some clay minerals.

The secondary reactions presented below may minimise the cyanide content in the tailings pond. However, it is very difficult and may even be impossible to establish the significance of those reactions in the overall natural degradation process of the cyanide.

Precipitation reactions

$$2M^{2+} + Fe(CN)_6^{4-} \Leftrightarrow M_2Fe(CN)_6\,(s) \quad (13)$$

The formation of solid metallocyanides may be desirable from an environmental perspective, representing a way for removal of the cyanide from the solution, and reduction of its potential toxicity.

Reactions with sulphur containing compounds

If sulphur-containing minerals are present, cyanides may combine with the sulphur.

$$2S^{2-} + 2CN^{-} + O_2 + 2H_2O \Leftrightarrow 2SCN^{-} + 4OH^{-} \quad (14)$$

$$S_2O_3^{2-} + CN^{-} \Leftrightarrow SCN^{-} + SO_3^{2-} \quad (15)$$

Equations 14 and 15 are beneficial environmentally as the thiocyanate ion is much less toxic than the cyanide ion.

Photodecomposition reactions of hexacyanoferrate (II) and hexacyanoferrite (III) ions

Cyanide reacts with both Fe^{2+} and Fe^{3+} ions in aqueous solutions to form, respectively, stable $Fe(CN)_6^{4-}$ and $Fe(CN)_6^{3-}$ complexes. Also, complexes of these types may be stabilized and their toxicity attenuated by precipitation with other metal ions (see equation 13). In the presence of strong ultraviolet light, even these stable complexes may be photolysed and broken down to give traces of free cyanide in equilibrium (equation 16).

$$[Fe(CN)_6]^{3-} + H_2O \Leftrightarrow [Fe(CN)_5H_2O]^{2-} + CN^{-} \quad (16)$$

However, the significance of this reaction is questionable under normal environmental conditions. Moreover, free cyanide formed from the photodecomposition of iron cyanide is subject to the various degradation and attenuation mechanisms previously discussed. This is also a potential degradation pathway for cyanide in the environment.

Adsorption reactions

The adsorption of the free cyanide ion and complexed cyanides from the liquid phase into solids present in the tailings pond represents another route by which cyanide may be temporarily removed from the solution. A generic reaction describing this phenomenon is given as Equation 17.

$$Me^{-}OH + CN^{-} \Leftrightarrow Me^{-}CN + OH^{-} \text{, where } Me^{-}OH \text{ represents a mineral surface} \quad (17)$$

Releases from the Cyanide Detoxification facility

The detoxified tailings will be disposed of in the TMF. The decant water will be recycled from the TMF to the mill via a floating barge. The minor seepage through the main dam will be collected directly in the secondary containment system (SCS) located down gradient of the toe of the embankment. The SCS will consist of a deep sump excavated into rock and a pumping system to pump water over the TMF embankment and back into the tailings impoundment. It is anticipated that cyanide will never reach the SCS because of the implementation of the SO_2/air process and natural degradation reactions that occur in the environment. In particular, oxidation, precipitation, reactions with sulphur, and adsorption may have a significant effect on cyanide in the seepage pathway. However, because many of these reactions are difficult to predict, the management of TMF seepage is based on containment of TMF water and recycling it back to the TMF or treatment. As a secondary measure, a treatment system will be developed that can be utilised at closure.

3.1.3.4 Domestic Wastewater Treatment Plant

Domestic sewage discharges from showers, toilets, sinks and washing machines originating from the mine plant site, including the mine workers' changing rooms, will be treated by the proposed domestic wastewater treatment plant. This plant will be a self-contained unit, with complete provision for heating and ventilation.

Sanitary sewage from the plant site will drain to a manhole located immediately upstream of the domestic wastewater treatment plant. Balancing tanks will be supplied, as well as booster pumps to pass the raw sewage through the treatment process. The domestic wastewater treatment plant will be designed for continuous, unsupervised duty 24 hours per day, 365 days per year with a nominal daily flow rate of 5.0 m^3/hour. The peak flow rate of 15 m^3/hour is expected to occur during the three, daily, one-hour shift changes.

The general treatment process will be determined through analysis by the manufacturer of the plant. The process selected by the manufacturer will contain all of the equipment and accessories necessary for proper operation and control. A minimum equipment design life of 20 years will be specified and all discharges must be demonstrated to meet applicable standards and guidelines. Residue generated by the plant will be used either as a natural fertilizer for the green areas inside the plant site or disposed of in accordance with specified requirements.

3.1.3.5 Containment for Site Runoff

The Project is located within hilly terrain and the proposed ditches around the pits, stockpiles, plant, and waste disposal areas will provide control of surface runoff (see *Section 2.2.3.6.2*). For the plant site, surface runoff will be directed to the plant storm water pond, which will also act as a secondary containment system. Water collected in the plant storm water pond will be pumped back into the plant as recycled water.

Surface water runoff from the site will be contained and collected behind constructed embankments for each drainage basin that will be impacted by the proposed development. These facilities will contain any impacted water and sediment runoff from the site. The impounded water will be recycled within the plant or pumped to the wastewater treatment plant for treatment prior to release. The location of containment structures and drainage collection ditches during operations is illustrated in *Exhibits 2.6, 2.7* and *2.8.* The principal elements of the site-wide management system may be summarised as follows:

- The Corna Valley TMF forms the largest containment and drainage control structure on-site. Water draining from much of the impoundment catchment will be collected in the treated tailings decant pond (as the solid portion of the tailings settle out), thus forming the major source of water for ore processing. The TMF left bank Corna diversion channel (south) and the north diversion channel will be constructed to collect and route unimpacted water around the TMF. The tailings impoundment and secondary containment system are designed for total containment under all expected operational conditions. There is sufficient storage above the normal operating levels for an extreme precipitation event in the TMF.
- The Cetate Waste Rock and Mine Drainage Pond will collect current and potential ARD runoff and seepage water from the Roşia watershed. This will include the Cetate waste rock stockpile, the low-grade ore stockpile, and drainage from Adit 714.
- The Cîrnic Waste Rock Drainage Pond will be constructed within the Corna basin, immediately downstream from the Cîrnic Waste Rock Disposal Site. The facility will be designed to collect possible acidic runoff from the waste rock and pump it to the wastewater treatment plant.
- Roşia Diversion Channel and Diversion Channel Dike: Diversion works will be constructed, to the extent practical, to direct clean water around the Cetate Waste Rock and Mine Drainage Pond to downstream of the Project area. These diversion works around the Cetate pond will divert the Roşia Stream and unaffected runoff water from the north slope of the Roşia Valley to downstream of the Cetate dam.

3.1.4 Summary

Various surface water and groundwater pollution sources for the Roşia Montană project have been identified. The project development plans address each pollution source and provide appropriate containment for recycle or treatment and discharge. The site hydrogeology indicates that groundwater within the Project site will report as surface water in either the Roşia or Corna Valleys. Containment structures are planned for both valleys that will capture surface water and allow recycle and/or treatment, if required. Only treated water from the wastewater treatment plant will be discharged from the site under normal operating conditions. In Corna Valley, for extreme rainfall conditions, water collected in the secondary containment dam and/or the reclaim pond in the TMF may be sampled to determine chemical concentration and then compared to discharge standards. If required, the water could then be routed through a series of treatment lagoons to ensure that water quality discharge standards are met before the water is released to Corna Valley.

In Roşia Valley, for extreme rainfall conditions, water collected behind the Cetate dam will be stored up to the level that water will be discharged over the spillway and mixed/diluted with water from the northern diversion channel. The water balance indicates that the site waters can be contained on site for normal operating conditions without discharge except for the discharges from the wastewater treatment plant. Specific detail pertaining to the management and handling of water at the site, including storm flow, are presented in Section 2.2.3.6.

3.2 AIR PROTECTION

3.2.1 Methodology

Sources of emissions to air are being identified as part of the EIA process through:

- The evaluation of all activities and operations of the Project; and,
- Selection of those activities and/or operations, which could represent atmospheric sources of pollution.

Emissions will be inventoried and quantified using available data and best professional judgement. The potential areal impacts associated with these sources will be estimated by conducting air dispersion modelling using OML and INPUFF software.

Emissions inventories and calculations will be developed for the construction, operation, and closure phases of the project.

Each of these phases is characterized by specific activities and operations developed within different areas, to meet different objectives. Based on the basic mining schedule, there are no strict delimitations in time between each phase. Thus, even in the construction period, which mainly consists of site and infrastructure preparation, several pre-production activities will also begin, such as partial open pit pre-stripping. The same applies to the closure phase, where some rehabilitation activities will start during the operation phase

Activities and operations that cause fugitive emissions will be considered, as well as the activities that will be associated with stacks, and other uncontrolled or controlled sources.

The emission inventories for each phase of the project and for each activity site will be assessed as part of the EIA. For each source, the following parameters will be determined:

- Physical parameters: the emission height, the emission temperature, the emission speed, the internal diameter of the top stack (for ducted sources), the source geometry: punctual - linear - surface sources; and,
- Hourly mass flows needed for input of the dispersion modelling for all the specific pollutants.

For the emission rate calculations, the following methodologies (based on emission factor) are being used:

- US EPA/AP-42 (Air CHIEF 11.0.2004) - for particulate matter emissions and other pollutants generated by the construction, mining, ore processing activities and other activities/stationary sources on the plant site, closure/post-closure activities etc; and,
- EEA/EMEP/CORINAIR 2000 for mobile sources (vehicles and equipment; for vehicles – COPERT III Programme).

In order to determine the impact on air from the emissions sources identified for different phases of mine life, several years have been considered as representative for dispersion modeling purposes. Each of these representative years is identified below, along with a brief discussion of the rationale behind their selection for modeling:

- Year 0 is the first major construction year, and includes major dust-generating activities such as road building, excavation of the plant area, operation of the concrete batch plant and the pouring of foundations, quarry operations, construction of the starter dam, creation of stockpile areas, construction of the inert waste landfill; and clearing and grubbing of organic material in the Tailings Management Facility basin and various other project locations; road traffic and associated exhaust impacts are likely to be heavy as plant equipment items, materials, and mining vehicles are brought to the mine site.
- Year 8 will see full-scale mining activity in all four pits;
- Year 10 will contain the highest levels of production for the Jig pit;
- Year 12 will contain the highest levels of production for the Orlea pit, which is the part of the mining operation that is closest to the community (Tarina) nearest to the project;
- Year 14 will see the greatest total amount of disturbed areas across the mine site and represents the greatest extent of overall activity in the four pits; and
- Year 19 will include the decommissioning, restoration, and rehabilitation of some of the largest impacted areas of the mine, including the Tailings Management Facility (embankment and tailings surface topsoil layer emplacement and revegetation), the process plant area, waste rock stockpiles, and major roadways.

Dispersion modelling results for these years will be included in the EIA.

3.2.2 Types of Air Pollutants and Their Main Sources

Pollutants emitted into the atmosphere include dust from site activities and wind erosion of waste materials (such as waste rock disposal sites and the TMF tailings areas potentially exposed to wind erosion), process plan gas emission and vehicle emissions as indicated in *Table 3.3 Potential Sources of Emissions to Air.*

Table 3.3 Potential Sources of Emissions to Air

Mining Operations	Blasting, excavation, loading	Blasting fumes and dust emitted by blasts; dust emitted by blast hole drilling rigs; dust raised by excavators and mobile equipment; wind erosion of non-vegetated surfaces; emissions from mobile equipment and vehicle exhausts.
Processing	Ore stockpile	Ore dust raised by stockpile creation; wind erosion of stockpile; vehicle and equipment exhaust emissions.
	Crushing	Ore dust from the crusher and handling of crushed ore.
	Crushing and milling	Essentially a wet process with little potential for dust emission.
	Gold recovery	Wet process; potential for lime dust emissions at point of addition; potential for incidental CN gas emissions; fumes from elution process; gold furnace fumes.
	Reagent storage	Reagent dust at point of mixing and gases.
	Detoxification plant	Release of SO_2.
Tailings disposal		Dust raised by wind erosion of dried tailings surfaces (there is an operational procedure to keep surfaces moist).
Waste rock disposal		Dust raised by haulage, mobile equipment, and unloading of trucks; wind erosion of non-vegetated surfaces; emissions from vehicle and equipment exhausts.

Table 3.3 Potential Sources of Emissions to Air	
Mine, plant and office facilities	Emissions from vehicle and equipment exhaust; wind erosion of non-vegetated, unsealed ground.
Ore haulage and transport of personnel	Vehicle exhausts emissions, dust from the surface of the road.

3.2.2.1 Particulate matter emissions

Dust represents one of the two main types of air pollutants related to the mining activities. The dust can result from activities such as drilling, blasting, handling, processing and hauling of soil and rocks, and as a result of the wind action on the disturbed surfaces.

Two key characteristics are related to the dust: its particle size and chemical composition. Dust generated by mining activities usually contains particulate matter with diameters between 1 and 100 µm. The composition of dust reflects the composition of the source materials; concentrations of specifically dangerous dust particulates such as silica or long-fibre asbestos-type materials have not been recognized in any dust samples.

Particulate matter emission sources, which are related to the activities during construction, operation and closure phases of the project, can be classified in three main potential sources of dust:

- Area sources represented by disturbed surfaces (open pits, waste rock disposal sites, topsoil stockpiles, non-vegetated surfaces);
- Local sources of small dimensions, including point sources (low-grade ore stockpile, crushed material pile, processing plant exhausts, etc.); and,
- Linear sources (haul roads and access roads).

Tables 3.4 to *3.6* present the estimates of the various disturbed surfaces in each mine life-cycle phase. It should be noted that, for the purposes of modelling, the total disturbed surfaces do not correspond to the final construction footprint of each facility due to allowances made for surface disturbance in access and immediately adjacent areas, and also where, in successive phases, only a partial area of a single facility may be disturbed.

Table 3.4 Disturbed Surface Area Estimate – Construction Phase

Phases	Location	Total surface disturbed (ha)*
Phase I	Cetate Waste Rock and Mine Drainage Dam (Balmoşeşti)	3
	Processing Plant (Schiolne Hill)	37
	Cetate Pit	12
	Cîrnic Pit	0.0
	Cetate Waste Rock Disposal Site	19
	Cîrnic Waste Rock Disposal Site	0
	Top soil stockpiles	21
	Cetate Low-Grade Ore Stockpile	5
	Porcului Sandstone Quarry	5
	Sulei Andesite Quarry	11
	TMF impoundment Corna Valley	59
	New access road to Plant site	11
	New access to Roşia Poieni	7

* Figures are rounded

Table 3.5 Disturbed Surface Area Estimate – Operation Phase		
Phases	**Location**	**Total Surface Disturbed (ha)***
Phase II-a (year 7)	Cetate Pit	49
	Cîrnic Pit	66
	Cetate Waste Rock Disposal Site	28
	Cîrnic Waste Rock Disposal Site	132
	Cetate Low-Grade Ore Stockpile	38
	TMF impoundment Corna Valley	183
Phase II-b (year 14)	Cetate Pit	69
	Cîrnic Pit	71
	Orlea Pit	39
	Jig Pit	24
	Cetate Waste Rock Disposal Site	28
	Cîrnic Waste Rock Disposal Site	139
	Corna Low-Grade Ore Stockpile	38
	TMF impoundment Corna Valley	268
Phase II-c (year 17) Stockpile Processing and Site Rehabilitation	Cetate Pit	69
	Cîrnic Pit	71
	Orlea Pit	39
	Jig Pit	24
	Cetate Waste Rock Disposal Site	28
	Cîrnic Waste Rock Disposal Sites	139
	Corna Low-Grade Ore Stockpile	38
	TMF impoundment Corna Valley	312

* Figures are rounded

Table 3.6 Disturbed Surface Area Estimate – Closure Phase		
Phases	**Location**	**Total Surface Disturbed (ha)***
Phase III (year 19)	Process Plant	37
	Cetate Pit	44
	Cîrnic Pit	29
	Orlea Pit	17
	Jig Pit	14
	Cetate Waste Rock Disposal Site	29
	Cîrnic Waste Rock Disposal Site	140
	Corna Low-Grade Ore Stockpile	38
	TMF impoundment Corna Valley	312

* Figures are rounded

The above sources may be classified as open, free, unducted sources, with ground-level fugitive emissions.

The following sites have been identified as potential sources of dust:

- Concrete batch plant;
- Roads;
- Open pit sites;
- Ore stockpiles, waste rock disposal sites and topsoil stockpiles (especially during construction and closure phases);
- TMF;
- Processing plant site (during the construction phase and later the crushed ore stockpile area);
- Rock drainage and mine wastewater (ARD) impoundment sites (during construction); and,
- Aggregate quarry sites.

In order to determine the pollutant emissions from those sources into the atmosphere, the following factors are being taken into consideration:

- Types of work to be carried out;
- Material quantities handled for various types of activity;
- Work intensity;
- Equipment and vehicle types;
- Number of units per each type of equipment and vehicle; and,
- Indicative levels of fuel consumptions, speeds and distances travelled.

The duration of pollutant emissions into the atmosphere would match the daily working hours, with possible hourly and daily variations.

Particulate emissions generated by wind erosion may take place continuously, but mass flow rates may vary significantly with the wind velocity.

In order to avoid underestimation, the following issues will need to be taken into account:

- Maximum work intensity;
- Conditions favouring maximised emissions (simultaneous work, maximum concentration of small particulates (<75 µm) in handled materials, minimum humidity of soil and rocks, etc.); and,
- Particulates carried off by wind erosion of disturbed surfaces.

<u>Construction Phase</u>

Particulate matter emissions:

- Concrete batch plant:
  - Aggregate paddocks (unloading, transfer, erosion);
  - Aggregate silos (unloading, transfer, erosion); and,
  - Cement and lime silos (loading).
- Access roads construction:
  - Top soil removal (digging and stockpiling, loading into vehicles);
  - Digging (excavation, loading into vehicles);

- Filling (unloading from vehicles, spreading and compacting); and,
- Wind erosion.

- Initial haulage roads construction:
  - Soil excavations (excavations and stockpiling, loading into vehicles);
  - Rock excavations (excavation, loading into vehicles);
  - Backfilling (unloading, spreading and compacting); and,
  - Wind erosion.
- Cetate and Cîrnic pits – preparatory works:
  - Top soil removal (excavation, loading into vehicles);
  - Drilling and blasting;
  - Excavations (crushing of oversize blocks, stockpiling); and,
  - Wind erosion.
- Orlea and Jig pits - preparatory works:
  - Site clearance;
  - Drilling and blasting; and
  - Wind erosion.
- Topsoil stockpile, waste rock disposal sites and low-grade ore stockpile:
  - Top soil removal (earthworks and stockpiling, loading into vehicles);
  - Wind erosion;
  - Material sorting;
  - Unloading; and,
  - Handling of materials inside storage areas.
- Tailings dam - construction:
  - Top soil removal (earthworks and stockpiling, loading into vehicles);
  - Clay and rock fill for the dam construction (unloading from vehicles, formatting and compacting); and,
  - Wind erosion.
- Processing plant site – preparatory works:
  - Top soil removal (earthworks and stockpiling, loading into vehicles);
  - Earthworks (excavation, loading into vehicles);
  - Foundations (unloading from vehicles, spreading and compacting); and,
  - Wind erosion.
- Mine and wastewater impoundments – construction:
  - Clay and rock fill (unloading from vehicles, formatting and compacting); and,
  - Wind erosion.
- Aggregate quarry –preparatory works and operation:
  - Top soil removal (excavation, loading into vehicles);

- Drilling and blasting;
- Excavations (crushing of oversize blocks, stockpiling, loading into vehicles);
- Crushing and classification; and,
- Wind erosion.

3.2.2.1.1 Operations Phase

Particulate matter emissions:

- Open pits:
  - Drilling;
  - Blasting;
  - Crushing of oversize blocks;
  - Grading;
  - Stockpiling;
  - Loading into vehicles;
  - Transportation; and,
  - Wind erosion.
- Waste rock disposal sites:
  - Classification of material,
  - Unloading from haul vehicles, and,
  - Wind erosion.
- Low-grade ore stockpile area:
  - Classification of material;
  - Unloading from the haul vehicles;
  - Handling of materials; and,
  - Wind erosion.
- Processing plant – controlled and uncontrolled unducted sources:
  - Run-of-mine ore stockpile (unloading from vehicles, handling and wind erosion);
  - Crushing (unloading from vehicles, crushing, conveyor transfer point);
  - Crushed ore stockpiles (conveyor transfer point); and,
  - Wind erosion.

The estimations for the average/maximal metal concentrations in dust will be for the following metallic elements: As, Ba, Sb, Cu, Pb, Sn, Mn, Cr, Ni, Zn, Co, V and Zr.

For the processing plant, which will be operational during this project phase, the following emissions will be considered:

- Fugitive emissions;
- Ducted sources (Total suspended particulates TSP, PM10, As, Cu, Pb, Cr, Ni, Mn, Co):
  - II. Reclaim, secondary crushing and lime adding:
    - Mass flow rates (g/h);

- Air flow rates (m^3/h); and,
- Concentration in emission (mg/m^3).

III. Gold and silver recovery (furnace for carbon regeneration, electrolysis cell, reagent tanks, lime hydration mill, lime silos):
- Mass flow rates (g/h);
- Air flow rates (m^3/h); and,
- Concentration in emission (mg/m^3).

