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Mining District File Summary Sheet

DISTRICT	Rosebud
DIST_NO	4010
COUNTY If different from written on document	Pershing
TITLE If not obvious	Hecla Mining Company Rosebud Deposit Geology and Mineral Resources, January 1996
AUTHOR	Muerhoff C
DATE OF DOC(S)	1996
MULTI_DIST Y / N? Additional Dist_Nos:	
QUAD_NAME	Sulphur 7½'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Rosebud deposit; Hecla Mining Co. ASARCO; Freeport McMoRan Exploration; St. Joe Minerals; USMX; Dozer Hill; Equinox Resources, Ltd.; LAC Minerals (USA) Inc; South Zone; East Zone; North Zone; Far East Zone
COMMODITY If not obvious	gold; silver
NOTES	geology; mineral list; statistics; assays; resources; deposit report 23p.

Keep docs at about 250 pages if no oversized maps attached
(for every 1 oversized page (>11x17) with text reduce
the amount of pages by ~25)

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Hecla Mining Company
Rosebud Deposit

Geology and Mineral Resources

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January, 1996

History of the Rosebud District

Mining has been intermittent in the Rosebud District since the discovery of gold and silver on the southern flanks of Rosebud Peak in 1906. The discovery led to a rush of miners and promoters to the area that resulted in the founding of two towns, Rosebud and Goldbug. By 1908, both towns were virtually abandoned, with a few miners remaining to develop gold and silver ore from the Dreamland Mine. The first shipments of ore from the Rosebud District were from the Dreamland Mine in 1908.

From 1908 to 1947, several small mines in the district produced minor amounts of gold and silver, with some copper and lead credits. Total production from the district was 3,775 ounces of gold, 116,293 ounces of silver, 18,722 pounds of copper, and 4,633 pounds of lead, with the majority of the production coming from the Dreamland Mine.

The Rosebud District is bordered by the Sulphur District to the north/northwest and by the Rabbit Hole District to the west. Mining in the Sulphur District began in 1874 with the discovery of high-grade deposits of sulphur ore on the margin of the Black Rock Desert. Hycroft Resources, Inc. currently operates the Crofoot-Lewis open pit gold-silver mine in the same area that sulphur was mined a century ago. The Rabbit Hole District is a placer gold district located on the extreme western flank of Rosebud Peak, extending down to the western extent of Rosebud Canyon. The placers in the Rabbit Hole District were reportedly worked as early as 1870 by Chinese placer miners. Placer mining by several different companies continued intermittently through 1963, and the placers are still worked by individual miners and prospectors today.

Recent activity in the area began in the early 1980's when Hycroft Resources, Inc. explored and developed the Crofoot-Lewis Mine, located approximately seven air-miles northwest of the Rosebud Deposit in southwest Humboldt County. Hycroft Resources, Inc. currently operates the open pit, heap leach mine under an environmental assessment and has reported a proven and probable reserve of 60MM tons containing 1.2MM ounces of gold.

In the early 1980's, surface exploration in the Rosebud District was undertaken by ASARCO, Freeport McMoRan Exploration, St. Joe Minerals, and USMX. Ten shallow reverse-circulation drill holes to test for open-pit minable gold mineralization in the Dozer Hill area were completed by Freeport McMoRan Exploration with no encouraging results, and the property was subsequently dropped.

In 1985, Equinox Resources, Ltd. (Equinox) of Vancouver, British Columbia staked claims throughout the Rosebud District and began surface exploration involving geologic mapping and sampling. LAC Minerals (USA), Inc. (LAC) staked claims over a portion of the Rosebud area and entered into an option agreement with Equinox Resources, Ltd. covering their Rosebud claims in 1988. In 1989, LAC exercised an option to earn a 51% interest in the Equinox portion of the property and by December had completed approximately 115,000 feet of reverse-circulation drilling, along with geologic mapping, geochemical sampling, and geophysical surveys. This work discovered and helped delineate the gold and silver mineralization of the Rosebud Deposit. Between 1990 and 1993, an additional 89,000 feet of reverse-circulation and core drilling were performed by LAC and the LAC/Equinox joint venture which brought the project to a pre-feasibility stage.

In 1993, LAC decided it was unlikely that their interest in the Rosebud property would meet their 1.0MM gold ounce minimum requirement to proceed with development. Subsequently, Equinox purchased LAC's interest in Rosebud for $5.5MM. Equinox partially financed the purchase by selling a 2.5% net smelter return royalty to Euro-Nevada Mining Company, Inc. for $3MM, with an option for an additional 1.5% NSR for $2.5MM after receipt of a bankable feasibility study.

In February, 1993, the Bureau of Land Management (BLM) completed an environmental assessment for underground exploration and test work as originally proposed by LAC Minerals. Following acceptance of the EA, Equinox Resources, Ltd. collaborated with Hecla Mining Company staff to design and develop an initial access decline into the Rosebud ore body.

Hecla Mining Company completed a successful acquisition of Equinox Resources, Ltd. and became the sole owner and operator of the Rosebud Project during the first quarter of 1994. Hecla continued with the exploration, and completed approximately 3,000 feet of decline, 25,000 feet of underground core drilling, and 32,000 feet of surface core drilling in 1994. Hecla also commenced project permitting, metallurgical testing, plant infrastructure design, and mine engineering.

Geology and Mineralization at the Rosebud Deposit

Stratigraphy

The Rosebud Deposit is situated in northwest Nevada, within the basin and range physiographic province. The project area is underlain by Tertiary volcanics and volcaniclastics (rhyolitic to andesitic in composition) and epiclastics of Miocene age, collectively known as the Kamma Mountain Volcanics. Units of the Kamma Mountain Volcanics are the primary ore hosts for the Rosebud Deposit. This volcanic package lies unconformably on metasediments of Jurassic/Triassic age (Auld Lang Syne Group).