IV. Smelting and casting into ingots (smelting furnace, slag crushing):
- Mass flow rates (g/h);
- Air flow rates (m^3/h); and,
- Concentration in emission (mg/m^3).

Closure Phase

- TMF rehabilitation:
  - Backfilling (unloading from vehicles, spreading and compacting); and,
  - Wind erosion.
- Waste rock disposal site rehabilitation:
  - Site levelling and re-grading (classification of material);
  - Backfilling (unloading from vehicles, spreading and compacting); and,
  - Wind erosion.
- Processing plant decommissioning:
  - Soil wastes (loading);
  - Backfilling (unloading from vehicles, spreading and compacting); and,
  - Wind erosion.
- Rehabilitation of topsoil stockpiles areas:
  - Backfilling (unloading from vehicles, spreading and compacting); and,
  - Wind erosion.

3.2.2.2 Exhaust gases

The primary emissions from the project will be from the internal combustion engines of haul trucks and mobile equipment. Exhaust gases from internal combustion gases contain nitrogen oxides (NO_x, N_2O), carbon oxides (CO, CO_2), sulphur oxides, volatile organic compounds (VOCs) (methane and non-methanic organic compounds), volatile and condensable polycyclic aromatic hydrocarbons (in case of equipment) and metal-bearing particulate matter (Cd, Cu, Cr, Ni, Se, Zn, Pb).

The requirement for mining equipment was calculated based on the annual mine production schedule, the mine work schedule, and equipment shift production estimates. *Table 3.7* presents the projected mine equipment fleet during the operation phase of the project.

Table 3.7 Mine Equipment Fleet

Equipment Type	Year of operation																	
	Prep	1	2	3	4	5	6	**7**	8	9	10	11	12	13	**14**	15	16	**17**
Blasthole Drill	**1**	3	3	3	3	3	3	**3**	3	3	3	3	3	3	**3**	3	2	**2**
19.5 cm (25.5 cy) Hyd. \Shovel	**1**	3	3	3	3	3	3	**3**	3	3	3	3	3	3	**3**	3	3	**3**
Wheel Loader (656kw/880hp)	**1**	1	1	1	1	1	1	**1**	1	1	1	1	1	1	**1**	1	1	**1**
Haul Truck (150 t)	**5**	14	14	17	18	18	18	**22**	23	23	20	19	17	15	**15**	13	13	**9**
Track Dozer (354kw/474hp)	**2**	3	3	3	3	3	3	**3**	3	3	3	3	3	3	**3**	3	3	**3**
Wheel Dozer (392kw/525hp)	**2**	2	2	2	2	2	2	**2**	2	2	2	2	2	2	**2**	2	2	**1**
Motor Grader (198kw/265hp)	**1**	2	2	2	2	2	2	**2**	2	2	2	2	2	2	**2**	2	2	**2**
Water Truck (746kw/1000hp)	**1**	2	2	2	2	2	2	**2**	2	2	2	2	2	2	**2**	1	1	**1**
Wheel Loader (380kw/520hp)	**1**	1	1	1	1	1	1	**1**	1	1	1	1	1	1	**1**	1	1	**1**
Haul Truck (60t)	**1**	1	1	1	1	1	1	**1**	1	1	1	1	1	1	**1**	1	1	**0**
Rock Drill	**1**	1	1	1	1	1	1	**1**	1	1	1	1	1	1	**1**	0	0	**0**
Excavator (140kw/188hp)	**1**	1	1	1	1	1	1	**1**	1	1	1	1	1	1	**1**	0	0	**0**
TOTAL	**18**	**34**	**34**	**37**	**38**	**38**	**38**	**42**	**43**	**43**	**40**	**39**	**37**	**35**	**35**	**30**	**29**	**23**

For the main phases of the project and for one or more representative years of the operations, the hourly emissions of pollutants from mobile sources released into the atmosphere by the equipment and vehicles will be calculated. The mass flow rates (g/t) will be estimated for: NO_x, CH_4, VOC, CO, N_2O, SO_2, particulates, Cd, Cu, Cr, Ni, Se, Zn and PAH.

In the case of blasting activities, the emitted quantities of NO_x, CO, SO_2 (kg/blast) will be considered, which will be estimated for each project phase and the representative years and for each operational location (aggregate quarry, open pits).

For the thermal plant (construction phase) the ducted emissions of pollutants ($NO_{x,}$, CO, SO_x, total particulates, organic particulates, N_2O, CH_4, TOC, formaldehyde, benzene, PAH, benz(a)anthracene, As, Cd, Cr, Ni) will be calculated, including the following parameters, and indicating the Emergency Threshold (mg/Nm^3) and the Intervention Threshold (mg/Nm^3):

- Mass flow rates (g/h);
- Gas flow rates (Nm^3/h); and,
- Emission concentration (mg/Nm^3).

Secondary emission sources within the Construction Camp are the following:

- Fuel tanks: storage and supply/delivery operations – fugitive emissions of volatile organic compounds (gasoline and diesel type hydrocarbons): maximum 1500 g/hour; and,
- Equipment and vehicles repair activities - fugitive emissions of volatile organic compounds and pollutants contained in the exhaust gases, but in very low amounts compared to those released by internal traffic and by fuel handling.

The stationary sources related to ancillary facilities and activities in the processing plant site are the following:

- Fuel storage area; and,
- Backup power generator.

The fuel storage area represents a complex of ductless sources of VOC – hydrocarbons specific to distilled oil products (diesel and gasoline – containing predominantly light hydrocarbons: butane, pentane, hexane). VOC emissions are generated by evaporation losses on:

- Free surface of the oil product stored in the fuel tanks, with emissions taking place through portholes; and,
- Product handling: tank filling and delivery. Emissions take place through tank portholes and vehicle fuel intakes.

The activities leading to VOC emissions are related to storage and handling of oil products. In the case of fuels, VOC emissions occur during all three related activities: storage, tank filling and delivery.

The fuel storage area will have the following capacities:

- Diesel storage tanks – 800 m^3; and,
- Gasoline storage tanks – 20 m^3.

The total annual amount of fuel conveyed through the storage area will be approximately 18,300 m^3 (15,830 t). The storage tanks and the related fuel station will be provided with fuel vapour recovery systems.

VOCs air emissions (g/h, t/year) associated to the following activities will be estimated:

- Storage;
- Supply; and,
- Delivery.

Also, emissions of persistent organic pollutants (POP): benzene, toluene and m,p-xylene will be estimated.

Backup power generator: the following parameters of ducted emissions will be considered for each pollutant (NO_x, CO, SO_x, total particulates, PM_{10}, CH_4, TOC, formaldehyde, benzene, toluene, xylenes, PAH, dibenz(a)anthracene, benz(a)pyrene):

- Mass flow rates (kg/h);
- Gas flow rates (m^3/h); and,
- Concentration in emission (mg/m^3).

3.2.2.3 Global Impact and Greenhouse Gases

The greenhouse effect, generated by the release of certain gases into the atmosphere, is produced in two different ways: by a reduced loss of long wavelength (caloric) radiations from the Earth's surface and by increased solar radiation (especially in the UV domain) reaching the surface of the Earth due to the depletion of the ozone layer.

Water vapour is the primary greenhouse gas. Large amounts of water vapour are discharged into the atmosphere through natural processes such as evaporation, respiration, and transpiration. Greenhouse gases generated by natural processes and/or by human activities are carbon dioxide (CO_2), carbon monoxide (CO), methane (CH_4), nitrogen oxides (NO_x), ozone (O_3) and halocarbons. Particulates from natural sources such as volcanoes may also contribute to variations in global warming.

Gold mining operations are not considered large dischargers of greenhouse gas emissions although they do use electricity and fossil fuels to power the operations. While the debate over the effect of greenhouse gases on global warming continues to evolve, RMGC views any reduction of greenhouse gases and its attendant decline in energy consumption to be a prudent management strategy.

3.2.3 Air Management and Mitigation Activities

As part of the proposed management system an *Air Quality and Noise Management Plan* will be developed which will detail the air management activities during construction, operation and closure of the Project. Air monitoring activities will be detailed in the *Environmental & Social Monitoring Plan.* Specific *Standard Operating Procedures (SOPs)* will be developed for both air management and monitoring.

In summary, RMGC will implement a number of dust avoidance and suppression measures, as described below.

Fugitive dust avoidance measures will include:

- Maintaining and sealing road surfaces;
- Controlling haul vehicle speeds;
- Attention to haul vehicle design avoiding downward pointing exhausts;
- Minimising drop height in material handling; and,
- Using coarse blasthole stemming materials (not drilling dust).

Dust suppression measures will include:

- Haul road watering as appropriate to surface conditions and potential receptors;
- Dust extraction system on blasthole drilling rigs and removal of dust from blast bench; and,
- Re-soiling/seeding of bare ground as appropriate.

Mitigation against blowing dust and subsequent dusting from the TMF will be achieved mainly via control of the moisture content of the tailings surface, by tailings delivery management (re-positioning delivery points), management of the decant pond area, and surface sprinkling using decant water, as required (e.g., during adverse weather conditions).

Residual gases and suspended particulate matter

Capture and control systems for residual gases and dust within the Construction Phase relates to potentially ducted sources, namely: the thermal plant and the concrete batch plant, during the construction phase, and process equipment during the operation phase.

Exhaust gases from the thermal plant will be captured and released into the atmosphere through a stack at least 20 m high. For this source, no extra abatement measures will be necessary, as they will use low-sulphur (<0.8 %) liquid fuel with estimated emission of pollutants below the limits provided for by M.O. 462/1993. These concentrations will also be smaller than the emergency and intervention thresholds.

Installation of emissions capture and control systems (particulates capture) will necessarily be carried out for cement and lime silos: bag filters (with vibration-joggle recovery).

These treatment systems will lead to concentrations smaller than the emergency and intervention thresholds, and also, below the limits provided for by M.O. 462/1993.

Other sources related to the process plant and the corresponding mitigation measures are:

- Primary crushing, crushed ore downloading onto the conveyor belt at the ore stockpile and loading from this deposit to SAG mill – dry fog system;
- The SAG mill, the classifier and the pebble crusher will be sited indoors and fitted with a mechanical installation for dust collection and treatment ;
- Grinding will be carried out by wet procedures;
- Sodium cyanide storage tanks (alkaline environment, buffered to pH > 11.5 with sodium hydroxide in order to prevent HCN generation), with evacuation through a stack at ambient temperature;
- Acid wash and carbon neutralisation – this is a closed system. Future requirements may warrant a local installation of columns with light solution of NaOH for capture and evacuation of air contaminated with HCN traces generated by the acidic environment; with evacuation through a stack, at ambient temperature;
- Elution columns – this is a closed system. Future requirements may warrant a local installation for capture and evacuation of air used for column ventilation (hot process, heat carrier supplied by a boiler), with evacuation through a stack, at ambient temperature;
- Regeneration Kilns Nos. 1 and 2 for carbon reactivation – local installations for capture and evacuation of air loaded with water vapours and carbon particles, evacuation through a stack, at a temperature of 80ºC;
- Electro-winning cells – local installation for capture and evacuation of air with traces of ammonia resulting from partial decomposition of cyanide to cyanate at the anode (see the chemistry of the gold recovery process); evacuation through a stack, at ambient temperature. Capture of traces of reagents (particulate matter escaped from handling), connected to an air emission control system; air flow rate 1000 Nm^3/h, evacuation through a stack, at ambient temperature;
- Storage of sodium metabisulphite – this is a covered system with vent. Future requirements may warrant a local installation for capture and evacuation of air contaminated with traces of reagents (particulate matter escaped from handling); with evacuation through a stack, at ambient temperature;
- Storage of NaOH - this is supplied as a liquid so does not have any possibility of particulate or gaseous emission;
- Retort for mercury recovery - the boat chamber is provided with exhaust system; water and mercury vapours are condensed into a collector. The mercury vapours are discharged to the bottom of the condensing recipient, and the water vapours as well as the mercury vapours are retained in a cooling condensate/water installation, which performs the fog elimination. The air flux with remaining mercury traces goes through an active carbon tower impregnated with sulphur. This sulphur reacts with the mercury traces forming mercury sulphide, which precipitates. The air flux then goes through a separator and is released into the atmosphere; the retort is provided with a hood for mercury recovery during the loading and downloading of the furnace burden. The hood is connected to a ventilator and an exhausting system. It is intended that the system eliminates mercury emission into the atmosphere;
- Lime silos Nos. 1 and 2 – local installations for capture and evacuation of air contaminated with lime particulates (from loading operations). The particulate capture systems are connected to a baghouse type control system of the emissions. The lime transportation systems are indoors;
- Lime hydration mill – this is a wet system. Future requirements may warrant a local installation for capture and evacuation of air laden with water vapour and contaminated with hydrated lime;

- TMF – low free cyanide and WAD cyanide concentration at levels below national and internationally permitted levels (e.g., draft EU Mining Waste Directive, World Bank Group guidelines), resulting in a very low HCN emission rate;
- Smelting furnace – local installation for capture and evacuation of air contaminated with fine particulates (gold and silver oxides, oxides of other metals) generated by evaporation of metals and condensation in air. Evacuation through a stack, at a temperature of 80ºC. The treatment system consists of a wet tower scrubber; and,
- Slag crusher – installation for capture and evacuation of air loaded with metal particulates, evacuation through a stack, at ambient temperature.

The additional abatement of particulate emissions, which represent the most important pollutant from unducted sources related to the process, will be achieved by a spray installation over ROM and crushed ore stockpiles.

Sources related to ancillary facilities and activities:

- Fuel storage area – tanks and fuel pumps fitted with fuel vapour recovery systems for VOC; and,
- Backup power generator – intake stack and forced evacuation of gases.

Only ducted sources can be assessed with regard to applicable legal provisions (M.O. 462/1993, M.O. 756/1997 and Government Decision 568/2001). Details concerning mass flow rates of released pollutants, flow rates of contaminated gas/air emissions, and concentrations of atmospheric emissions will be given for each source in the EIA study.

The most important conclusions to be drawn from the analysis of the Project and of the results to date regarding the emissions into the atmosphere are the following:

- All sources related to the processing plant, and with emissions that can be retained with currently available technology, are fitted with mechanical installations for capture and evacuation of contaminated gases/air;
- The most important sources related to the production process and which determine significant pollutant emissions are fitted with highly efficient emission control (abatement) systems; and,
- The technology, equipment and installations used, are designed according to high performance standards both for productivity and for air quality protection following procedures that have been applied for many years in the gold mining and processing industry worldwide; the abatement of emissions is thus intrinsic to the technology, equipment and installations involved.

It is planned to ensure that pollutant concentrations in emissions from ducted sources will be below the limits provided by M.O. 462/1993 and Government Decision 568/2001. These will also be below the emergency and intervention threshold provided by M.O. 756/1997.

Unducted sources (other than VOC emissions in fuel storage area) cannot be assessed with regard to applicable regulations concerning emission concentrations. Their evaluation will be done on the basis of results concerning the impact on environmental air quality.

3.3 PROTECTION AGAINST NOISE AND VIBRATION

3.3.1 Sources of Noise and Vibration

Blasting for ore exploitation, as well as operation of heavy machinery and equipment will represent the main sources for noise and vibrations, as indicated in *Table 3.8 Potential Sources of Noise and Vibrations.*

Table 3.8 Potential Sources of Noise and Vibrations		
Mining Operations	Blasting, excavation, loading	Noise and vibrations from blasting, functioning of heavy machinery for ore loading and transport.
Processing	Ore stockpile	Noise from vehicle and equipment used for ore stockpiling.
	Crushing and milling	Noise and vibrations from equipment used for ore crushing and milling.
Waste rock disposal		Noise and vibrations from vehicles used for waste rock haulage and unloading.
Mine, plant and office facilities		Noise and vibrations from vehicles and equipment used for different activities performed in the mine sites.
Ore haulage and transport of personnel		Noise from vehicles used for materials and personnel transport.

3.3.2 Noise Sources

Current Situation

Sources of noise associated with the existing mining operations are open pits (drilling, blasting and excavation operations), surface ore transportation, ore transportation via conveyor, operation of locomotives with electrical or diesel engines, preparation plant, workshops and road traffic.

Traffic on local roads contributes to local ambient noise levels. Official traffic census data are not available for local roads; accordingly RMGC undertook a traffic survey during May 2001, which will support assessment of baseline conditions in the EIA. The local road network and the location of traffic census points are shown on *Exhibit 3.1 Traffic Census Locations*. The National Road DN 74A skirts the western side of the Project area and provides a link with the Romanian truck route network via the regional centre of Albă Iulia (*Exhibit 1.2*). This road sees moderate use by a mix of heavy and light vehicles in line with its role as a link between centres of population in Albă Iulia County.

National road DN 74 connecting Abrud to Brad to the west carries significantly lower volumes of traffic compared to DN 74A. Other roads include the County Road DJ 742, which links DN 74A with Roşia Montană and Corna. This road is used by a mix of heavy and light traffic with heavy lorry traffic associated with mining activities.

Construction Phase

During the construction phase the following activities are likely to generate noise:

- On-site vehicle traffic (haul trucks, bulldozers, and other heavy equipment):

  The construction of the various features of the mine will require the operation of heavy machinery including excavators, front-end loaders, bulldozers, graders, tip trucks, off-road haul trucks, and compactors. Operation of heavy machinery will be required for the following construction activities: TMF starter dam, water management dams, access and haul roads, processing plant, construction camp, laydown areas, topsoil stockpiles, clearing and grubbing of the tailings impoundment, waste rock disposal sites, and open pit areas, construction and operation of the quarries, and construction of water diversion channels.

- Off-site traffic:

  The delivery of construction materials, operational equipment, and heavy machinery will result in an increase in the volume of traffic on local roads. A more comprehensive evaluation of the increase of noise related traffic falls within the purview of the EIA.

- Blasting (quarries and open pit preparation):

  The operation of the quarries and the preparation of the open pits will require the use of explosives. An Ammonium Nitrate-Fuel Oil (ANFO) mixture will be the primary blasting agent, supplemented by the use of emulsion (slurry) type explosives. It is estimated that 2.25 kilograms of explosives will be consumed for each tonne of rock blasted. *Section 3.3.6* provides a description of the precise blast timing technique to be used by the project to minimise ground vibration and air-blasts and thereby reduce the potential for any damage to surrounding structures.

- General construction activities (including operation of temporary electricity generators):

  In addition to vehicle traffic associated with the construction of the mining facility, there will also be noise from the operation of the construction camp, the operation of portable generator sets, compressors and pumps, and operation of power tools.

- Off-site construction activities including water supply pipeline:

  The project will involve construction activities away from the main mining site, including the water supply pipeline. This construction would involve use of heavy equipment and the types of noise associated with general construction activities.

- Operation of concrete batch plants and temporary electrical generator:

  The mobile concrete batch plant will be operated with a concrete production capacity of approximately 60 t/hr. RMGC may also need to provide its own sources of electrical power for a portion of the construction period. This would be accomplished using conventional diesel engine generator sets.

<u>Operations Phase</u>

The mine will be operated 24 hours a day, seven days a week. The blasting and hauling activities started during construction will continue over the operating life of the mine. Construction activities at the processing plant will have ceased, and be replaced by operation of the processing plant. Key sources of noise include:

- On-site equipment and vehicle traffic:

Operation of haul trucks, bulldozers and other heavy equipment will be required for the following activities during the operation phase:

  - Drilling, blasting and loading of waste rock and ore;
  - Transportation of ore to stockpiles;
  - Transportation of waste rock to waste rock disposal sites;
  - Expansion of the tailings embankment with waste rock or selected materials from the quarries; and,
  - Operation of the water truck.

- Off-site traffic:

The operation phase of the project will result in an increase in commuter traffic and of transport trucks delivering supplies required for the processing plant and vehicle operation.

- Blasting (open pits):

Blasting will be required to excavate ore and waste rock from the four open pits. Blasting within the pits that are operational at any one time (only the Cetate and Cîrnic pits are mined for the first seven years) will be co-ordinated and scheduled to occur at the same time each day.

- Operation of processing plant:

The heavy equipment at the processing plant will generate considerable noise. Key equipment includes:

  - Gyratory crusher;
  - SAG mill;
  - Pebble crusher;

- Ball mills;
- Air blowers;
- Wastewater treatment plant; and,
- Emergency electrical generator.

In the Operation Phase rehabilitation activities will be initiated and will consist of topsoil transportation, coverage of some areas, decommissioning, demolition and other related activities. All those activities will not represent new noise sources because the same vehicles and equipment will be used for the operational phase itself.

Closure Phase

The noise sources during the closure and rehabilitation phase will be the following:

- On-site equipment and vehicular traffic:

The decommissioning of the industrial facilities and the rehabilitation of the main sites of the mine will require the operation of the same heavy machinery, as in the construction phase, including excavators, front-end loaders, bulldozers, graders, tip trucks, off-road haul trucks and compactors. Operation of heavy machinery will be required for the following activities: decommissioning of the processing plant, rehabilitation of the processing plant site, Cîrnic and Cetate Waste Rock Stockpiles, TMF site, topsoil stockpile areas, water management dams and access roads.

- Off-site traffic:

The closure phase of the project will result in an increase of transport trucks taking wastes for off-site disposal. However, the general levels of traffic will decrease in comparison with that of the other two phases.

- Blasting:

The closure phase will require limited blasting activities for rehabilitation purposes. The same types of explosives and the same technique will be used as during the first two phases.

3.3.3 Mitigation and Management Measures for Noise

The primary mitigation strategy to minimise noise and vibration impacts on inhabited areas is to ensure an adequate physical separation of working areas and neighbouring inhabitants. The width of separation maintained in a certain location will be based on site-specific conditions including the specific activity at the location and the topography of the land. The following sections describe management measures that have been planned at this time. A more detailed evaluation of impacts on sensitive receptors falls within the scope of the EIA. Appropriate management measures will be implemented as defined in the *Air Quality and Noise Management Plan*, which will be developed as part of the EIA process.

Construction Phase

During the EIA the need for noise abatement measures, such as the following, will be determined:

- Use of acoustical enclosures for noisy equipment, where appropriate;
- Maintaining all equipment in proper running order and with effective silencers. In addition to this reducing overall noise levels, this will eliminate noise emissions with impulsive or intermittent tonality. Such tonal components are often generated by malfunctioning equipment and can be eliminated by proper maintenance;
- Application of modern blasting technology including the use of millisecond delays that reduce the total power of the explosive charge seismic waves and the use of appropriate blast hole distribution to minimise, to the extent possible, the seismic wave energy resulting from

blasting. The blast holes pattern and their charging exert a significant influence on the blast effectiveness;

- Performing one blast per day which will take place at a regularly scheduled time; and,
- Identification of the need for and maintenance of suitable buffer separation from sensitive receptors.

Off-site noise will be managed by further restricting noisy activities to normal working hours in locations near sensitive receptors, and by scheduling off-site movements of heavy goods vehicles and delivery vehicles to working hours.

Operations Phase

The noise mitigation measures introduced in the Construction Phase for static equipment within the processing plant and for mobile equipment will be maintained throughout the operations phase. Surface mining activities will be carried out within deepening open pits. As the project progresses, pit walls will form an effective barrier between noise emission sources related to development of the pits and adjacent communities. Development of management and mitigation plans will address the need for noise abatement measures, including the examples provided above.

Closure Phase

It is anticipated that noise levels will be lower during this phase than during construction or operations as there will be no, or only limited, blasting activities and use of heavy machinery will be reduced. The noise abatement measures will be similar to those above mentioned.

3.3.4 Sources of Vibration

Construction Phase

The main sources of vibration that may propagate off-site are blasting and movement of heavy vehicles delivering equipment and materials to the site. Other on-site sources of vibration, such as operation of batch plants, etc; are not expected to have an effect off-site.

Operations Phase

Sources of vibrations during this phase will be associated with blasting and continued movement of heavy vehicles delivering materials to the site.

Closure Phase

Most blasting activities are expected to stop at the end of operations; however, movement of heavy vehicles will continue. As closure activities begin winding down, there will be fewer movements of heavy equipment and machinery.

3.3.5 Mitigation and Management Measures for Vibration

In addition to the seismic wave generated by blasting, and propagated into the ground, an atmospheric disturbance is produced. Pressure disturbances with frequencies above 20 Hz are perceived as noises, whereas the ones having frequencies below 20 Hz (infrasound) are perceived as air blast. Often these disturbances interact with parts of various structures, such as windows, and a transfer of energy is produced which results in these structures becoming resonant.

Blasting will be carried out during daylight hours at times to be communicated to the local population. This will minimise the startle effect of blasting. The following modern blasting principles will be adhered to, ensuring that the energy of the blast is used efficiently to break and move the rock rather than transferring vibrations to the surrounding rock mass and thereby impacting communities:

- Ensure accurate blast drilling (spacing and depth) and appropriate loading with explosive charges;

- Assess results of monitoring and adjust blast design and practice as required to minimise vibrations to acceptable levels;
- Maintain liaison with local community, including establishing a complaints procedure;
- Use millisecond delays in blasting, thereby reducing the instantaneous total power of the explosive charge and associated seismic waves;
- Blast hole pattern and the detonation sequence, which can exert a significant influence on the blast effectiveness, will be used to minimise to the extent possible the seismic wave energy resulting from blasting; and,
- Schedule of blasting at one fixed time per day.

The abatement of airblast-induced vibration may be achieved through:

- Use of millisecond delays between blasts, which will significantly reduce air blast. It is anticipated that this practice will result in lower levels of induced-induced vibration than from current mining activities. This will be further evaluated in the project detailed design stage and monitored and adjusted throughout the operations phase.

The impact of vibration arising from increased heavy traffic on local roads will need to be the subject of evaluation in the EIA process.

The vibration abatement measures implemented during the operation phase will be the same as during the construction phase and it is anticipated that vibration and induced impacts on receptors will be lower than existing levels.

During closure, vibration will be restricted to the operation of heavy machinery required in the dismantling of those features of the mine no longer required and to occasional blasting. Operation of vehicles near sensitive receivers will be limited to agreed hours and vehicles will be maintained in proper running condition.

3.3.6 Precise Blast Timing

The design of surface mine blasts has been revolutionized during the last 30 years with the advent of Non-Electric (Nonel) millisecond delays for blast timing and initiation. Blast initiation for surface mines is accomplished by using lightweight detonating cord to carry the detonation from hole to hole. This light initiating cord is so small that it does not contribute significantly to noise.

Two types of Nonel delays are used:

- Surface delays are used to momentarily delay the detonation front along the surface initiating cord (millisecond intervals); and,
- Down hole delays are located in the hole as part of the blast initiator and are also used to momentarily delay the detonation of the booster (again by millisecond intervals). Typical large open pit hard rock mines may initiate blast sequences that contain 50 to 80 blast holes. However, during that sequence only a small number of holes are fired simultaneously.

Ground motion away from the blast is a function of the separation distance and amount of explosives detonated simultaneously. When the firing sequence is properly delayed, only small amounts of explosives are detonated simultaneously. The blast sequence controlled by Nonel delays allows for the multiple small “blasts” to work as single unit without generating any more off-site ground motion than the individual small blast.

The millisecond delays work well because the physical movement of rock away from a single blast hole is about 3 milliseconds per metre. For example, if two rows of blast holes are separated by eight metres, the second row will experience rock breakage approximately 24 milliseconds after blasting of the first row and detonation of the second row can be timed to maximise the efficiency of its breakout response to this.

When a mine blast is properly executed, the observer will see the ground rise and settle in a wave pattern in the same way as if one has gently induced a wave in a carpet on the floor. As the wave propagates, there are multiple small explosions keeping the rock breakage wave moving.

Precise delays combined with a proper match of down hole explosive type and velocity to the rock mass will result in efficient breakage of the rock and no damage to surrounding structures.

3.4 PROTECTION AGAINST RADIATION

3.4.1 Sources of Radiation

There are no natural sources of radiation in or around the mining areas. The geological setting of the project does not have radioactive material. However, certain process monitoring equipment to be used in the project contains minor quantities of radioactive material as described below.

Density Measuring Nuclear Devices

Density measuring devices will be used to monitor the density of the ore/tailings at key points in the process plant including: the crusher discharge, the regrind mill discharge and the CIL tailings thickener. These devices contain small amounts of radioactive material. When installed and handled as designed they do not pose any risk to human health. RMGC will install devices that are supplied by the authorized dealer/supplier and operate them in accordance with supplier recommendations.

Electric and Magnetic Fields

The high voltage power transmission lines that cross the site will generate electric and magnetic fields.

The electric and magnetic fields from electrical transmission lines are at the relatively long wavelength and low frequency end of the electromagnetic spectrum. Their energy levels (quanta) are unable to break molecular bonds, do not effect biological cells, and are considered non-ionising.

The low energy fields caused by the electric power transmission lines within the Project area are not anticipated to have any adverse effects on humans or other life forms.

No other source of radiation will be present or operated in the Project area.

3.4.2 Protection

Density Measuring Devices Containing Radioactive Substances

RMGC will apply for the necessary permits required in Romania for the transport, installation, and operation of density measuring nuclear devices. The devices will be installed and operated in compliance with the specifications of the manufacture of the devices and accepted international best practice.

Electric and Magnetic Fields

Countries of the world have their own standards concerning exposure to radiation. The International Commission on Non-Ionising Radiation Protection (ICNIRP, 1990; 1998) has published interim guidelines on limits of exposure to 50/60 Hz electromagnetic fields. The ICNIRP (1998) guidelines state that occupational exposure continuing throughout the working day should be limited to below 4,167 mG for magnetic fields and below 8.33 kV/m for electric fields. The guidelines also state that exposure for members of the general public should be limited to 833 mG for magnetic fields and 4.16 kV/m for electric fields.

Romanian *General Norms for the Protection of Workers 2002* state limits of electric exposure as 10 kV/m per shift, with magnetic exposure limits of 0.5 mT (5,000 mG).

Recorded measurements in the proximity of the existing 110 kV power lines have shown values of the magnetic fields at less than 100 mG. With the addition of the new substation at Roşia Montană, the charge of the conductors will increase somewhat, as will the magnetic fields. An expected increase of about 50-60 mG will still render the levels of magnetic fields far below the international limits.

The right-of-way for the electricity line will be designed to ensure that both the national and international exposure guidelines are met. In addition, no residences or permanent structures will be allowed within the designated right-of-way for the transmission line.

3.5 PROTECTION OF SOIL AND SUBSOIL

3.5.1 Soil Characteristics and Land Use

The soil types found in the project area are presented in *Exhibit 3.2 Soil Types*.

The present assessment of land-use has been restricted to general description, assessing impacts on the basis of land use capability of the sites, in terms of potential productivity and the loss of the soil resources. It has not considered impacts of loss of land to individual farmers.

The topography and geology of the area dictate, to a significant extent, the nature of the agriculture and forestry land uses in the study site. The mountain setting restricts agriculture to low output farming, including: grazing of stock and hay production conducted on the steep hillsides. Access for farm machinery is severely limited due to the terrain and most land work is conducted by hand with transport by horse drawn cart. No synthetic fertilizers or sprays are used, largely due to the impracticality of their application. Farmhouses and buildings are generally located along the valley floors.

Much of the upper slopes of the valleys are covered with deciduous woodland (mainly beech) that is utilised as both a local fuel source and increasingly for construction timber.

The other major land use is mining, which occupies the Roşia Valley and surroundings consisting of both the current workings (open pit and haul roads) and a large area of remnant historic mine workings. Much of the historic area is now considered to be semi-derelict land with no formal use.

The main centre of population is the village of Roşia Montană, with smaller settlements following the orientation of the river valleys or scattered around the hillsides.

The two primary limitations to land-use in the study area are generated by the steep slope gradients and shallow depths of fertile soil. By the *Romanian Land Capability Rating System* the majority of the study area is graded as Class V land, with limitations on its use from the severe slopes.

Some areas also have limitations due to inadequate soil depths, with either thin natural soil over bedrock or disturbed areas with thin soils formed from the weathering of exposed bedrock material. Rock outcrops cover part of the site either as natural features or as exposures left from historic mining. These areas are graded as Class VI, suitable only for haymaking or forestry and are unsuitable for agricultural production.

3.5.2 Potential Impacts

3.5.2.1 Site-wide Impacts

The proposed mine development has several main components which have the potential to impact on the soils and land-use potential of the area. These approximate disturbance areas during three phases of mine activity are detailed in *Tables 3.4, 3.5, and 3.6*.

It is evident that the primary impact arising from the Project operations is the loss of land within the footprint of the mine and industrial development; soil contamination represents a much smaller secondary impact.

The degree to which the land use is impacted is a function of the quality of the land affected and the ability to mitigate the impacts. *Tables 3.9, 3.10*, and *3.11* summarise the Project activities that are likely to impact land quality and area during the construction, operations, and closure phases of the project, respectively.

Table 3.9 Potential Soil Pollutants and Activities During Construction

Pollutant / Activity	Location / Feature
Soil loss and land use loss as a result of Project development.	Areas including: open pits; waste rock disposal sites; TMF dam; processing plant; topsoil stockpiles; and, ancillary facilities.
Agricultural and forestry land use degradation as a result of deposition of particulates from construction activities and wind erosion.	Zone around the Project area with the potential for impact on vegetation.

Table 3.10 Potential Soil Pollutants and Activities During Operation

Pollutant / Activity	Location / Feature
Soil loss and land use loss as a result of Project development.	Areas including: open pits; waste rock disposal sites; TM impoundment; processing plant; topsoil stockpiles; and, ancillary facilities.
Agricultural and forestry land use degradation as a result of deposition of particulates.	Zone around the Project area with the potential for impact on vegetation.
Temporary degradation and erosion of soil quality during storage.	Topsoil stockpiles.
Contamination of soils from leaks or spills of process chemical and effluents such as cyanide, caustic soda, hydrochloric acid, lime, flocculants, fuel oils/lubricants.	Soils and sub-soils at or near the roads, plant site and storage areas.

Table 3.11 Potential Soil Pollutants and Activities During Closure

Pollutant / Activity	Location / Feature
Re-establishment of land use after closure and reclamation	Process plant site, TMF, water management dams, and waste rock disposal sites
Replacement of soil and rehabilitation of affected lands.	Soil rehabilitation and re-vegetation of the impacted sites throughout the Project area.

The current land use includes the existing mining operations, ancient mining impacted areas including old waste rock piles and rock exposures around old workings, woodland plantation consisting primarily of conifers and areas of urban and urban fringe development. This urban fringe development includes small agricultural fields used for grazing and hay production.

A large part of the industrial zone, and in particular the area of the proposed pits, consists of current or ancient mining disturbance. The areas around the pits are either covered with vegetation or are urban fringe zones. Due to the thin soils and very steep slopes the land use potential is classified as low (*Romanian Land Capability Rating Class VI*).

The current mining areas have not been assessed, as their current land use will remain unchanged. The soil resource associated with the old mining areas is significantly depleted, as most natural topsoil has been lost during the mining operations, leaving either bare rock or shallow soils resulting from the weathering of the in situ materials. The soils in the old mining areas are not capable of supporting productive use and are not considered an important soil resource.

In the woodland areas the topography is typically steeply sloping with thin soils formed directly over weathered bedrock (Leptosols). Within the urban areas the soil resources are found within the small fields associated with the settlement fringe. On the lower slopes of the hillside the soils are silty and clayey with moderate potential for productivity.

3.5.2.2 Process Plant Site

The plant site occupies land on the relatively gentle upper slopes of the ridge to the southeast of Roşia Valley. The plant site will be constructed using cut and fill techniques to create level development platforms. Topsoil will be stripped, salvaged, and stockpiled.

The plant site is in an area of mixed agricultural and forestry use. There are no inhabited dwellings or farm buildings within the site boundary. Agricultural use is restricted to pasture or forage production. Woodland areas are small with cut wood being used for fuel and building materials. The construction of the plant site will result in the loss of the existing uses within the site perimeter.

The soils are moderately deep silty soils over weathered bedrock. The surface soils and weathered rock provides an average rooting profile in excess of 1 m. This varies where competent rock occurs locally within 0.5 m of the surface, which results in the soil having only a moderate potential for productivity.

3.5.2.3 Waste Rock Disposal Sites and Tailings Management Facility

The proposed locations of the waste rock disposal sites, the low-grade ore stockpile, and TMF and water management dams, are in the Roşia and Corna Valleys. Old waste rock piles are located on the upper slopes, at the head of the Corna Valley in the general vicinity of the future waste rock disposal sites. The TMF dam and impoundment, a portion of the low-grade stockpile, and the Cîrnic Waste Rock Drainage Pond, will be located in the Corna Valley. The Cetate Waste Rock Disposal Site and the remainder of the low-grade ore stockpile will be located in the Roşia Valley.

The Roşia and Corna Valleys are primarily agricultural with a series of farmsteads situated along the valley floor. Agricultural activity includes cattle and sheep pasturing and fields for forage, with small gardens for vegetable cultivation. Overall the valleys have restricted capability for agricultural use (*Romanian Land Capability Rating Class V*).

The principal impact on land use is the potential loss of existing uses. On a local scale this area of loss is assessed to be of moderate significance. On a regional scale, the loss of this area of poor quality agricultural land is of limited significance.

Potential secondary impacts to the agricultural productivity of the surrounding area are from the deposition of dust from the tailings surface, waste rock disposal sites and low-grade ore stockpile.

3.5.2.4 Topsoil Stockpiles

Topsoil stockpiles are proposed at a number of points around the industrial zone. Final selection of alternative sites must necessarily consider:

- Haul distances and routes from source areas and to final restoration areas;
- The footprint of each stockpile, sterilization of underlying areas and minimisation of impacts on existing land use;
- Height and profiling of stockpiles to minimise degradation of soil components;
- Minimisation of losses due to erosion and maintenance of stockpile stability; and,

- Situating of stockpiles to minimise other site impacts (e.g., noise suppression, visual intrusion etc.).

Exhibit 2.6 Site Conditions at Year 14 illustrates proposals for stockpile sites at their maximum extent, with locations at the head of the Roşia Valley and also between Salistei and Corna Valleys. The evaluation of alternative options will be part of the EIA process. Land use at potential sites for soil stockpiles is primarily agricultural with cattle and sheep pasturing and fields for forage; there are limited areas of woodland.

Sterilization of the soil resource under the topsoil piles will be temporary for the life of the project. Following removal of the topsoil stockpiles the soils can be utilised for their original use as supporting fodder for grazing and forage.

3.5.3 Mitigation of Impacts on Soil and Subsoil

With respect to land use and impacts on people, the proposed mitigation strategy centres on the *Resettlement and Relocation Action Plan (RRAP)*. The *RRAP* ensures that people affected by land take will be resettled and compensated to minimise impact on their social and economic well-being. Details on the protection of human settlements and mitigation of social and economic impacts are presented in *Section 3.7.*

The principal strategy for the mitigation of impacts on the soils and land-use resources of the area is to establish a closure plan that maximises the re-establishment of appropriate uses, by conserving the soil resources of the site. As part of the closure strategy, topsoil and subsoil resources within selected areas will be stripped prior to operations and stored, separately, for use as restoration material during progressive and final closure. Detailed soil handling storage and replacement will be specified as part of the preliminary and final closure planning.

3.5.3.1 Open Pits

The current mine plan specifies that mining in the Cîrnic pit will be completed prior to the end of mining. Therefore, this pit is available for backfilling with waste rock, with subsequent topsoil cover, during the later years of the mine life. The long-term closure strategy proposed for the other pits is to allow each pit to flood, creating an area of open water covering the waste rock and rock outcrops. No formal use is defined for these areas but closure will aim to enhance the ecological value of the site. The establishment of vegetation cover on exposed benches will be encouraged.

3.5.3.2 Process Plant Site

At the plant site, cut and fill operations will be undertaken to create the level platforms required for the construction of the plant and associated structures. Prior to this operation, soil will be stripped and stockpiled for use in the final restoration of the site. At closure, all plant and machinery will be removed. Soil will then be replaced and the land-use re-established. Therefore the presence of the process plant represents only a temporary loss of land use and soil. The generally low relief topography of the reclaimed plant site will make it much more useful for a variety of land uses than the original sloping terrain.

To ensure that no contamination of the sub-soil from process chemicals and effluents occurs during the operational phase of the plant, an environmental management plan will be developed that will provide for the safe handling and storage of all potentially contaminative materials. The appropriate development and operation of this plan will ensure that the future land-use potential of the area is not compromised by contamination liabilities.

In addition, RMGC's production facilities will be designed and constructed to standard and accepted engineering specifications consistent with international standards, the manufacturer's guidelines, and all (local, regional, and national) Romanian regulatory requirements. All tanks and pipelines for process solutions will be constructed of steel, high-density polyethylene, or other materials known to be compatible with the materials being stored or handled.

Specific design measures for primary and secondary containment of hazardous materials used within the plant area are presented in *Section 3.9***;** a containment pond will be constructed at the plant to capture all surface water runoff.

3.5.3.3 Waste Rock Disposal Sites

All waste rock disposal sites will remain in situ at closure and will be progressively restored to an appropriate after use during the operational and post closure phases. Final restoration strategy will be designed to allow the re-establishment of alternative land uses.

Prior to the placement of waste rock, soil will be stripped from the disposal sites and stockpiled for use in the rehabilitation of the area. The rock materials are currently being assessed to determine their potential to generate ARD. The final cover system will be designed to control any potential contamination and to facilitate the development of a sustainable vegetation cover.

3.5.3.4 Tailings Management Facility (TMF)

The TMF accounts for the single largest area of project land requirement. At closure the dam and impoundment will significantly alter the landscape in the Corna Valley and will permanently alter the land use potential of the site.

The TMF at closure will consist of two main features: the downstream slope of the embankment and the near flat tailings surface. The embankment slope will be approximately 180 m in height (toe to crest elevations) with a final crest length of approximately 1.1 km. The slope of the embankment face will be similar to the existing valley side and at completion will be soil covered to provide a growth medium suitable for the establishment of a grass and tree cover.

The tailings impoundment area will be approximately 300 ha. The final cover is designed to avoid any surface acid generation. The final cover system placed over the tailings will be designed to allow for the development of a grass cover with the intention of re-establishing a meadow system on this area.

The creation of this large level platform within the valley effectively removes the slope limitation to land use within the area, thus providing more options in the selection of an end use or uses, including any combination of productive, conservation, or recreational uses.

3.5.3.5 Topsoil Stockpiles

The topsoil stockpiles will be removed and redistributed at the completion of the project. The former stockpile undersides will be rehabilitated and seeded back to alternative land use (pasture, forage or woodland).

3.6 PROTECTION OF TERRESTRIAL AND AQUATIC ECOSYSTEMS

3.6.1 Existing Situation

RMGC has engaged international consultants to work in conjunction with Romanian specialists of recognised international stature to prepare a detailed *Ecological Baseline Report* for the project area, which will be submitted as part of the EIA. The limits of the baseline study area were extended in order to reach the natural limits of the local watersheds which include the entire watershed areas for the Roşia Montană, Corna, Abruzel and Saliste streams, and the southern part of the Vartop stream catchment.

The existing ecological situation around the Project Area is summarised below.

Vegetation

The area comprises a wide range of landscape and vegetation types, as presented in *Exhibit 3.3*. The principal determinants are topography, geological parent material and climate; because of this framework inherent vegetation patterns generally follow the linear arrangement of valleys and ridges, as does the pattern of human use. The project area is a classic example of this interplay of factors. Here, the naturally occurring variability of habitats and ecosystems has been either reduced or enhanced by various land uses. Because this interaction has been ongoing for centuries or, probably, millennia, and has taken numerous forms, it is often impossible to separate the natural from man-induced influences on the vegetation cover.

Field investigations recorded the presence and locations of 34 specific vegetation community types in 11 general categories as being located within the project industrial zone and immediately surrounding area. These categories include:

- Open Cliff;
- Deciduous Forest;
- Mixed Forest;
- Coniferous Forest;
- Cultural Plantation;
- Cultural Woodland;
- Cultural Thicket;
- Cultural Meadow;
- Shallow Marsh;
- Submerged Shallow Aquatic; and,
- Floating-Leaved Shallow Aquatic.

A total of 279 plant species were recorded during the field investigations, including 233 species of herbs, 23 species of shrubs and 23 species of trees. There were no species identified during the field investigation that are listed as threatened, endangered or otherwise protected.

Terrestrial and Aquatic Fauna

Eighty-two bird species were recorded in the area during the breeding season, a conservative approach would therefore assume that all of these species are breeding in the area. Fifty-five of the bird species breeding in the area are listed under the Bern Convention (Appendix II). Six species are of conservation concern under the EU Bird Directive and require special conservation measures for their habitats. Four are species of European conservation concern, whose world population is concentrated in Europe (SPEC II). Five species are listed on both the Bern Convention (Appendix II) and the EU Bird Directive lists. Combined with the four species identified under SPEC II, a total of nine bird species have been identified as priority conservation species in the Project Area. These species include: *Dendrocopos leucotos, Dendrocopos medius, Dryocopus martius, Lanius collurio, Lullula arborea, Otus scops, Phoenicurus phoenicurus, Picus canus* and *Picus viridis*.

Five amphibian species and four reptile species were recorded in the area. One amphibian species (*Hyla arborea*) and one reptile species (*Podarcis muralis*) are listed as strictly protected fauna species (Bern Convention – Appendix II) and listed by the IUCN as Vulnerable. *Salamandra salamandra, Bufo bufo* and *Anguis fragilis* are also listed by the IUCN as Vulnerable.

Twenty-one mammal species were recorded in the area during field investigations. Two mammal species, Eastern hedgehog *(Erinaceus concolor)*, and Hazel dormouse *(Muscardinus avellanarius)* are listed by the IUCN as Vulnerable.

Sampling of aquatic macro-invertebrates was undertaken in both stream and river and lake habitats in and around the Project site. In addition, a number of quantitative techniques were employed to assess the biological quality of these water bodies.

Fish (*Carp sp.*) were reported in several local lakes in the upper sectors of the Roşia and Corna valleys. Fish species were generally absent in local streams, as well as the Abrud River, due to physico-chemical characteristics that make them generally unsuitable for fish.

Significant Ecological Features

Baseline results indicate that both the landscape and habitat structure have been significantly influenced by human activities. The deterioration of the area falls into two broad categories, namely, deterioration through landscape structural changes and deterioration through changes at the ecosystem level. These changes are attributed to: old and current mining activities and related pollution (including acid rock drainage); transformation of natural systems to meadows; human settlements and planted forests; development of semi-natural systems (man-made lakes); and, the exploitation of renewable resources. The TMF in the Salistei Valley represents such an impacted area where the deposition of tailings has resulted in habitat loss.

Such activities have resulted in significant changes to the local flora and, as a consequence, the number of habitats of interest from a conservation point of view is low.

Three sites within or adjacent to the project industrial zone contain environmental features that can be considered significant:

- Tăul Mare Rock Outcrops: located northeast of Roşia Montană, on the high points of land immediately outside the Project industrial zone, the area is comprised of a mixture of habitats, including open cliff habitats that are not found elsewhere within the Project Area. The rock outcrops provide habitats for several species of herbs, grasses and lichens, small mammals and top-level bird predators such as *Buteo buteo*. Although man-made, Tăul Mare Lake provides habitat for a number of aquatic species, including crayfish, frogs and toads, as well as serving as a source of water for local wildlife. From a biodiversity and landscape perspective, this area represents the most significant ecological feature in the Project Area;
- Virtop Valley Forest: located adjacent to the northwest section of the Roşia Valley. The complex of diverse vegetation communities includes some of the best examples of mixed deciduous forest in the general Project Area as well as a Norway Spruce plantation. The forest provides habitat for a number of area sensitive bird species, most notably resident woodpeckers such as White-backed Woodpecker (*Dendrocopos leucotos*), Middle-spotted Woodpecker (*Dendrocopos medius*), Black Woodpecker (*Dryocopus martius*), Grey-headed Woodpecker (*Picus canus*) and Green Woodpecker (*Picus viridis*), as well as amphibian species such as *Salamandra salamandra*; and.
- Salistei Valley Beech Forest: the upper catchment of this valley contains the largest contiguous blocks of Beech forest adjacent to the Project Area, although lying largely outside the industrial zone. These blocks contain most of the flora and fauna species associated with the Beech forest community, and represents the best examples of this climax forest type in the Project Area. The large size and relative remoteness of the forest blocks provides sufficient habitat for area sensitive bird species, and contributes to the greater regional mosaic of natural forest habitat to the west of the Project Area.

The position of these sites in the Project Area can de identified in *Exhibit 3.3*.

3.6.2 Pollutants and Activities with Potential to Affect Aquatic and Terrestrial Ecosystems

Pollutants and activities with the potential to impact aquatic and terrestrial ecosystems are presented in tabular format below, reflecting the construction, operations and closure phases of the project, in *Table 3.12, Table 3.13* and *Table 3.14,* respectively.

Construction Phase

Table 3.12 Potential Ecosystems Pollutants and Activities during Construction	
Pollutant / Activity	**Location / Feature**
Terrestrial habitat loss as a result of land take and change of land use.	Land take for the open pits; waste rock disposal sites; TMF; processing plant; and, ancillary facilities.
Terrestrial habitat severance and loss of wildlife corridors as a result of land take and change of land use.	Throughout the Project area, with the greatest potential for impact on existing wildlife corridors in the Corna Valley.
Disturbance of terrestrial fauna from noise, vibration, and visual disturbances.	Limited to the Project industrial zone.
Terrestrial habitat degradation as a result of dust deposition from site activities.	Zone around the Project areas with the potential for impact on vegetation.
Increased mortality rates from vehicle strikes.	Access and haul roads.
Degradation of streams and lakes resulting from toxicological stress and low flows.	Watercourses in the Roşia and Corna Valleys already severely impacted.
Losses of riparian habitats because of land take and change of land use.	TMF in the Corna Valley.
Reduction in local biodiversity because of terrestrial and aquatic habitat loss.	Limited to the Project area; minimal impact to upstream areas.

Operation Phase

Table 3.13 Potential Ecosystems Pollutants and Activity during Operation	
Pollutant / Activity	**Location / Feature**
Disturbance of terrestrial fauna from noise, vibration, and visual disturbances.	Limited to the Project area, with the greatest potential for impact adjacent to the TMF, pits and hauling roads.
Terrestrial habitat degradation as a result of dust deposition from site activities.	Zone around the Project areas with the potential for impact on vegetation.
Increased mortality rates from vehicle strikes.	Access and haul roads.

Closure Phase

Table 3.14 Potential Ecosystem Pollutants and Activities during Closure	
Pollutant / Activity	**Location / Feature**
Restoration of affected habitats.	Limited to the Project Area, with greatest emphasis on the process plant site and waste rock disposal sites.
Rehabilitation of affected habitats.	TMF in the Corna Valley.
Creation of freshwater lakes by flooding.	Open pits: Cetate, Orlea, Jig

3.6.3 Measures for Protection of Terrestrial and Aquatic Fauna and Flora

A *Biodiversity Conservation Plan* is in development as part of the EIA. This plan will be based on existing Romanian legislation, and will also consider the relevant World Bank Group Operational Policies, International Conventions and EU Directives as they apply to biodiversity conservation at the Project level. Key components of the plan include the development of a comprehensive database of ecological information in the Project Area, biodiversity management, monitoring and public education.

3.7 PROTECTION OF HUMAN SETTLEMENTS AND OTHER OBJECTS OF PUBLIC INTEREST

3.7.1 Current Situation

The *comuna* of Roşia Montană has a surface of approximately 42 km^2, and includes 16 localities in total with a combined population of 3,865 people according to the 2002 census. The largest village in the *comuna* is Roşia Montană. Within the *comuna*, the following four localities are affected: Roşia Montană and Ţarina in the Roşia Valley, Corna and Bunta in the Corna Valley.

In the adjacent town of Abrud (total population in 2002: 6,213), the only locality that will be impacted by the Project is Gura Cornei, where only ten households might be directly affected.

- The topographical relief in the Project Area and its vicinity is dominated by the valley of the northwards flowing Abrud River, which broadly delimits the western margin of the project. The Abrud Valley receives the right-bank tributaries to the Corna Valley and Roşia Valley, both of which drain westwards.

River valleys have traditionally been used as corridors for transportation. Homes and towns have been built along these transportation routes, with the confluences becoming important crossroads and the sites of many towns in the area. Because the river valleys are narrow, towns have grown up in linear patterns. On the valley floor, where land is relatively level, the building pattern is quite dense. On the steep hillsides, fewer homes are built and the pattern of occupation is scattered. The land on the hillsides has traditionally been used for growing hay in the lower part and summer pasture in the upper part.

Human settlement tends to organize along these valleys, where the most densely inhabited areas are found. Organization of human settlements in the Project area appears also to result from a combination of agro-climatic and industrial factors:

- Most homesteads are installed in the lower part of the valleys, for obvious climatic reasons but also because stream water was required in large quantities for gold washing; and,
- Those households that are (or were) less mining-oriented and more agriculture-oriented tended to settle in higher areas, as in Ţarina; preferred exposures are to the South or West.

The total population of the Roşia Montană *comuna* has been decreasing, not only over the recent period (about -0.7% per year between 1992 and 2002), but also during the whole 20th century. The birth rate is low as in the rest of Romania, and the result is an ageing population with females largely predominant in the oldest categories (widows). The average size of households is about 3 individuals. Except for the oldest population, the educational status is usually high.

<u>Roşia Montană</u>

Roşia Montană locality is a longitudinal settlement with two centres: Roşia Piata in the east (the main town square), and Roşia Biserica in the west (with the administrative centre – the town hall and the headquarters of Roşia min).

Other homesteads are scattered on the hills and their inhabitants are called side–settlers (latureni), their main occupation being subsistence agriculture. There are also some temporary houses for summer in the hay land, where cattle stables and one–room buildings (salase) can be found.

<u>Corna</u>

The different hamlets of Corna Valley, from Tăul Cornei in the upper part to Gura Cornii near Abrud, are situated along the stream. Many homesteads are scattered on hills and along the valley, with the only concentration in Corna Centru area, where the two churches are found (Greek–Catholic and

Orthodox, with their cemeteries). There is no regular street network but small streets winding through properties, following the uneven relief.

Livelihoods

The two main employers in the Roşia Montană *comuna* are, by far, Roşia min and RMGC: as an average, there is one Minvest employee in 25% of households, and one RMGC employee in about 7% of households. The state and local governments are also significant employers.

About 15% of households declare themselves as primarily farmers. However, about three quarters of households keep farm animals of various kinds in various quantities, and almost 90% have an agricultural production of variable significance.

Crops are mainly subsistence oriented, with little produce sold. The main crops are fruit trees, grown by 85% of households, vegetables (80%), hay (49%), and nut trees. Seventy-four percent of households have poultry, 33% have cattle, and 38% have pigs. However, fewer than 10 households in the entire *comuna* mainly derive their livelihoods from animal husbandry. Milk is mainly self-consumed as fresh milk or transformed into butter, cheese or sour cream. Many households are self-sufficient in dairy products and poultry. Wood is another source of income as it is sold for heating and cooking purposes, and for furniture production. More than 99% of households use wood for heating, and about 60% use wood for cooking.

Almost 50% of households are dependent on pensions. Most pensions are in the order of 50 to 100 USD per month. Miners' widows' pensions can be as low as 25 USD per month.

The average monetary income has been found to be 653 USD per annum per capita, which is only one third of the average Romanian GDP per capita. one percent of people live on less than 1 USD per day, 7% on less than 2 USD per day.

Thirty-three businesses are potentially affected by the Project. Most of these are groceries or general stores (16), bars (4), or a combination of those two (3). These businesses are small: 75% had an annual turnover of less than 5,000 USD for the year 2001.

Sixty-two percent of households had one or more members who sought medical attention for serious illnesses in the past year. Causes of health problems apparently include occupational hazards (particularly mining), a high-fat diet, stress and alcoholism. Also, existing mining and ore processing facilities are in poor condition and pose safety hazards to workers and risks to the environment.

In summary, the area has pre-modern industrial activities in a rural setting and, as a result, livelihoods are derived from a combination of wage-earning activities related to the mining sector, and from some small-scale agricultural activities. Non-monetary activities play a significant role in peoples' livelihoods. Occupations in the formal sector are essential but do not account for the entire livelihood of all potentially-impacted people, and subsistence-oriented agricultural activities are critical as a "safety net" to the poorest in the community, among which female pensioners are predominant.

3.7.2 The Impact of the Project on People and Assets

The Project will bring positive economic and social benefits to the community, including the clean-up of badly impacted sites and water bodies, the maintenance or development of employment, the reconstruction of modern communities with improved environs, greatly increased fiscal resources for the local councils, and the preservation and enhancement of the cultural and historical heritage. Consultation shows that a majority of people in the area, along with most elected representatives, expect the Project to improve presently harsh living conditions for people who choose to resettle or relocate as well as the remaining people in and around the mining project area.

RMGC recognises that to be successful the project must protect the human settlements and other objects of public interest in and around the mining area. The key protection plans include:

- The *Resettlement and Relocation Action Plan (RRAP*); and,
- The *Cultural Heritage Management Plan (CHMP)*.

Both management plans will be included as appendices to the EIA. Both must conform to Romanian laws and regulations as well as international directives, policies, and guidelines especially those established by the EU and the World Bank Group.

From the 2002 census, the total number of households in the Roşia Montană *comuna* was 1,362. The relocation and resettlement process may potentially affect 960 families only. Of these, 613 families reside in Roşia Montană, 138 in Corna and 114 in Gura Cornei, while the remainder reside in the Bunta, Tarina, Blidesti and Salistea localities. The remaining households around the Project-Impacted Area will be the subject of protection as stipulated in the two above mentioned plans. RMGC will assist the remaining population to preserve their cultural heritage and customs and to benefit from the economic development of the area

3.7.2.1 Resettlement and Relocation

3.7.2.1.1 <u>Consultation</u>

RMGC has developed its Resettlement and Relocation Strategy based on its assessment of the legal background and the socio-economic conditions, and on consultation with potentially affected people and their elected representatives, which is essential to the success of this undertaking.

Public meetings were initially organized to address resettlement and compensation in 2000 and 2001. Many potentially affected people and their elected representatives indicated that they preferred a consultation approach based on one-to-one meetings (with over 2000 meetings held to date). RMGC therefore started individual discussions in May 2002, while also organizing community consultation through Focus Groups, public meetings and discussions with elected representatives. RMGC has continuously disclosed the proposed plans and activities for compensation and resettlement through a "Project Gazette" circulated to each potentially affected family (11 issues to date), sought feedback from the community on these Gazettes, and amended modalities accordingly.

In addition to consultation specifically intended for the *RRAP*, RMGC has also engaged in more general consultation activities, within the framework of the EIA, which are on-going and include specialist workshops in Bucharest and Albă Iulia, public meetings in Abrud and Roşia Montană, and focus group discussions in various localities of the region.

RMGC also operates a Community Information Centre in Roşia Montană where anybody can obtain information on the Project, including the full *RRAP* and other documentation.

The *RRAP* is the document in which RMGC presents the procedures it is following and the actions that it will take to mitigate adverse affects, compensate losses, and provide development benefits to persons and communities affected by the development of a new mine at Roşia Montană. The *RRAP* outlines eligibility criteria, establishes rates of compensation for lost assets, and describes levels of assistance for resettlement and relocation of affected households.

The *RRAP* has been developed by RMGC, with consultants, to comply with Romanian legislation and with resettlement policies recommended the World Bank Group. The work on the *RRAP* started in 2001 and the milestones achieved were made public through the publication of the Gazettes, which summarised the policies and the progress on the *RRAP*. The *RRAP* was publicly released on January 31, 2003, on RMGC's website and in the Project public information centre in Roşia Montană,

3.7.2.1.2 <u>Principles</u>

The *RRAP* complies with Romanian legislation and the World Bank Group policies applicable to resettlement and relocation. As Romania moves towards EU membership, RRAP strategies have been reviewed for compliance with EU Directives. Beyond its obligations under Romanian law, RMGC is also committed to the following, in compliance with World Bank Group *Policy Guidance OP 4.12*:

- RMGC compensates all affected assets at replacement value; and,
- RMGC implements a comprehensive resettlement and livelihood restoration package.

Project-Affected People are offered a choice between:

- Resettlement, which is the receipt of a new parcel of land at one of two locations with a home chosen from a range of models developed by RMGC; the two resettlement sites include one in the territory of the *comuna* of Roşia Montană and one in Albă Iulia; and,
- Relocation, which is the receipt of monetary compensation for their current property and the freedom to move wherever they choose.

The community infrastructure and public facilities of Roşia Montană will be re-established at the resettlement site located within the territory of the *comuna,* i.e., at the New Roşia Montană Town (Piatra Albă). The *RRAP* also takes into account the following:

- The design of the resettlement sites takes into consideration the need for most people to practice small scale agriculture as a complementary source of livelihood;
- The design of the resettlement houses takes into consideration the possibility that only limited resources are available for their maintenance;
- Different types of resettlement houses will be offered, both traditional and more modern;
- Assistance and training will be provided for affected people to restore their livelihoods;
- Processes will be transparent and consulted upon;
- Businesses will be compensated for lost income during the period required for their re-establishment, and will be assisted in re-establishment; and,
- A grievance handling mechanism will be in place.

3.7.2.1.3 Relocation

The relocation package includes:

- Compensation at replacement cost for affected properties; and
- Additional assistance, including both in-kind and in-cash components, intended to facilitate the process of relocation to a new home.

Compensation rates have been determined to enable property owners to replace fully their current property with equivalent assets within an area of 250 km around the Project. No “wear coefficient” or similar depreciation factor is taken into consideration, in conformance with the “replacement value” requirement.

For residential structures (except those under construction or that are unoccupied), existing houses are to be assessed on a scale with five levels, taking into account also the specific features of the individual houses. Certain special features on the inside or outside of residential buildings are to be separately compensated for according to defined criteria, including certain on-plot immoveable features (e.g. fences and ovens).

Land compensation rates are revised in accordance with the land values, which are recorded in an area of 250 km around the project, for corresponding categories of land. The rates are calculated based on the replacement value of the land and the costs to re-establish the same cultivation and land use elsewhere. The owners will be compensated at a level which will allow them to restore their households and their pattern of land use elsewhere, taking account also of the value of the crops lost at the time of the move.

Forested land is to be compensated based on the RomSilva method, taking into account the age of the forest, the amount of wood that can be cut per year, the accessibility of the forest area and the auction price for that wood as recorded in recent transactions in the area.

To protect affected people against a potential decrease in the value of the Romanian currency, all rates for compensation are determined in USD, with the amount paid in Romanian Lei at the National Bank at the exchange rate of the day of payment.

RMGC will pay an allowance to each relocated family, which will be subject to the number of family members. This allowance is designed to provide a sum that, together with the rest of the relocation package, enables affected households to re-establish themselves securely. RMGC also provides two trips with a suitable vehicle to each affected household for the transportation of household effects. The provision of additional transportation resources will be considered on a case-by-case basis, to those people who may need more belongings to be moved. People are, subject to certain limitations, allowed to harvest their existing crops. In addition, subject to certain limitations, households are also allowed to salvage readily moveable materials like doors, windows, wooden floors and certain roofing materials from their structures.

3.7.2.1.4 Resettlement

The resettlement package includes:

- The replacement of lost properties by houses, based on a range of designs; and,
- Additional assistance intended at facilitating the process of resettlement to a new home.

Resettlement sites have been investigated early in the process of developing the Roşia Montană mining project and both a detailed technical evaluation of each identified site and consultation with potential resettlees and their elected representatives have led to the selection of two sites:

- Piatra Albă in Roşia Montană *comuna*, a large area above Gura Rosiei on the hill between Roşia Valley and the next valley to the north; and,
- Furcilor Hill, a large, level site not far from the centre of the city of Albă Iulia.

Following a specific consultation exercise, a detailed housing policy has been designed by RMGC using the following principles:

- For each resettler household, the entitlement to a replacement plot and house is based on the calculation of the compensation that would be due for these assets under the relocation policy, with the same rates applied; and,
- This calculated compensation is a budget that the resettler household can use to purchase a new plot and house within the available range of new house designs and plot sizes, each of which is priced in conformance with the "replacement value" principle (the same rates are applied for new houses as those applied to existing houses).

RMGC proposes eight house plans including 1-, 2-, 3-, and 4-room houses, with an accompanying garden plot. These are summarised on *Table 3.15 Types of Resettlement being Provided by RMGC*.

If the existing house has 4 rooms or more, and a built area of 140 m^2 or larger, the resettler household will be eligible to receive a custom new house designed by RMGC's architects on one of the 3 standard size plots, provided that the total cost does not exceed the total value of the compensation.

In addition, resettlers will have the choice of three different levels of interior finishes. New houses in Piatra Alba will be provided with wood-burning systems for space and hot water heating. Houses in Alba Iulia will have the option to use gas for space and hot water heating.

New houses in Piatra Albă (Roşia Montană) and Varianta (Abrud) will be provided with wood-burning systems for space and hot water heating. Houses in Albă Iulia will have the option to use gas for space and hot water heating.

Minimum plot surfaces will also be respected in order to accommodate the building and to comply with regulations.

Table 3.15 Types of Resettlement being Provided by RMGC		
House Type	**House Surface**	**Minimum Plot Surface**
One-Room (1 storey)	65 m^2	300 m^2
One-Room (1 storey)	88 m^2	490 m^2
Two-Room (1 storey)	88 m^2	490 m^2
Two-Room (1 storey)	107 m^2	442 m^2
Three-Room (1 storey)	111 m^2	607 m^2
Three-Room (1 storey)	120 m^2	607 m^2
Three-Room (2 storey)	139 m^2	415 m^2
Four-Room (2 storey)	149 m^2	415 m^2

Larger plots can be chosen beyond these minimum surfaces, from within the range of standard size plots provided by RMGC, if the total value of their compensation allows the resettlers to do so.

Other components of the resettlement package (re-establishment allowance, transportation assistance, assistance for partial salvage and harvesting) are the same as those that apply for relocation.

3.7.2.1.5 Livelihood Restoration Package

Businesses

Eligible businesses are being assisted to re-establish themselves, whether the owner elects to resettle or to relocate, with the following restoration package:

- Compensation for temporarily lost income as a result of the displacement during the transition period required to re-establish the business;
- Additional cash compensation for permanently lost income in the case of those business-persons who would not have the ability to re-establish their business because of old age;
- Cash compensation for new operating licenses;
- Assistance in moving equipment and stock;
- Advisory assistance to re-establish the business; and,
- Access to loans and grants as provided by the RMGC Small Business Enhancement Fund (see hereunder).

The Skills Enhancement Fund

In order to help the restoration of livelihood of people who, after relocation or resettlement, find their productive skills are less applicable in their new environment, and to comply with World Bank relocation guidelines, RMGC has set up a Skills Enhancement Fund, as part of an education and training programme for displaced persons from the Project-Impacted Area.

The Skills Enhancement Fund entitles each relocated or resettled household to a grant of up to a maximum 1,000 USD towards the cost of one or more designated family members to undertake an educational or vocational training course of their choice. The sum of 1,000 USD is a maximum available per family, no matter how many members need educational financing assistance.

The objective of the RMGC Skills Enhancement Fund is to provide affected household members with education and training support to improve their socio-economic opportunities, and, where relevant, to help them to run any small business which may be eligible for funding as part of the Livelihood Restoration Package.

The Skills Enhancement Fund is complementary to the Small Business Enhancement Fund, which together provide safeguards to address and mitigate any risks of impoverishment following relocation or resettlement.

The Small Business Enhancement Fund

A loans programme for the enhancement of small businesses is designed to operate through a process of competitive proposals for awards for micro-finance and small businesses development support. This is aimed to assist income restoration and economic growth for people displaced by the Project, who wish to create new businesses or expand existing businesses.

RMGC has set aside a fund of 1 million USD, to be available to persons impacted by the Project-Impacted Area, for loan finance for the development of new small businesses and the re-establishment and/or improvement or expansion of existing businesses. This lending programme will be the means for training people in managing credits and running their own small businesses, and is considered an important tool to achieve income restoration, economic growth and new community integration of displaced families.

The current resettlement and relocation plan will provide skills development and financial resources for businesses creation and development, as cornerstones for meeting the main objective of reducing the negative social and economic impacts on community residents caused by displacement.

Hiring Policy

Prior to relocation and resettlement, RMGC has continued to provide affected people with short-term employment thus generating transitional financial support. In addition a programme has been implemented to notify them, together with other local inhabitants, of relevant employment opportunities and of the procedures to apply for such posts, both in the area of their new host community and in relation to the development of the new project.

3.7.2.1.6 Grievance Handling Mechanism

RMGC has put in place a two-tier mechanism, as follows:

- The Community Relations Department, RMGC's organization in charge of the implementation of the *RRAP*, will appoint a part-time grievance officer, who will process grievances in the first instance according to procedures detailed in the *RRAP*; and,
- RMGC will hire an independent ombudsman who will be available to the public on a part-time basis: any grievance that has received a negative answer or unsatisfactory settlement proposal from RMGC in the first instance can be submitted by the aggrieved person to the ombudsman. In addition, the ombudsman will independently prepare a quarterly report that will be publicly released.

Notwithstanding the existence of this mechanism, any aggrieved Romanian citizen has access to legal process and to Court action.

3.7.2.1.7 Monitoring and Evaluation

Monitoring (internal) and evaluation (external) have the following objectives:

- Monitoring of specific situations or difficulties arising from the implementation, and of the compliance of the implementation with the *RRAP*; and,
- Evaluation of the mid- and long-term impacts of the *RRAP* on livelihoods, environment, local capacities, economic development and settlement.

Monitoring will be directed at the following aspects:

- Negotiation process and conclusion of agreements;
- Social and economic monitoring, including livelihood restoration and hiring;

- Technical monitoring; and,
- Grievances and grievance management system.

An annual monitoring report will be developed by RMGC and publicly released.

Evaluation will essentially be based on the following:

- The administration to the same sample of households of the same questionnaire that was done in 2002;
- The key leader survey that was undertaken in July 2002 will be redone using a similar questionnaire and targeting the same individuals;
- The resettlement component will be specifically evaluated against technical and socio-economic indicators, applied to all three resettlement sites;
- Identified vulnerable people will be put into specific focus; and,
- The grievance management system will also be evaluated.

The auditor in charge of evaluation will be an independent consultant or NGO with experience in *RRAP* design and practical implementation, and with no previous involvement in the Project. The evaluation reports will be publicly released.

3.7.2.1.8 Implementation

Implementation Organization

RMGC takes direct responsibility for the implementation of the *RRAP* and will implement it with its own staff and consultants. RMGC has put in place the Community Relations Department (CRD), under the RMGC Director responsible for Community Relations. RMGC has strengthened its own resources with technical expertise and outsourced personnel, mainly from two consulting firms, Planning Alliance of Canada, and Proiect Albă of Albă Iulia, Romania.

The Community Relations Department has six divisions:

- Topography;
- Property titles clarification;
- Private negotiation;
- Institutional negotiation;
- Property acquisitions;
- Socio-Economic Development Division;
- Database; and,
- Salvage and Moves Division.

The total staff of the Community Relations Department is about 91 staff and consultants.

Budget

RMGC has budgeted over 60 million USD for the implementation of the *RRAP* and for the community development programmes.

3.7.2.2 Cultural Heritage Assets and Conservation

From the very beginning of project development, RMGC has taken responsibility for conserving the cultural aspects of the Roşia Montană area so that the development of the mining project could progress in conformance with the Romanian legislation.

The main legislative documents that guide the protection of cultural heritage in Romania include:

- Law No. 378/2001, the main law that regulates activities concerning archaeological heritage in Romania, outlining the legal framework for archaeological field research, and providing definitions and regulations for areas of protected archaeological heritage. This law also indicates the institutions and special bodies entitled to make decisions regarding the protection of Romania's archaeological and architectural heritage. (Law 378/2001 on Archaeological Heritage Protection and Declaring of Certain Archaeological Sites of National Interest, Revised by Law 462/2003, issued November 2003);
- Law No. 182 / 2000[1], the main law that regulates activities regarding movable heritage, outlining the legal framework for the evaluation, classification, export, etc. of movable heritage items, and providing definitions and regulations for movable heritage items. This law also indicates the institutions and special bodies entitled to make decisions regarding the protection of Romania's movable heritage;
- Law No. 422/2001[2], which establishes the owner or investor as responsible for financing archaeological research required to obtain an archaeological discharge and that conservation of historical monuments must be coordinated by an authorised specialist;
- Law No. 311/2003 *Concerning the Museum and the Public Collections*; and,
- The General Urban Regulation Decision No. 525/1996.

RMGC has maintained contacts with the MCC in order to ensure professional performance of the research project and protection of the cultural heritage, both movable and immovable. In this context, RMGC has enlisted the collaboration of a number of independent consultants and institutions on a partnership basis with the objective of demonstrating that a new standard of cooperation can be established between major investors, cultural experts and the national administration. Extensive underground sites and surface areas have been explored during the project development period and will continue to be investigated.

The work programme has been performed both in the old underground workings and also through surface excavation activities. Work has been designed to explore systematically the areas in and around the proposed mine, where the Project would either establish mining operations or construct new infrastructure. Extensive investigation and the corresponding results have been documented and are in the process of progressive publication. As the largest archaeological programme in the country and one of the most extensive in Eastern Europe, this research programme has helped to develop the skills and capabilities for archaeology in Romania, including fostering exchanges between international and Romanian archaeologists. All this has led to a better training and strengthening of the institutions entrusted with safeguarding the national cultural heritage.

This partnership has been based on RMGC's commitment to finance the necessary research and studies and equally on the responsibility assumed by the MCC to deal with all organizational issues and permanent monitoring of the project.

By virtue of this partnership that started in 2000, RMGC has financed a complex study for the diagnosis of archaeological sites and historical monuments in the area that might potentially be affected by the mining project. Specialists from the Project Centre for National Cultural Heritage in Bucharest and experts from the MNUAI were assigned to carry out the research that resulted in an extensive documentation submitted to the members of the National Commission for Archaeology and the National Commission for Historic Monuments.

[1] Law No. 182 / 2000 *Regarding the Protection of the National Cultural Movable Heritage,* published in the Official Gazette No. 530 on 27th of October 2000, part I.

[2] Law No. 422/2001 *Concerning the Protection of the Historical Monuments.*

3.7.2.2.1 Archaeological Sites Research Programme

Given the importance of the national cultural heritage of the Roşia Montană area, as well as the economic significance of the investment project, the MCC established the National Research Programme "Alburnus Maior" by Order No. 2504 of 07/03/2001.

The main objectives of the programme were identified as:

- Exhaustive research of the archaeological patrimony, including complete recording of all data resulting from excavations, followed by publication of the results;
- Implementing the required procedure to issue archaeological clearance for the existing sites in the Project Affected area;
- Examination of the Roman and medieval mining galleries carried out by specialists and delivery of viable solutions for preservation/restoration of such, if appropriate;
- Delimiting the protected area that shall include segments of the mining galleries and architectural monuments;
- Architectural studies and area planning documentation; and,
- Examination of the intangible cultural patrimony by research, with a special focus on ethnography and verbal history.

This national programme was organized under the scientific authority of the National Commission for Archaeology and the National Commission for Historic Monuments, specialised commissions within the MCC. The national research programme is coordinated by the National History Museum of Romania in Bucharest.

In 1999, an archaeological exploration programme was designed under the scientific authority of the National Commission for Archaeology and the National Commission for Historical Monuments by specialised commissions within the MCC. A team from the MNUAI, in partnership with a French team from the University Le Mirail from Toulouse (UTAH), undertook an underground archaeological survey of all the sites of scientific interest in 2000. During the initial visit in 2000, the team established the perimeters within which the archaeological excavations were carried out during the 2000-2004 campaigns.

The 2000 archaeological reconnaissance was performed to ensure that archaeological sites were not disturbed before their significance had been evaluated and assessment was performed to identify archaeological sites of importance. A team from MNUAI and the Design Centre for National Cultural Heritage (CPPCN) undertook an archaeological survey of all the sites of scientific interest in the Project-affected area.

The archaeological investigation programmes described in Section 2.2.1.3.2 were designed on the basis of the diagnostic reconnaissance. Investigation programmes in 2001, 2002 and 2003, have resulted in the issue of the relevant regulatory Certificates of Archaeological Discharge in respect of the areas of the Cîrnic and Cetate pits and other surface areas, as specified in Romanian legislation. Work continues in other adjacent areas. An essential step has been the creation of an inventory of significant archaeological assets for which protective measures will be required.

3.7.2.2.2 Measures for Protection of Cultural Heritage Assets

A *Cultural Heritage Management Plan* is being developed and presented for review and comment by stakeholders and will be submitted in Volume III of the EIA. The plan will address management activities for the construction, operation, and closure phases of the project to ensure the proper expertise and resources are focused on this aspect of the Project. At the end of 2003, RMGC had spent 6 million USD on this effort and remains committed to an ongoing, archaeological and cultural heritage programme throughout the life of the Project.

The National Research Programme "Alburnus Maior" will continue over the coming years. RMGC will continue to provide financial support for activities required for the research, protection and museum conservation of the national cultural heritage, tangible and intangible, as recognition of the significant contribution of this area of activity to the sustainable development of the Roşia Montană community.

Measures in place for protection and conservation of cultural heritage assets are summarised below.

Conservation in situ

RMGC has undertaken the in situ conservation of the double circular tomb dating from the Roman period discovered in the Găuri -Hop area in 2002. A temporary protective structure was erected in order to ensure the integrity of this monument until implementation of the relevant restoration project which will be fully funded by RMGC.

Archaeological Monitoring

All the works carried out so far by RMGC, mainly geological and survey investigations, have been placed under the regime of archaeological monitoring. Specialists from the National History Museum of Romania, as well as from other institutions involved, have continually provided professional assistance on the sites where works liable to affect the land have been performed. RMGC has undertaken the responsibility to ensure archaeological monitoring in the area throughout the entire duration of the mining project.

Establishment of the Protected Area

Area planning documentation has been prepared to establish the Protected Area within the historic centre of Roşia Montană - approved by the *National Commission of Historic Monuments by its authorizations No. 61 of February 2002* and *No. 178 of June 2002*.

The Protected Area includes 33 historic monuments, three churches, the entrance to the Cătălina – Monuleşti gallery, and the location of a possible future mining museum.

A PUZ for the Protected Area will be prepared for submission to the relevant authorities.

Reopening of the Cătălina – Monuleşti Gallery

RMGC has started working on the rehabilitation of the Cătălina – Monuleşti Mining Gallery, where the famous Roman waxed coated tablets were found in the 19th century. Due to the lack of maintenance, the gallery has collapsed and is currently flooded. Guidance from the French mining archaeological team suggests that this gallery could be considered in the future as a public access museum feature. The mining works required for rehabilitation started in 2002 and a RMGC team continues clearance work in the gallery, under the supervision of the French mining archaeological team.

The Mining Museum

It is proposed that a new Mining Museum of Roşia Montană should be located in the historical centre of Roşia Montană. The plans for the museum are currently drafted, as well as special studies for defining the various themes of the museum. In 2005-2006, specialists in various relevant fields (archaeology, history, ethnography, geology and natural sciences) will undertake research in relevant institutions across Europe. RMGC will provide the financial support for this, working in close collaboration with MCC. It is anticipated that the museum may be established with RMGC support and operated by some form of foundation managed for and by local people.

Historic Buildings and their Protection

The centre of Roşia Montană includes a number of buildings of historical interest. Most of these buildings date back to the 19th century and represent diverse periods or influences in Austro-Hungarian architecture. These buildings have been listed and described in detail by specialists, as part of a culture preservation effort initiated by RMGC. Their characteristics and interest, together with the specific preservation measures suggested by RMGC, in cooperation with the relevant Government authorities, are addressed in the *Cultural Heritage Management Plan*. RMGC is evaluating the preservation of certain historical buildings in Roşia Montană and a pilot project for restoration of four houses in the Protected Area was initiated in 2004.

3.8 MANAGEMENT OF WASTE GENERATED ON THE SITE

The various waste streams associated with RMGC's mining operations will be the subject of a comprehensive *Waste Management Plan.* The *Waste Management Plan* will be documented as an Appendix to the EIA, and describes how RMGC will minimise and manage the various waste streams resulting from mining operations, in accordance with applicable Romanian and EU regulations.

The *Waste Management Plan* will provide overall guidance for the preparation and maintenance of a detailed waste inventory. It will also address consistent, systematic processes for the collection, segregation, storage, and disposal of wastes, in accordance with a waste management hierarchy that, wherever possible, encourages minimisation, recycling, or beneficial use in lieu of disposal. Where third-party waste management contractors are to be used, the plan will invoke a mandatory surveillance and audit process to ensure that such contractors exercise a similar level of control over their operations.

The *Waste Management Plan* will be supported by a suite of speciality plans (also included as Appendices to the EIA) that are designed to eliminate, minimise, and/or manage the impacts associated with specific waste streams, especially those typically associated with large-scale mining operations (e.g., topsoil, overburden, waste rock, and tailings). The *Cyanide Management Plan* addresses not only the safe management of process reagents, but also the controlled, systematic detoxification of residual cyanide lixiviants present in the tailings slurry. Such detoxification is designed to reduce residual concentrations of cyanide in the slurry below the hazard levels specified in current international guidelines and anticipated EU regulations. Detoxification will occur within the confines of the process plant, prior to transfer of tailings to the Tailings Management Facility. The detoxified tailings are themselves subject to the long-term disposal and operational requirements specified in the *Tailings Facility Management Plan*. Topsoil, overburden, and waste rock will be managed in accordance with the *Mine Closure and Reclamation Plan* and the *Water Management and Erosion Control Plan*, which together describe the measures taken to minimise the potential for acid generation, contamination of surface water, and other potentially negative environmental effects, in both routine and extreme meteorological conditions. Further discussions of the management methods that will be applied to the management of these materials are provided in Sections 2.2.2, 2.2.3, and 2.2.4 of this Project Presentation Report.

The waste streams that will be generated and managed under the Roşia Montană Project are categorised under the Romanian *National Plan for Waste Management* as municipal, production, and special wastes, as noted in *Table 3.16, Waste/Waste Subcategory Descriptions and Applicable RMGC Management Plans.*

Collectively, the *Waste Management Plan* and the associated plans noted in Table 3.16 are elements of the overall *Environmental and Social Management Plan* established for RMGC's operations, included as an Appendix to the EIA. Each plan will be further supported by a number of detailed, lower-tier standard operating procedures. These procedures will be compiled in the *RMGC Standard Operating Procedures Manual*, the development, review, approval, distribution, and update of which is controlled by the *Environmental and Social Management Plan*. Other specific document distribution, change control, personnel training, and records management needs associated with the implementation of these plans are likewise addressed through the processes and procedures defined in the *Environmental and Social Management Plan.*

Table 3.16 Waste/Waste Subcategory Descriptions and Applicable RMGC Management Plans	
Waste Categories	***Waste/Waste Subcategory Descriptions and Applicable RMGC Management Plans***
Municipal Waste	*Municipal waste* is defined as non-hazardous waste from households, as well as other waste, which, because of its nature or composition, is similar to waste from households. For the Roşia Montană Project, this is interpreted to apply to office and canteen waste, general garbage, and sewage sludge from the on-site municipal wastewater treatment plant. Certain types of municipal wastes (e.g., packaging waste, batteries/accumulators, electric and electronic waste, car tyres) are subject to additional regulatory conditions and are classified as "special" wastes as noted below. Municipal wastes will be managed in accordance with the RMGC *Waste Management Plan*, and will be transported to a licensed municipal waste landfill.
Production Waste	*Production waste* is broadly defined by the *National Plan for Waste Management* as the totality of wastes from mining and other extractive industries, as well as all types of manufacturing, construction, and agriculture. Production waste includes hazardous waste. For the Roşia Montană Project, the production waste category is also interpreted to include non-hazardous inert wastes from industrial processes associated with mining activities, as described below.
	Hazardous waste is defined as any dangerous or toxic waste covered by GD Number 856, August 16, 2002, *Waste Administration.* Wastes considered to have hazardous properties addressed by Emergency Governmental Ordinance (EGO) 78/2000 amended and approved by Law No. 426/2001, Annex I E may be explosive, reactive, corrosive, oxidising, flammable/very flammable, toxic/ecotoxic, infectious, cancerous, mutagenic, and/or teratogenic. Small quantities of hazardous wastes may be generated over the life of the mining operation, and include paint and solvent wastes, along with spill cleanup wastes contaminated with process reagents and chemicals associated with the municipal wastewater treatment plant, the acid rock drainage water treatment plant, and the carbon-in-leach operations. Any used oils or grease encountered from historical mining operations that are suspected to contain polychlorinated biphenyl-bearing compounds or other dangerous chemicals will be considered a hazardous waste. Any spills of these materials will be subject to appropriate neutralisation or detoxification processes; however, resulting cleanup waste residues will still be managed as hazardous wastes. Hazardous wastes will be stored in a temporary hazardous waste disposal facility pending identification of a properly licensed Romanian hazardous waste landfill or disposal facility, as noted in the *Waste Management Plan.* Management of all detoxified cyanide spill cleanup wastes is separately addressed in RMGC's *Cyanide Management Plan.*

Table 3.16 Waste/Waste Subcategory Descriptions and Applicable RMGC Management Plans	
Waste Categories	***Waste/Waste Subcategory Descriptions and Applicable RMGC Management Plans***
	Non-Hazardous Inert Waste is defined as non-extractive industrial waste, not otherwise addressed as a special waste, resulting from construction or mining operations (e.g., demolition waste), that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade, or adversely affect other matter with which it comes in contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant concern of the waste and the ecotoxicity of any leachate is not significant, and will not endanger the quality of surface water and/or groundwater, in accordance with GD No. 162/2002, Annex 1. Non-hazardous inert wastes will be managed in accordance with RMGCs *Waste Management Plan* and disposed of in the RMGC Inert Waste Disposal Facility.
Special Waste	*Special waste* refers to certain types of municipal or production waste that, although not considered to be hazardous wastes, are nevertheless subject to additional waste management requirements at the European Union level under specific legislative acts. Per the Romanian *National Plan for Waste Management*, special wastes include the following:
	Packaging wastes; wood, plastic, metal, composite, and mixed packaging waste will be subject to the waste minimisation and disposal requirements of the RMGC *Waste Management Plan.*
	Waste oils; this waste stream includes mineral-based lubrication or industrial oils, which have become unfit for the use for which they were originally intended.[3] Waste oils will be subject to a reuse/recycling program in accordance with the requirements of the RMGC *Waste Management Plan*.
	Lead (acid) batteries and accumulators; this waste stream will be subject to a recycling program in accordance with the requirements of the RMGC *Waste Management Plan*
	Acid rock drainage wastewater treatment plant residue: treated clarifier underflow solids from the acid rock drainage wastewater treatment plant are not expected to present hazardous characteristics, and will have enough residual water content to permit them to be transported as a slurry for deposition in the Tailings Management Facility, as noted in the RMGC *Waste Management Plan*, Water *Management and Erosion Control Plan,* and *Tailings Facility Management Plan.*
	End-of life vehicles; RMGC and contractor vehicle fleets are expected to be rotated (sold to new users) before their useful service life is over, hence this waste will exist only for those vehicles subject to accidents whose repair value exceeds the vehicle's probable resale value. Wrecked vehicles in this category will be sold for scrap value as noted in the RMGC *Waste Management Plan*.

[3] No oils or compounds containing polychlorinated biphenyls and polychlorinated terphenyls or other toxic and dangerous products will be permitted to enter the Project site; any contaminated oils that may be encountered from historical mining activities will be segregated and disposed of as a hazardous waste.

Table 3.16 Waste/Waste Subcategory Descriptions and Applicable RMGC Management Plans	
Waste Categories	***Waste/Waste Subcategory Descriptions and Applicable RMGC Management Plans***
	Electric and electronic waste; obsolete or dysfunctional electronic equipment and electric appliances will be subject to a reuse/recycling program in accordance with the requirements of the RMGC *Waste Management Plan*.
	Used tyres; tyres for RMGC and contractor vehicle fleets will be recycled (for re-treading/re-use or energy recovery) or used for erosion control purposes, in accordance with the requirements of the RMGC *Waste Management Plan.*
	Medical waste; medical waste from RMGC first aid facilities and medical clinics will be segregated and disposed of in accordance with the requirements of the RMGC *Waste Management Plan.*
Special Waste (continued)	Mining and quarrying waste (referred to generally as "extractive" waste) is directly generated from the extraction and processing of ore. Using the definitions provided in the *Proposal for a Directive of the European Parliament and of the Council on the management of waste from the extractive industries* [2003/0107 (COD)], extractive waste consists of topsoil, overburden, waste rock, and tailings; these are further defined as follows: Topsoil is the upper layer of the ground surface (after grubbing and removal of saleable timber); although identified as a waste, topsoil will be stockpiled for reuse in the revegetation of excavated areas of the site, as well as in the closure phase of the mining operation. Management of topsoil is addressed in the RMGC *Waste Management Plan*, Water *Management and Erosion Control Plan, and Mine Reclamation and Closure Plan*. Overburden and waste rock (generally referred to as "waste rock") are the non-ore-bearing materials that must be removed to expose the ore body. Waste rock will be stockpiled and managed as described by the RMGC *Waste Management Plan*, *Water Management and Erosion Control Plan,* and *Mine Reclamation and Closure Plan*. Tailings are defined as the waste solids that remain after the completion of ore extraction and lixiviant detoxification processes. Detoxified tailings will be transported as a slurry, deposited in the Tailings Management Facility, and managed under the requirements of the *Tailings Facility Management Plan* and *Mine Reclamation and Closure Plan.*

3.9 MANAGEMENT OF TOXIC AND HAZARDOUS SUBSTANCES

A preliminary listing of the toxic or hazardous substances that are expected to be encountered in the construction, operations, and closure phases of the project are summarised in *Table 3.17, Summary of Toxic or Hazardous Materials.*

Table 3.17 Summary of Toxic or Hazardous Materials

Phase	Materials
Construction	• Fuels and lubricants (e.g., diesel fuel, petrol, lubricating oil, grease, transmission fluid, hydraulic fluid) • Antifreeze • Battery acid • Paints and solvents • Pesticides/herbicides • Laboratory chemicals • Compressed gases
Operation	• Fuels and lubricants (e.g., diesel fuel, petrol, lubricating oil, grease, transmission fluid, hydraulic fluid) • Antifreeze • Battery acid • Process reagents, including sodium cyanide, hydrochloric acid, sodium metabisulphite and sodium hydroxide • Slaked lime • Flocculants • Paints and solvents • Pesticides/herbicides • Laboratory chemicals • Compressed gases • Detonators and bulk explosives [e.g., ammonium nitrate and fuel oil (ANFO)] and/or emulsions
Closure	• Fuels and lubricants (e.g., diesel fuel, petrol, lubricating oil, grease, transmission fluid, hydraulic fluid) • Antifreeze • Battery acid • Process reagents, including sodium cyanide, ,hydrochloric acid, sodium metabisulphite and sodium hydroxide • Slaked lime • Flocculants • Paints and solvents • Pesticides/herbicides • Laboratory chemicals • Compressed gases • Detonators and bulk explosives (e.g., ammonium nitrate and fuel oil)-and/or emulsions

As noted in Section 3.8, the *Environmental and Social Management Plan* lays out a hierarchy of management plans, several of which apply directly to the management of toxic and hazardous substances. These management plans are summarised as follows:

- The *Emergency Preparedness and Spill Contingency Plan* presents the measures RMGC will use to prevent, prepare for, and implement in response to emergency situations that could potentially occur at the RMGC site. The plan is designed to meet the requirements of Article 20 of *Government Emergency Ordinance No 78/2000*, *Waste Management*, and *Law No. 106/1996 Civil Protection.* In addition, it will conform to the guidance of the United Nations Environment Programme Awareness and Preparedness for Emergencies at a Local Level for Mining, the *European Union Directive 96/82/EC* on the control of major accident hazards, Gover*nment Decision 95/2003,* as well as with best management practices used in mining operations throughout the world.
- The guidance and procedures provided in the *Emergency Preparedness and Spill Contingency Plan* are designed to support RMGC's policies for minimising potential hazards to human health, property and the environment. Pre-planning, preventative measures, training, and efficient execution of the procedures outlined in this plan are intended to minimise the potential hazards and reduce the potential impact of hazardous operations within RMGC's mining and mineral processing operations. The *Emergency Preparedness and Spill Contingency Plan* is also designed to be implemented in conjunction with local community emergency plans, as well as RMGC's *Cyanide Management Plan, Waste Management Plan*, and other related documents.
- The *Cyanide Management Plan* describes the specific measures RMGC will implement in order to minimise the risks to employees, communities, and the environment from the use of cyanide lixiviants in the metals recovery process. This plan addresses the necessary design, construction and operation of RMGC's facilities for unloading and storage of cyanide, its use in the recovery process, and its eventual detoxification and safe disposal. Rigorous programmes for employee safety and training are discussed, as are the necessary plans and procedures for responses to any potential cyanide exposures and releases. This plan also emphasizes RMGC's commitments to full public disclosure of cyanide-related information. It also requires that the cyanide manufacturer and transportation contractor also demonstrate that their activities are conducted in a safe and environmentally protective manner. The *Cyanide Management Plan* conforms to the *International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide in the Production of Gold* (International Cyanide Management Institute, May 2002), and implementation of this Code will allow RMGC the option of independently certifying the compliance of its cyanide operations with Code requirements.

As previously noted, all of these plans are elements of RMGC's overall *Environmental and Social Management Plan*, and will be supported by a suite of lower-tier Standard Operating Procedures.

It must also be emphasised that a wide range of engineered containments will be constructed in accordance with best management practices, in order to support the concepts set forth in the aforementioned plans and to minimise the potential impact of the use of these substances on the workforce, adjacent communities, and the environment.

RMGC's production facilities will be designed and constructed to proven, widely-accepted engineering specifications; relevant international standards; manufacturer's guidelines; and all applicable local, regional, and national regulatory requirements. In general, the storage containers in which hazardous materials arrive on site are considered the primary containment system and as such shall be required to meet applicable international standards. Secondary containment systems will include coated concrete floors and concrete containment berms, polyethylene-lined containment ponds, and other appropriate structures. All tanks and pipelines for process solutions will be constructed of an appropriate grade of steel, high-density polyethylene, or other materials known to be compatible with the materials being stored or handled.

These measures will provide secure storage areas for hazardous chemicals and materials. However, since these materials must be transferred or transported to their point of use in the process plant via pipes, tanks, bins, or barrels, a certain potential exists for inadvertent releases, drips, or spills. In order to contain these materials before they could potentially enter a surface water drainage system, a lined (polyethylene) surface water pond will be constructed at the most downstream of the plant area to collect any surface water runoff from the plant. Surface water drainage ditches within the plant will be graded to drain to the surface water runoff pond. Water collected and stored in the pond will be either pumped directly to the plant to supplement recycle water or to the Tailings Management Facility decant pond, where it will be mixed with the decant water and then recycled back to the plant for use as process makeup water.

The entire processing area will be located within a concrete secondary containment with sufficient capacity to hold at least 110% of the largest tank within the containment as well as all piping that could drain back to such a tank. Sumps within the containment will be equipped with pumps to return any released solutions to the appropriate section of the processing circuit. Float valves or other types of level indicators will be placed at key locations within the secondary containment to immediately detect the presence of solutions and alert operators in the plant control room. Process solution pumps will be interlocked to automatically shut down to prevent releases if a downstream pump were to fail. In addition, the secondary containment system design will allow the solids or liquids to be cleaned up, detoxified as required, and removed without damage to the containment system or generating a further hazard to the workforce or the environment.

Exhibit 3.1 Traffic Census Locations

Exhibit 3.2 Soil Types

Exhibit 3.3 Vegetation Communities

4 ACTIVITIES RELATED TO THE SITE REHABILITATION/ CLOSURE

4.1 INTRODUCTION

The *Mine Reclamation and Closure Plan* under development for the Project will outline a plan for decommissioning the facility and for mitigating impacts once mining operations have ended. As part of the EIA process, a mine closure process, schedule and financial guarantee will be defined. The preparation of a decommissioning and rehabilitation strategy before the development of the Project is an integral part of the process. This section describes the steps that will be taken by RMGC during the operational and closure phases of the Project to rehabilitate the site in preparation for final closure.

This approach to mine planning recognises that mining, while permanently changing some surface topography, represents a temporary use of the land and that appropriate closure of the operations is in accordance with the sustainable use of mineral resources.

The principal objective of the closure plan and design process is to ensure that the potential environmental, safety and health impacts associated with a decommissioned mine (together with their associated financial and legal liabilities) are identified at an early stage and thus minimised as a consequence of actions taken during both the design and operational phases of the project.

The objectives of the Roşia Montană Project *Mine Reclamation and Closure Plan* include the following:

- Continue to protect public health and safety following closure of the mine;
- Reduce or eliminate long-term environmental impacts;
- Rehabilitate disturbed land and promote productive use;
- Minimise, to the extent possible, the sterilization of remaining mineral resources; and,
- Establish a financial guarantee to ensure funding of mine closure plan and activities.

Romanian mining legislation stipulates that the issue of an Exploitation Licence requires, among other documentation, the submission and approval of a mine closure and environmental restoration plan, as part of the licensing process prior to construction (*Mining Law 85/2003* and *Ministerial Order No. 273/2001 regarding the approval of a Mine Closure Manual*).

4.2 DESCRIPTION OF FACILITIES AND PROPOSED REHABILITATION MEASURES

The proposed site layout and site conditions after the end of the Operations Period and in the later stages of the closure phase are illustrated on *Exhibits 4.1 and 4.2 Site Conditions at Years 19 and 21, respectively.* To assist in the development of the Project *Mine Reclamation and Closure Plan*, rehabilitation strategies and measures potentially applicable at the Roşia Montană site are outlined in *Table 4.1 Proposed Rehabilitation Measures for Facilities at the Roşia Montană Site.* This table divides the on-site facilities into two categories:

- Physical landforms or facilities that will remain after closure; and,
- Structures/facilities or impacts that will be removed prior to closure.

Table 4.1 Proposed Rehabilitation Measures for Facilities at the Roşia Montană Project	
Physical Landforms that will Remain After Closure	
1.	All openings to portals of adits and declines shall be secured.
2.	Mine workings shall be assessed by a qualified professional engineer to determine their stability, and any surface areas disturbed or likely to be disturbed by such workings shall be stabilized or made secure to prevent access.
3.	Transportation corridors shall be closed off and revegetated to an extent that is consistent with the specified future use of the land.
4.	Landfill sites and other waste management sites shall be rehabilitated.
5.	Tailings, waste rock piles and overburden piles shall be rehabilitated or treated to ensure permanent physical stability and effluent quality.
6.	Materials or conditions created because of mining that produce or may produce ARD, or metal leaching, shall be dealt with in accordance with the management plan.
7.	Impoundment structures shall be certified by a qualified professional engineer with respect to their stability against static and dynamic loadings to which the structures are likely to be subjected, to ensure that the materials are completely contained and the specified land use maintained.
8.	Decant structures, other than dam spillways, shall be removed or left inoperable.
9.	Remaining on-site watercourses or drainage channels shall be left to minimise maintenance and shall be consistent with the specified future use of the land.
10.	Disturbed sites shall be re-vegetated, as appropriate.
11.	Process facilities or utilities that will be utilised by the existing community will be turned over to the appropriate authorities for ongoing operations.
Structures / Facilities or Impacts that are to be Removed Prior to Closure	
1.	Buildings, power transmission lines, pipelines and other structures shall be dismantled and removed from the site to an extent that is consistent with the specified future use of the land.
2.	Machinery, equipment and storage tanks shall be removed from the site to an extent that is consistent with the specified future use of the land.
3.	Concrete structures, foundations and slabs shall be removed or covered by overburden and revegetated.
4.	Petroleum products, chemicals and waste shall be disposed of safely on site or removed.
5.	Explosives shall be disposed of or removed from the site.
6.	Soils in the vicinity of sites used for storing or transferring petroleum products, chemicals, ore, concentrates or waste during the life of the project shall be sampled and tested for contamination and, if contamination is found, a management plan consisting of a risk assessment and action plan for the contaminated soils shall be implemented.
7.	Disturbed sites shall be re-vegetated, as appropriate.

4.3 PHYSICAL LANDFORMS AND FACILITIES THAT WILL REMAIN AFTER CLOSURE

The following physical landforms or facilities that will be constructed as part of operations are expected to remain after the completion of mining at the site:

- TMF;
- Waste rock disposal sites;
- Open pits;
- Water management dams;
- Site-wide water management facilities;
- Access roads;

- Wastewater treatment plant;
- Low-voltage electrical power lines and transformers;
- Potable and process water supply systems; and,
- On-site domestic wastewater treatment facility.

The specific measures to be implemented at each of these sites to minimise or eliminate environmental impacts and to stabilize the facilities for long-term closure are described below.

4.3.1 The Tailings Management Facility (TMF)

On completion of the operational life of the TMF impoundment, the area containing the tailings will total approximately 300 ha and the TMF dam will have a footprint of approximately of 68 ha.

The preparation for closure of the TMF will commence prior to the cessation of mining, during the final years of operations (to ensure that the objectives can be achieved cost effectively). The tailings will be deposited in a manner to promote their stabilization, and reduce the potential for wind and water erosion. During this time, the preparatory work will include modification of the tailings disposal system to achieve the final landform. In addition, during operation, a passive or semi-passive, organically-based treatment system will be developed and tested to treat and discharge the long-term TMF seepage that may occur in the Corna Valley.

Once tailings deposition is complete, the tailings delivery and distribution pipelines will be flushed with water and the wastewater directed to the TMF. The pipelines will be cut up for recycling as scrap or disposed of in a landfill. The reclaim barge and associated pipelines will be retained for the purposes of pumping down the TMF decant pond to allow for the installation of a soil cover. The decant pond water will be pumped to the mine pit lake system where it will provide a benefit for that closure. A soil cover will be placed over the entire tailings impoundment. The purpose of the cover is to:

- Control infiltration of precipitation by shedding surface water off the cover and directing it via engineered grading and ditching towards the closure spillway;
- Substantially reduce the potential ARD from the tailings by controlling infiltration;
- Reduce wind and water erosion;
- Provide a growth medium upon which to establish vegetation; and,
- Reduce visual aesthetic impacts once vegetation has taken hold.

Once a soil and vegetative cover has been established there will not be a need for a long-term maintenance and inspection programme for the tailings. However, the vegetation and the drainage system will require monitoring and may require some maintenance.

At its ultimate development, the TMF dam will reach approximately 180 m in height and will be constructed primarily with waste rock. The down slope of the TMF dam will be terraced to mitigate erosion, and to facilitate access to instrumentation. Once the final terracing is completed, the slope of the TMF dam will be covered with soil and revegetated. Progressive rehabilitation will be initiated in the final years on completed benches.

The TMF dam will be subject to ongoing monitoring, instrumentation, and inspection to help ensure embankment integrity and stability are maintained consistent with statutory requirements. A closure spillway will also be constructed that will discharge to the Corna Valley.

The secondary containment system will be retained throughout the transition phase of closure to collect seepage from the TMF. Water collected in the secondary containment system will be routed through an organically-based, passive or semi-passive treatment system. Such systems are currently in use and recognised as an effective means to treat gold mill tailings in Europe. This system will be designed, developed, and tested during operation so it may be used to discharge seepage water or water from extreme rainfall events. At closure, the treatment system will be upgraded to configure and optimise the system for the closure configuration and expected flow rates.

4.3.2 Waste Rock Disposal Sites

Waste rock from open pit development will be used to construct the TMF embankment and other impoundment structures. Current planning is that once the first open pit has been worked out, (Cîrnic Pit; completed from Year 10) waste rock will be deposited within the void. The balance of waste rock will be deposited in two waste rock disposal sites.

A one-metre constructed layer of durable dacite will underlay the disposal sites and will serve as a drainage blanket. During operations, the run-off from the Cetate Waste Rock Disposal Site, which lies in the Roşia Valley, will be directed to the Cetate Waste Rock and Mine Drainage Pond. The collected wastewater will be pumped to the wastewater treatment plant for treatment prior to release into the local streams. Likewise, the collection pond for the Cîrnic Waste Rock Disposal Site will be retained and the collected water will continue to be directed to the wastewater treatment facilities.

The waste rock disposal sites will be terraced with a 30 m lift height and 41 m width. The waste rock will be deposited on the waste rock disposal sites over the operational life of the facility, thus restricting concurrent reclamation until the final years of operation.

At closure, the Cîrnic Waste Rock Disposal Site will be re-graded to control run-on and to direct runoff to the TMF. Water from the Cîrnic Waste Rock Drainage Pond will continue to be directed to the wastewater treatment system, which initially will be the wastewater treatment plant, but subsequently the pit lake treatment system. A soil cover will be installed over the waste rock disposal site and revegetated.

Drainage from the Cetate Waste Rock Disposal Site will continue to be directed to the Cetate Waste Rock and Mine Drainage Pond at the early stages of transition from operations to closure. After the installation of the cover on the Cetate Waste Rock Disposal Site, and if water quality conditions require it, the runoff will be pumped or carried via a ditch to the completed Orlea or Cetate open pit. This would provide the advantage of a passive collection system. Once the run-off meets discharge criteria, it could be discharged to the Roşia Montană stream.

4.3.3 Open Pits

Perimeter berms around the pits are required for the purpose of public safety, and to control vehicle access to the pits. The construction of berms around the pits will be ongoing during operations. The material used for the berms generally would be waste rock material from the mining operations. Safety berms will be augmented with appropriate warning signs.

Following the cessation of mining activity in all of the openpits, the valved bulkhead that was constructed during operations in the main 714 adit would be used for a controlled discharge out of the open pits, if and when a discharge is needed. The mining equipment and the pit dewatering equipment would be removed. Internal pit roads (with the exception of the Orlea open pit into which access will continue to be required during transition) will be blocked through the placement of berms across the pit entrance. A lockable gate and appropriate warning signs will be used to control access to the entrance of the Orlea open pit.

The Orlea, Cetate, Cîrnic and possibly the Jig open pits will form one interconnected hydrologic system. The flooding of the pit lake will be accelerated by pumping the TMF decant water to the pits at closure. The remainder of the flooding will be the result of precipitation on the pit lake watershed, and some groundwater seepage. The purpose of the flooding would be to provide maximum water cover of the pit walls, which could be potentially acid-generating when precipitation runs down the walls when they are open to air. The alkaline TMF water will provide some initial buffering of the pit lake pH.

Eventually, discharge of treated pit lake water may be required to control the pit level so that an uncontrolled discharge of water to the surface or groundwater system does not occur. This is because precipitation exceeds evaporation at the site, so a discharge will eventually need to occur to maintain the water balance. The appropriate treatment system and scale of treatment will be developed based on observations of any actual ARD occurrence during the operational period. Geochemistry data collected to date suggests that some ARD generation will occur, and it is assumed that treatment will be needed at closure. As the pit lake system fills with water, the pit lake chemistry will be managed so that when a discharge is required, the treatment requirement is reduced or eliminated. This treatment will be conducted using an on-shore treatment plant located near the Orlea pit. A barge-mounted pump would be installed in the Orlea open pit and the water will be pumped from the Pit Lake System to the pit lake treatment plant. During the pit filling period, the water will be returned directly to the Orlea and Cetate pit lakes with excess alkalinity and without clarification. This is in effect a means of adding lime to the Pit Lake System, which will adjust the pH and precipitate metals. However, it is subjected to the limitations of batch treating a very large volume of water, and further treatment may be needed for a discharge to Roşia Valley. A controlled flow through the 714 adit bulkhead will be treated in a passive or semi-passive treatment system downstream of the Cetate Dam to polish the pit lake water. However, if the chemistry is not suitable for this method of treatment, the treatment plant would also be available to treat water for discharge.

The science of mine pit lake treatment is advancing and insitu methods to achieve water quality suitable for direct discharge are being developed. These methods include the addition of organic matter to stimulate the activity of sulphate-reducing bacteria and other biological means of treatment. Such treatment methods may be used at closure if suitably developed at the time of closure.

As noted earlier, the completed Cîrnic open pit may be used for disposal of waste rock in the final five years of operation. This would not affect the approach to closure, in that flooding of the pits would provide an aqueous cover for a portion of the waste rock disposed of in such a manner.

4.3.4 Water Management Dams

Decision on the final closure and rehabilitation of the Cetate Waste Rock and Mine Drainage Dam will depend on the situation where there is no longer mine-impacted and acid water flows in the catchment of the dam so that the quality of the water being collected within the impoundment can be discharged directly to the Roşia Valley Stream. In the interim during closure, water that collects behind the dam will be pumped to the Orlea or Cetate mine pit lakes. Subject to agreement with regulatory authorities, options are that the water impoundment should remain as a freshwater and wetland environment, or the dam may be breached, in which case, any exposed areas would be re-graded to reduce the residual ponding effect and reinstate where possible the original stream course through this area. In this case there will be strategic revegetation in this area, with the intent that the residual pond becomes naturally overgrown with wetland species.

Subject to agreement with the regulatory authorities, the Cîrnic Rock Drainage Dam, which is a shallow structure, may be allowed to silt and support natural wetland vegetation.

4.3.5 Site-Wide Water Management Facilities

As described throughout this section, the site water management strategy during the transitional period is to minimise the ARD potential of the drainage from the waste rock disposal sites and the tailings, through installation of soil covers to limit infiltration of surface water and precipitation and to prevent non-impacted water reaching waste rock and tailings. Surface water and groundwater monitoring will be conducted to ensure that potentially-impacted waters are directed to the wastewater treatment plant for treatment; waters that meet water quality discharge criteria will be directed away from potentially-impacted waters, where possible.

4.3.6 Access Roads

In general, the on-site access roads will be retained during the early years of closure to continue access to work areas undergoing reclamation activities. Lockable gates and appropriate signage will restrict use of the roads. Once most of the major closure work has been completed, the culverts from the access roads will be removed and the roads will be ripped or scarified and revegetated. Certain access roads will be retained to allow for monitoring activities or, as required, for the planned post-mining land use.

4.3.7 Wastewater Treatment Plant

The wastewater treatment plant will be dismantled similarly to other plant structures once there is no longer a need for active water treatment at the site. In the interim, all or a portion of the wastewater treatment plant may be retained and relocated to near the Orlea pit. At this location, it would be used to treat water contained in the open pits.

4.3.8 Electrical Power Lines and Transformers

The on-site electrical power line will be maintained during transition or close-out as long as necessary for the operation of the wastewater treatment plant. Decommissioning will include removing the line and the towers, commensurate with the planned post-mining land use. Alternatively, the low and medium voltage lines could be turned over to the electrical utility for use with local infrastructure development. However, it has been assumed that the high voltage lines and transformers would be removed at closure.

Electrical equipment, including transformers and switch-gear, will be removed where possible and resold. Surplus electrical transformers that are not resold will be transported by a licensed carrier for disposal at an approved facility.

4.3.9 Potable and Process Water Supply Systems

Water requirements will diminish during closure, as the number of on-site personnel decreases and process operations cease. Drinking water requirements may then be met by retaining a contractor to deliver potable water. The potable water supply will be turned over to a local municipal authority or will be decommissioned, including the main supply line along the Abrud River and up the Roşia Valley.

4.3.10 On-site Sewage Treatment Facility

During operations, sanitary waste from offices and plant facilities (e.g., toilets, kitchen wastewater and wash facilities) will report to a domestic wastewater treatment plant to be located within the plant site. The treated effluent from the domestic wastewater treatment plant will be disposed of according to accepted practices. At closure, the on-site domestic wastewater treatment plant may be transferred to a local municipal authority, or be decommissioned. Decommissioning will include purging and cleaning the system, dismantling and disposal at an approved facility or site. If the system is decommissioned, the on-site domestic wastewater treatment system will be replaced by a smaller, more appropriate system for the remaining workforce, in accordance with good practice and prevailing regulations.

4.3.11 Site Security

Site maintenance, security, and monitoring will be ongoing activities during closure. Plant operators will maintain the wastewater treatment plant.

Individuals carrying out maintenance and monitoring activities will be familiar with security procedures, protocols, and reporting requirements. They will also report security concerns.

Site security during the early years of closure is important as there will be varying numbers of contractors and workers on-site and few mine employees overseeing the site. Security measures will include the use of lockable gates and signage as well as regular security checks.

4.4 FACILITIES FOR REMOVAL AT OR PRIOR TO CLOSURE

The following facilities or site features will be removed at or prior to site closure:

- Plant site;
- Storage tanks;
- Explosives and chemicals; and,
- Tailings pipeline and distribution system.

The specific measures to be implemented at each of these sites to minimise or eliminate environmental impacts and to stabilize the facilities for long-term closure are described below.

4.4.1 Plant Site

Inventory control will be implemented to ensure that the stockpiles of crushed and uncrushed ore are used up at the cessation of operation of the plant. Soils at the plant site, including the soil under the plant surface water run-off collection pond, will be checked for contamination and, in the event that contaminants are identified, remediated in situ or disposed of off-site at an approved licensed disposal facility.

With the exception of the wastewater treatment plant or other process facilities that will be turned over to local authorities, the fencing, buildings, and structures at the plant site will be removed if they are portable and retained for re-sale or salvage value. The equipment in the remaining buildings will be removed for salvage and structures and foundations will be demolished to ground level. Structural materials will be salvaged for re-use or sale where appropriate. Waste materials will be removed and disposed of in an approved facility. Remaining inert materials will be buried, covered with a soil layer, and the area revegetated. The inert disposal cell will be located within a portion of the Cetate waste rock pile. Soil cover material and topsoil material will be stockpiled near this disposal cell to be used at final closure.

Machinery to be used on-site includes excavators, front-end loaders, dump trucks, drill rigs, bulldozers, motor graders and miscellaneous motorized ancillary equipment. All mobile equipment will be transferred to other operations or sold. Equipment having no sale value will be sold for scrap.

Stationary process equipment such as the crusher, SAG mill, and the ball mills will probably have some salvage value. These will be removed from their foundations and sold. Non-salvageable machinery and equipment will be checked to ensure that all fluid compartments are drained and the contents disposed of in an approved facility. The equipment will then be removed from the Project site sale, for scrap or disposal at an appropriate waste disposal facility.

4.4.2 Storage Tanks

Careful inventory control will be implemented to minimise the contents in the storage tanks at the end of the mine's operational life. The transportable cyanide storage tanks will be returned to the supplier for continued use. The diesel fuel, gasoline and lubricant tanks and dispensing systems may continue to be used, if deemed worthwhile, in the early years of closure during which the covers are being installed and significant earthworks are being carried out. The advantage of maintaining these tanks and dispensing systems will be to realize the benefits of existing infrastructure and to minimise the potential for accidental spills.

All storage tanks will be decommissioned in accordance with all applicable environmental and safety regulations. This includes the use of personal protective and safety equipment, air quality and off-gas monitoring, draining/transferring of tank contents, removal of any residues in containment structures, cleaning, cold or hot cutting of tanks, and removal by a licensed hauler to an approved landfill. Many of the tanks that were fabricated on site, including the CIL tanks and thickeners, will be cut up into scrap metal for removal. Soils below storage tanks will be sampled and tested to confirm there is no residual contamination below each facility.

4.4.3 Explosives and Chemicals

Explosives and chemicals will be returned to the supplier or disposed of by a licensed contractor. Inventory control in the final years of operation will be implemented to reduce the quantity of explosives/chemicals remaining at closure. The explosive storage magazines will be decommissioned.

4.4.4 Tailings Pipeline and Distribution System

The above ground tailings pipeline and distribution system will no longer be required once processing activities cease. The tailings lines will then be purged (with wastewater directed to the TMF), dismantled, cut up into manageable portions, and removed.

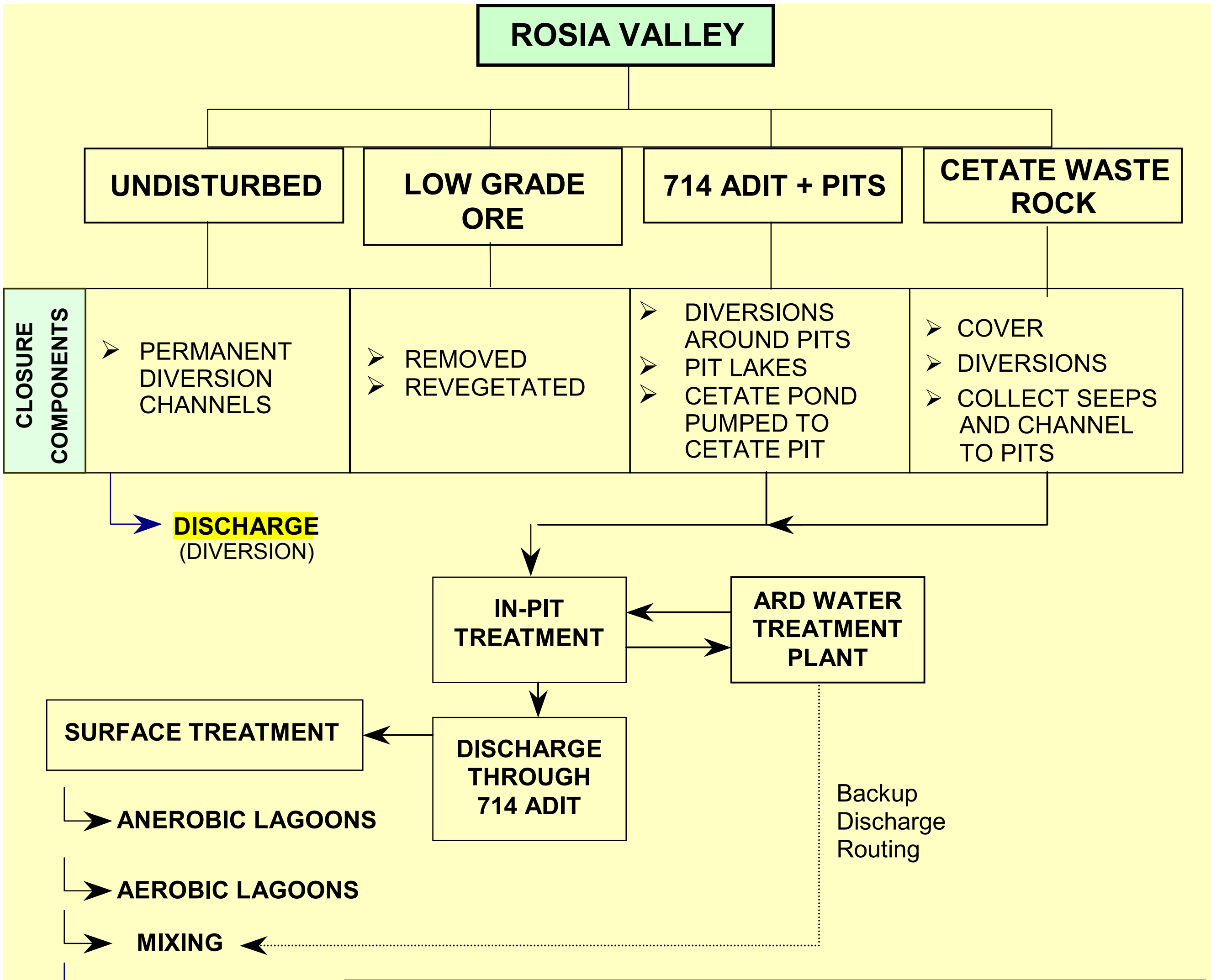
The tailings reclaim pumping and piping system will be removed after the consolidation of tailings has ceased and the soil cover has been placed over the tailings. The pumping systems will be removed for re-sale and the barge and piping systems will be either re-sold or cut up for recycling.

4.5 WATER MANAGEMENT AT CLOSURE

Water will need to be managed in the two site watersheds at closure. The focus will continue to be routing clean water around the mine facilities and collecting and treating water impacted by the mining as necessary. At closure, the majority of the ARD sources that are currently impacting the Roşia and Corna Valleys will have been removed, and the management will largely only need to focus on the facilities constructed as part of the proposed project. The advantage of this is that the project facilities will be discrete facilities simplifying water management and treatment, if needed. An important component of this strategy for all facilities is the source control that results from the closure activities. For example, the covers that will be place on the TMF and waste rock facilities will significantly reduce water contact with the materials contained in these facilities, and thereby reduce the formation and transport of any ARD. However, such source controls are rarely 100 percent effective and some long-term water management will be required in both the Roşia and Corna Valleys. The water management strategy at closure for both the Roşia and Corna Valleys is presented in the following two sections.

4.5.1 Roşia Valley Water Management

The components of the water management strategy in the Roşia Valley at closure are illustrated in *Text Figure 4.1 - Roşia Valley Closure Water Management*. Diversion of water around the mined area will continue in permanent diversion channels. The low-grade ore will be processed near the end of operation, and the area of the low-grade stockpile will be revegetated. Therefore, this water will not be collected. However, residual ARD may still issue from the Cetate Waste Rock pile and in the mine pits with the remaining interconnected underground mine workings (the Pit Lake System). The flow from the Cetate Waste Rock will be greatly reduced by the closure cover, and the residual seepage will be routed to the Pit Lake System through gravity drainage or pumping. The primary means of treatment will be in the Pit Lake System using an ARD treatment plant to feed lime to the lakes. When a discharge is required it can be through the ARD treatment plant or through the 714 adit with a biological treatment system utilising passive or semi-passive ARD treatment technologies, such as anaerobic and aerobic systems. The method of treatment will be based on the quality of the water in the pit lakes. However, the goal will be to treat the water in the mine pits to a quality that is suitable for discharge through a low maintenance, passive treatment system for polishing. The active ARD treatment system would be available if this goal cannot be achieved. The water from either treatment system will mix with other site water and be discharged. The long-term goal will be to improve water quality in the Pit Lake System so that a direct, untreated discharge can occur.



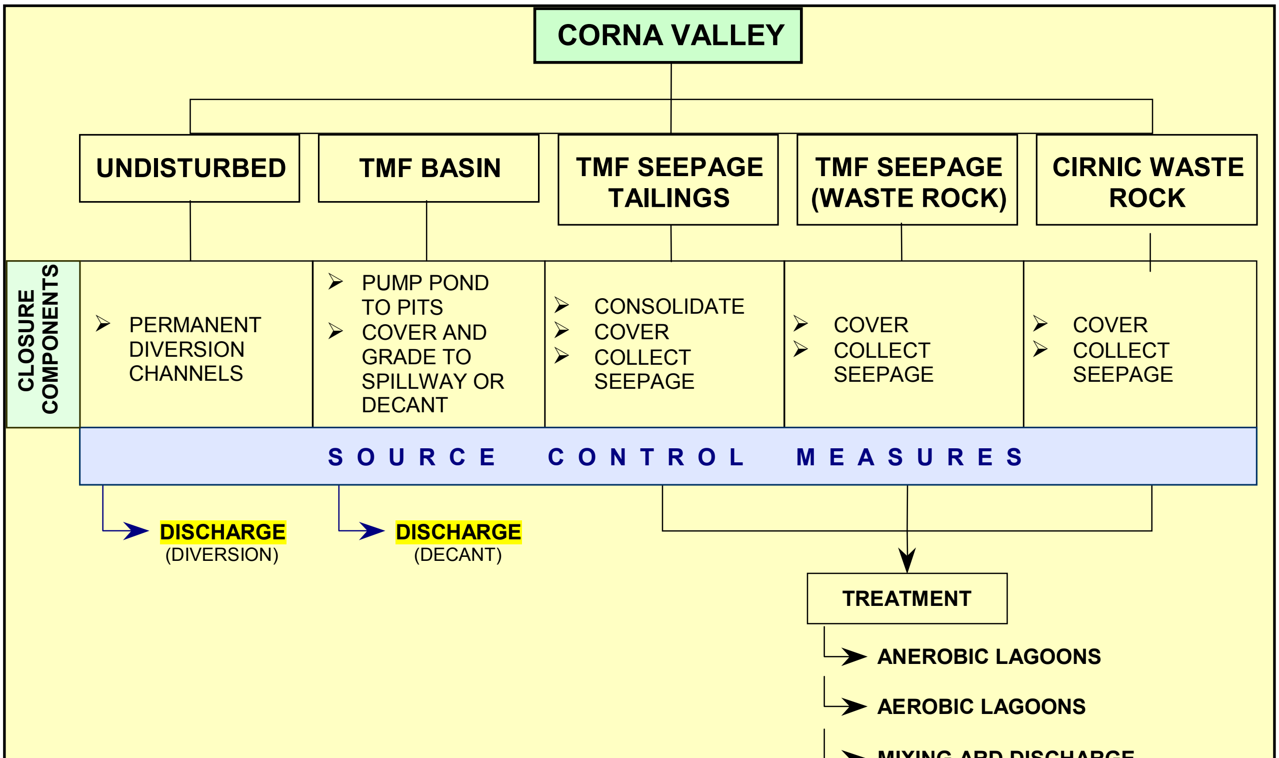
TEXT FIGURE 4.1 - ROSIA VALLEY CLOSURE WATER MANAGEMENT

The Pit Lake System will be the focus of the water management activities at closure in the Roşia Valley. The lakes will form in the mine pits at closure, and because of the positive site water balance, the Orlea pit lake will overtop the pit rim if not managed. Because of the network of underground mine workings, the other pit lakes will flow to the Orlea pit if it overtops. The flooding of the Pit Lake System will occur up to a level of the 714 adit if a bulkhead is not placed in the adit or if the water level is not managed below the adit level. If the 714 adit is bulkheaded, then overflow would occur at an elevation of approximately 745 meters above sea level from the Orlea pit rim. A bulkhead with a valving system will allow for a controlled discharge from the Pit Lake System to the external semi-passive or passive treatment system and, additionally, will allow for the maintenance of a water level below the pit rim with freeboard for storm water storage capacity.

An important component of the pit lake management is the accelerated flooding of the pit lakes. This flooding helps reduce potential ARD generation by submerging potential ARD-generating rock, and helps ensure the continuity of closure operations, that is, a prolonged period does not occur between site closure and the need to treat mine pit water.

4.5.2 Corna Valley Water Management

The water management strategy for closure is illustrated in *Text Figure 4.2 - Corna Valley Closure Water Management*. The initial component of this strategy will be to pump the decant pond water to the mine pits. This will assist in the closure of the TMF, as well as the mine pits. As the result of covering the TMF and TMF dam with soil covers, the runoff from these facilities could be allowed to discharge directly to Corna Valley. The diversion ditches will also continue to discharge to the Corna Valley. Seepage will continue to be derived from the TMF tailings, TMF dam, and Cîrnic Waste Rock in the Corna Valley; although, the seepage rates will be significantly reduced by the closure source control measures. This residual seepage will be treated and discharged through the treatment system located below the TMF, which was developed during site operation. This discharge will require a permit from the appropriate regulatory authority.



TEXT FIGURE 4.2 - CORNA VALLEY CLOSURE WATER MANAGEMENT

4.6 MONITORING DURING AND AFTER CLOSURE

Potential changes in physical, chemical and biological parameters in the project vicinity will be monitored throughout construction, operations, and closure phases of the Roşia Montană Project. Environmental monitoring after mining has ceased will be required to confirm that the remediation measures have been properly implemented and are effective. Monitoring will be performed under the guidance of the mine personnel and will include:

- Environmental inspections during active periods of closure; and
- Collection/analysis of monitoring data.

Mine personnel will regularly visit the site to inspect the property during periods of closure and will be apprised of the objectives for the monitoring programme. Personnel will be trained to identify areas of concern (e.g., areas where re-vegetation has not taken place, signs of physical stress, erosion or instability), which may arise between regularly scheduled monitoring periods. Following final closure, a qualified individual on a regular basis will inspect the property. These inspections will be conducted in accordance with procedures cited in the *Environmental and Social Management Plan*, developed as a part of the EIA process. The inspections will continue until it can be determined that the closure objectives have been met.

The monitoring programme during closure will include specific monitoring for physical stability, chemical stability and biological conditions. The specific components to be measured, locations, parameters, methods, and frequency are presented in *Table 4.2, Roşia Montană Project Closure Monitoring Requirements*.

4.6.1 Response Plan in Case of Accidents and/or Emergencies

The *Emergency Preparedness and Spill Contingency Plan* will be implemented by RMGC and will contain the measures that will be used to prevent, prepare for, and respond to emergency situations that could potentially occur at the RMGC site. The plan will be in accordance with the requirements of *Article 20 of Government Emergency Ordinance No. 78/2000, Waste Management*, and *Law No. 106/1996, Civil Protection*. It will also conform to the guidance of the United Nations Environment Programme Awareness and Preparedness for Emergencies at a Local Level for Mining, the *EU Directive 96/82/EC* on the control of major accident hazards, and will encompass good management practices typical of world-class mining operations. The *Emergency Preparedness and Spill Contingency Plan* will support other RMGC policies for minimising potential hazards to human health, property and the environment. Pre-planning, preventative measures, training, and efficient execution of the procedures outlined in the emergency preparedness plan are intended to minimise the potential hazards and reduce the potential impact of hazardous operations within the RMGC mine and mineral processing operations. The *Emergency Preparedness and Spill Contingency Plan* will be designed to be implemented in conjunction with a local Community Emergency Plan, and will provide guidance for community officials, emergency response personnel, and nearby businesses and residents on emergency preparedness and response procedures to be taken in the event of an emergency at the RMGC facility that could impact the environment or adjacent communities, as well as other potential emergencies the community might face.

Table 4.2 Roşia Montană Project Closure Monitoring Requirements				
Component	**Location**	**Parameters**	**Methods**	**Frequency**
PHYSICAL STABILITY				
Cetate, Cîrnic, Jig, and Orlea open pits	Ditches / berms / fences / signage around pit	Access	Visual inspection of condition	Routine inspection frequency during construction; annually during closure, subject to review based on data results
	Within open pits	Slope stability	Visual inspection for tension cracks, signs of failure, gully erosion; survey slope movement and water levels	
Cetate and Cîrnic Waste Rock Disposal Sites and any site waste disposal areas	Ditches / berms / fences / signage	Access	Visual inspection of condition of disposal sites	Visual inspection for stability, erosion and re-vegetation success
	Waste rock disposal sites and waste disposal areas	Slope stability	Visual inspection for tension cracks, signs of failure, gully erosion, re-vegetation progress	
	Waste rock disposal sites and waste disposal areas	Cover stability	Visual inspection for sheet and gully erosion, alluvial fans, re-vegetation progress	
Tailings impoundment and water management structures	Ditches / berms / fences / signage	Access	Visual inspection of condition	Routine inspections annually. Inspection frequency reduced for post closure
	Ditches, spillways and dam structures	Physical stability	Visual inspection for tension cracks, signs of failure, gully erosion, wind erosion, slope deformation, re-vegetation progress, seepage stains, survey rates of settlement. Water levels in impoundment area	Routine inspection frequency during construction; annually during closure, subject to review based on data results
Tailings Management Facility Dam	Tailings Management Facility	Physical stability	Instrumentation (vibrating wire piezometers, survey monuments and slope indicators) installed to determine phreatic head and signs of lateral movement settlement	Quarterly readings and evaluations

Table 4.2 Roşia Montană Project Closure Monitoring Requirements				
Component	**Location**	**Parameters**	**Methods**	**Frequency**
CHEMICAL STABILITY				
Surface Water Quality	Secondary containment system outlet	To be established in operational phase: selected general physical/chemical and metal parameters as area is rehabilitated	Grab samples	As per operational phase with reduced frequency (seasonal or annual) as area becomes rehabilitated
Tailings management area discharge				
Waste rock disposal sites and plant site runoff ponds	Sediment pond outlet (or drainage ditch when pond removed)	To be established in operational phase: selected general physical/chemical and metal parameters as area is rehabilitated	Grab samples	As per operational phase with reduced frequency (seasonal or annual) as area becomes rehabilitated
Flooded pits	Flooded pits	General physical/chemical parameters plus metals scan (or as appropriate based on operational phase data)	Integrated composites over entire depth	Seasonal with frequency and parameters reduced as pit lake water quality stabilizes
Hydrogeology:				
Groundwater quality down gradient of waste rock disposal sites	As per operational phase	General chemistry, metals scan and total phosphorus or as appropriate based on operational phase data.	Sampling of selected monitoring wells following current protocols	Will be subject to review annually based on data results
Groundwater quality down gradient of TMF dam	As per operational phase	General chemistry and metals scan or as appropriate based on operational phase data	Sampling of selected monitoring wells following current protocols	Will be subject to review annually based on data results
BIOLOGICAL MONITORING				
Aquatic Biology				
Water quality and habitat	Roşia and Corna Stream systems as per operational phase	Water quality as determined from chemical stability monitoring and stream habitat conditions	Visual inspection of habitat	Will be subject to review annually based on data results

Table 4.2 Roşia Montană Project Closure Monitoring Requirements				
Component	**Location**	**Parameters**	**Methods**	**Frequency**
TERRESTRIAL BIOLOGY				
Natural Vegetation	All reclaimed areas	Vegetation type and density	Visual inspection and photo documentation	To be performed annually, each spring
Wildlife Presence	All reclaimed areas	Wildlife Sighting - Species - Number	Visual observations	Annual

Exhibit 4.1 Site Conditions at Year 19 (REV C)

Exhibit 4.2 Site Conditions at Year 21 (REV A)

5 PROVISIONS FOR ENVIRONMENTAL AND SOCIAL MONITORING

This section describes RMGC's current environmental and social monitoring programmes, which will be expanded to accommodate the broad range of environmental and social performance monitoring needs associated with the construction, operation, decommissioning and closure of mining operations. A comprehensive *Environmental and Social Monitoring Plan* will be developed as a component of the EIA process, and will be maintained and updated over the life of the project as a permanent feature of the RMGC Environmental and Social Management System.

The primary objective of the *Environmental & Social Monitoring Plan* and its associated plans and supporting procedures is to acquire accurate, representative, and defensible data to support 1) verification of RMGC's continuing compliance with all relevant regulatory requirements, and 2) detection of any negative performance trends that could jeopardise RMGC's compliance status or otherwise compromise the environmental and social policy goals of the project. Implementation of the *Environmental & Social Monitoring Plan* will prompt timely corrective and preventive actions for any such negative trends, as well as support the development of potentially *positive* environmental and social impacts that may also be observed in the EIA process.

5.1 SUMMARY OF CURRENT ENVIRONMENTAL AND SOCIAL MONITORING PROGRAMMES

In preparing the *Environmental and Social Monitoring Plan*, major elements of RMGC's current aquatic environmental monitoring programme and social performance monitoring activities are being evaluated, updated, and, where necessary, supported by a suite of documented *standard operating procedures*. Other monitoring needs associated with ambient and workplace air quality, industrial noise, the integrity of earthworks and other engineered systems, plant safety, and the Project's various social programmes will be integrated and supported by additional standard operating procedures, as appropriate. Current baseline monitoring programme capabilities are summarised as follows:

Environmental Monitoring: RMGC's current aquatic environmental monitoring system is designed to enable RMGC to understand and manage the aquatic environment in the vicinity of the Project, and was initiated in 2000. The monitoring system is presently based upon a sampling network consisting of four engineered weirs to measure stream flows, over 60 groundwater level monitoring wells, over 70 hydrochemistry monitoring points (equally divided between surface and ground water, respectively) and a meteorological station.

The aquatic monitoring programme has documented extensive existing environmental impacts in the watersheds within and adjacent to the Project boundaries. Historical mining operations, as well as subsistence farming, residential and industrial developments have generated most of these impacts. ARD conditions from historical mining operations in particular have severely impacted local drinking water sources and downstream watercourses. RMGC designed, developed and is managing the ongoing monitoring programme using in-house staff and independent international consultants, and the features of the programme have been presented to Government authorities in a number of separate visits.

Monitoring of Social Programmes: RMGC has established a series of social programmes for those families that will be displaced by the project, with the aim of facilitating the integrate of these families into new host communities; and restoring impacted livelihoods; and sustaining the general development of the host communities. The programmes include:

- Selection and preparation of resettlement and replacement homes;
- Assistance in managing issues associated with the influx of displaced residents to new host communities;
- Relocation schedule and logistical assistance;

- Replacement of impacted services and enterprises;
- Restoration of livelihood;
- Preservation and protection of cultural property; and,
- Providing special assistance for vulnerable ethnic or social groups.

Specific types of monitoring activities associated with these programmes will be defined in their governing management/action plan (e.g., *Cultural Heritage Management Plan, Resettlement and Relocation Plan, Public Consultation and Disclosure Plan),* and will include regularly scheduled inspection, surveys, public outreach meetings, and other appropriate performance data gathering activities.

5.2 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

5.2.1 Description

The *Environmental and Social Monitoring Plan* will be developed for submission as part of the EIA, and will describe the comprehensive programme established by RMGC to monitor not only the quality of surface water and groundwater, but also the performance of the Project in relation to the full range of voluntary or regulation-based environmental and social management requirements that will apply over the entire mine life cycle. The *Environmental and Social Monitoring Plan* is a necessary key component in the continual improvement process established by the Environmental and Social Management System documented by RMGC's *Environmental and Social Management Plan*. The *Environmental and Social Monitoring Plan* will be periodically benchmarked against applicable legal and regulatory requirements, and will identify current environmental (e.g., physical, chemical, and biological) monitoring protocols, as well as the application of other procedures that will be used to monitor RMGC's social programme performance. The specific monitoring requirements to be established by the *Environmental and Social Management Plan* and other individual environmental action plans (e.g., the *Cyanide Management Plan*, the *Tailings Facility Management Plan*, the *Waste Management Plan*, or *Biodiversity Conservation Plan*) will be included in the scope of the monitoring programme embodied therein.

Monitoring data generated from specific types of monitoring activities will be captured in a controlled database that will be used as a management tool to support the planning and timely execution of the required monitoring actions and the early detection of negative trends. Database updates will be performed on a routine basis to ensure that the monitoring programme remains accurate, comprehensive, and suitable for the evolving needs of each phase of the RMGC project. The results of RMGC's environmental and social monitoring activities will be periodically compiled, evaluated, and summarised in an *Annual Environmental and Social Monitoring Report*, discussed below in *Section 5.2.6*. This report will also serve as a key input to an annual management review process designed to generate appropriate changes, improvements, or refinements in RMGC's environmental management practices.

The *Environmental and Social Monitoring Plan* will be subject to periodic review and update over the life of the mining operation, in response to internal and external reviewer comments, regulatory changes, changes in mining operations (i.e., changes from construction to operational and, ultimately, closure and post-closure phases), stakeholder communications, internal verification audit and management review results, and other important inputs. It will be a vital element of RMGC's overall *Environmental and Social Management Plan*, and will address key operational control needs to be established for those areas for which the EIA indicates that potentially significant environmental or social impacts are either known to exist, or may occur in later phases of the mine life cycle.

The implementation of the *Environmental and Social Monitoring Plan* will also be supported by a number of detailed, lower-tier *Standard Operating Procedures*. These procedures will be compiled in the *RMGC Standard Operating Procedures Manual*, the development, review, approval, distribution, and update of which will be controlled by the *Environmental and Social Management Plan*. Other specific document distribution, change control, personnel training, and records management needs will likewise be addressed through processes and procedures defined in the *Environmental and Social Management Plan*.

5.2.2 General Requirements

Environmental monitoring requirements concerning physical stability, chemical stability and biological issues are identified based on:

- Governing legal and regulatory requirements; and,
- Various other monitoring requirements established by the *Environmental and Social Management Plan* or individual environmental action plans (e.g., the *Tailings Facility Management Plan*, the *Waste Management Plan*, or the *Biodiversity Conservation Plan*).

Other environmental and social monitoring requirements are based on:

- Governing legal and regulatory requirements;
- The progress-monitoring requirements associated with actions related to the implementation of the management and mitigation measures recommended by the EIA process, as documented in RMGC's *Environmental and Social Performance Improvement Plan*; and,
- Other monitoring requirements established by the *Environmental and Social Management Plan* or individual environmental social action plans as previously noted.

Table 5.1 Environmental Performance Monitoring Requirements, identifies the primary information fields to be included in the RMGC Monitoring Database as to the initial categories of environmental monitoring:

- The operational areas of the mine site that are affected;
- The sources to be monitored; and;
- Monitoring requirements.

Potential additional environmental monitoring will be identified in the EIA.

Table 5.1 Environmental Performance Monitoring Requirements[1]

Impact Category	Operational Area	Source of Monitoring Requirement	Monitoring Requirement
Hydrology and Surface Water Quality	Process plant, Tailings Management Facility, Cetate Water Catchment Reservoir, ponds, lagoons, berms, dikes, and associated engineered water management structures	• *Tailings Facility Management Plan* • *Water Management and Erosion Control Plan*	• Surface water quality and flow monitoring • Structural safety/integrity of the tailings impoundment and other engineered structures
	ARD wastewater treatment facility	• *Water Management and Erosion Control Plan*	• ARD wastewater treatment plant effluent quality and slurry monitoring
	Domestic wastewater treatment facility	• *Environmental and Social Monitoring Plan*	• Domestic wastewater treatment plant effluent quality/sludge monitoring

Table 5.1 Environmental Performance Monitoring Requirements[1]

Impact Category	Operational Area	Source of Monitoring Requirement	Monitoring Requirement
Groundwater	Process plant, Tailings Management Facility, Cetate Water Catchment Reservoir, ponds, lagoons, berms, dikes, and associated engineered water management structures	• *Tailings Facility Management Plan* • *Water Management and Erosion Control Plan*	• Groundwater monitoring
Air Quality and Climate	Tailings Management Facility	• *Tailings Facility Management Plan* • *Environmental and Social Monitoring Plan* • *Air Quality and Noise Monitoring Plan*	• Monitoring of air quality and meteorological parameters
	Pit areas and haul roads	• *Environmental and Social Monitoring Plan* • *Air Quality and Noise Monitoring Plan*	• Monitoring of air quality and meteorological parameters
	Process plant	• *Environmental and Social Monitoring Plan* • *Air Quality and Noise Monitoring Plan*	• Monitoring of air quality and meteorological parameters
Noise and Vibration	Blast zones, pit areas, haul roads, waste rock disposal sites, process plant, access roads	• *Environmental and Social Monitoring Plan* • *Air Quality and Noise Monitoring Plan* • *SOP for Workplace Hearing Protection*	• Ambient noise/vibration monitoring • Workplace noise monitoring

[1]The example monitoring requirements listed herein are generally associated with environmental impacts typical of the pre-production and operational phases of mine life. Currently predicted closure-phase monitoring requirements are documented in the current version of the RMGC *Mine Reclamation and Closure Plan* and summarised in *Section 4* of this document; final requirements associated with closure/post closure monitoring will be incorporated in the *Environmental and Social Monitoring Plan* prior to the initiation of reclamation and closure actions.

As the EIA and *Environmental and Social Monitoring Plan* are further developed, additional information field will be added, including:

- Social impact categories, as well as additional environmental impact categories;
- Monitoring requirements source document references;
- Locations in which the monitoring events will be performed;
- Monitoring frequency, limits, and action level; and,
- Responsible personnel.

5.2.3 Overview of Environmental Performance Monitoring by Phase

Environmental monitoring is intended to support the determination of the potential effects on specific receptors resulting from exploration activities, as well as the actual environmental impacts associated with the construction, operation, and closure of mining facilities.

5.2.3.1 Monitoring Prior to Operations

Monitoring activities prior to operations support a range of environmental inspection, surveys and evaluations, sample collection and analysis of associated monitoring data. Such inspections/surveys are required to ensure:

- Definition of baseline conditions;
- Appropriate construction management techniques are employed, particularly as they relate to erosion and sediment control during construction in or adjacent to watercourses;
- Compliance with approved construction practices; and,
- Mitigation measures are implemented and functioning properly.

5.2.3.2 Operational Phase Monitoring

Ongoing environmental inspection and monitoring activities will be carried out during operations to:

- Track trends or changes in, or potential impacts to, the environment resulting from the daily operation of the mine;
- Acquire representative environmental data that will provide the basis of predicting long-term environmental impacts;
- Detect negative trends and prompt effective corrective and preventive actions to avoid or mitigate potentially adverse environmental impacts;
- Ensure that RMGC maintains compliance with currently applicable legal and regulatory requirements, permits, licenses, and environmental endorsements; and,
- Help ensure that proper procedures, management systems, and training are in place to prevent or respond to spills or other emergencies, as required by RMGC's *Emergency Preparedness and Spill Contingency Plan* and its supporting plans and procedures.

The operational phase programme will include air, surface water, groundwater, noise and vibration monitoring as necessary to address potential impacts of mine/plant operations and processes.

5.2.3.3 Closure Plan Monitoring

Environmental inspection and monitoring during the closure/post closure phases will be required to confirm that the remediation measures have been properly implemented and are effective. *Section 4* separately summarises an initial iteration of closure/post-closure monitoring requirements. These will be updated in the EIA and RMGC's *Mine Reclamation and Closure Plan* and final requirements associated with closure/post closure monitoring will be developed prior to the initiation of reclamation and closure actions.

5.2.4 Quality Assurance/Quality Control Considerations

The monitoring programme will include the following measures to ensure a high degree of confidence in the data:

- Strict adherence to standard procedures for collection, preservation, storage, handling and shipping of samples;
- Documentation of any unusual conditions or deviation from the protocols, as part of the sampling procedures;
- A field quality control programme for analytical samples that includes submission of travel and field blanks and duplicate samples to test the purity of chemical preservatives, to check for contamination of sample bottles and other equipment used in sample collection or

handling, and to detect other systematic or random errors introduced between the time of sampling and analysis;

- The establishment and implementation of laboratory QA/QC standards as part of procurement conditions (including laboratory certification);
- Validation of data in accordance with established protocols; and,
- Timely review of analytical results to identify areas of concern (including methodology and potential impacts).

5.2.5 Social Management Performance Monitoring

Monitoring requirements associated with the performance of RMGC’s social programmes are based on governing legal and regulatory requirements, as they may exist, public outreach and communication programmes, and the progress-monitoring requirements associated with actions related to the implementation of the management and mitigation measures recommended by the EIA process. General categories of social performance monitoring requirements will also be contained in the environmental and social monitoring database described in the *Environmental and Social Monitoring Plan*, as previously noted in Section 5.2.2.

The data acquired from these monitoring actions will be used to develop a suite of annually updated Environmental and Social Performance Improvement Instructions, as noted in RMGC’s *Environmental and Social Performance Improvement Plan.* These documents will identify specific management and mitigation measures and appropriate operational controls or performance improvement actions, for each impact and management measure identified by RMGC through the EIA process. The *Environmental and Social Performance Improvement Plan* also describes the process that RMGC will use to ensure that improvement actions are prioritised for implementation on the basis of:

- The relative magnitude of their associated impacts;
- The presence or absence of current regulatory issues, social concerns, or specific stakeholder issues that may affect the urgency or course of actions taken for a given impact;
- Evaluation of the general adequacy or effectiveness of current operational controls or management and mitigation measures;
- The application of operating standards that, wherever appropriate and feasible, exceed the requirements of national law;
- Respect for the social, economic and cultural rights of indigenous people; and,
- Social responsibility, including health and safety and community relations.

Such instructions will provide technical guidance and appropriate scheduling information for each action, at appropriate functional levels of RMGC’s operations, and provide a mechanism for ensuring that RMGC’s management resources are continually re-focused on the resolution of the most pressing environmental and social issues associated with each phase of mine life.

5.2.6 Preparation and Submission of Annual Monitoring Report

The RMGC Director responsible for Community Development and the RMGC Environmental Manager are responsible for the preparation of an *Annual Environmental and Social Monitoring Report*. The report will compile the results of monitoring analyses, present a summary of the conclusions that can be drawn from the data and highlight any noted trends or specific issues that will need to be addressed through management action. A specific course of action will be proposed for the mitigation or elimination of negative trends or issues. Details of any rehabilitation work carried out over the past year and any proposed for the coming year will also be discussed, along with any project changes that may result in revisions to the closure plan or proposed rehabilitation work. The draft report will be submitted to the RMGC Chief Executive Officer and RMGC's General Counsel for their review and comment. *The Annual Environmental and Social Monitoring Report* may be released to the public at the discretion of the RMGC Chief Executive Officer and General Counsel, as noted in RMGC's current *Public Consultation and Disclosure Plan.*