In the project area, the Kamma Mountain Volcanics have been informally subdivided into six (6) units, from youngest to oldest: Chocolate Tuff, Bud Tuff, LBT, Oscar Sediments, Dozer Tuff, and the Basal Tertiary Sediments.

The *Chocolate Tuff* unit is a series of inter-bedded, fine-grain, moderately- to densely-welded ash flow tuff and coarse-grain, poorly-sorted, matrix- to clast-supported heterolithic volcanic breccia that ranges in thickness from zero (0) to 600 feet.

Underlying the Chocolate Tuff is the *Bud Tuff* unit, in which three (3) distinct lithologic members have been identified. The Upper Bud member is a latitic, lithic lapilli ash flow tuff with associated tuff breccia and epiclastics (reworked tuff), up to 100 feet thick. This is underlain by the Bud Marker Bed member, which is a porphyritic alkali rhyolite flow that ranges from zero (0) to 120 feet in thickness. The Lower Bud member ranges in thickness from zero (0) to 100 feet and is a latitic, lithic lapilli (fiamme) ash flow tuff and tuff breccia, with a minor, discontinuous, epiclastic component.

Below the Bud Tuff is the *LBT* unit, which is a primary ore host. The LBT unit is comprised of up to 600 feet of fine-grain waterlain and airfall tuff, and lithic-lapilli ash flow tuff and tuff breccia. Nine (9) distinct volcanic facies have been identified in the LBT unit in the immediate project area, from youngest to oldest:

1. Monolithic, autobrecciated, fine-grain tuff
2. Massive-bedded, fine-grain tuff
3. Planar-laminated, fine-grain tuff
4. Medium-grain, wavy-laminated airfall(?) tuff
5. Vesicular, flow-banded tuff (leopard spot texture)

6. Massive, very fine-grain vitrophyre
7. Matrix-supported, chaotic-bedded, heterolithic tuff breccia
8. Clast-supported, chaotic-bedded, monolithic tuff breccia
9. Flow-banded, matrix-supported, lithic tuff breccia

The *Oscar Sediments* unit locally underlies the LBT unit and consists of coarse-grain epiclastics (reworked tuff), with occasional inter-bedded lithic ash flow tuff and andesitic flows.

Underlying the LBT unit and/or the Oscar Sediments is the *Dozer Tuff* unit, which ranges in thickness from zero (0) to locally 1,000 feet in the project area. The Dozer Tuff is an aphanitic, fine-grain, siliceous, weakly flow-laminated ash flow with local 'ghost' autobreccia textures. An unconformity (disconformity?) is interpreted to exist at the top of the Dozer Tuff.

Locally underlying the Dozer Tuff is a discontinuous, thin (0-100 ft.) series of channel-fill sediments including carbonaceous sandstone, siltstone, and pebble conglomerate, referred to as the *Basal Tertiary Sediments* unit.

The Jurassic/Triassic-age *Auld Lang Syne Group* comprise the basement rocks in the project area. The Auld Lang Syne Group is a sequence of folded and faulted metasediments which include graphitic slate, phyllite, quartzite, and hornfels.

Structure

Situated in a north-south trending horst block of the basin and range province, the Rosebud Project area is dominated by two prominent structures, the Rosebud Shear and the South Ridge Fault.

The *Rosebud Shear* is a northeast-trending regional fault/shear zone with 1,700 to 2,500 feet of left-lateral displacement and 400 to 800 feet of normal displacement (down to the northwest). The Rosebud Shear roughly exhibits itself on the surface as the canyon which transects the project area. The Rosebud Deposit, as currently defined, is located entirely on the footwall of the Rosebud Shear, although ore-grade mineralization is known to occur on the near and distal hanging wall, as defined by recent drilling and the historic Dreamland Mine, respectively.

The *South Ridge Fault* is an arcuate, northeast- to east-trending listric normal fault (i.e., a fault whose dip is steep at the surface and shallows downward) which exists on the footwall of, and terminates at, the Rosebud Shear. Whether or not the South Ridge Fault was a controlling (feeding) structure for precious metal mineralization is uncertain, but clearly it is spatially important in that it acts as a either a footwall or hanging wall boundary to the majority of the currently defined ore grade mineralization.

In addition to these two major structures, there is also a series of northeast-trending, high-angle, mineralized structures that occur on the hanging wall of the South Ridge Fault. These faults appear to be synthetic to the Rosebud Shear and were subsequently offset by a late episode of movement along the South Ridge Fault. Data acquired from recent drilling and development at Rosebud suggest these northeast structures are 'scissor-like' in their displacement; exhibiting normal displacement to the south and reverse displacement to the north due to the rotational, listric movement along the South Ridge Fault. The apparent 'hinge-point' between the two directions of displacement is a zone of intense shearing, alteration, and block rotation, with high-grade gold-silver mineralization which comprises much of the high-grade "chimney" area of the deposit.

Geologic interpretive modelling in 1994 also revealed the existence of several previously undefined east-west to northwesterly ($\pm$ N80°W) mineralized structural trends that may post-date and offset the South Ridge Fault. These trends are the location of the Far East and Southeast exploration targets.

Mineralization and Alteration

The Rosebud Deposit is a low-temperature, epithermal, quartz-sericite, precious metal deposit which is primarily hosted in volcanic rocks of Miocene age.

The majority of the gold occurs in two dominant grain size populations of $\pm$10 microns and $\pm$350 microns, with some grains exceeding 700 microns in diameter. Silver occurs over an extremely large range of grain sizes (pyrargyrite (Ag_3SbS_3) crystals up to 1/4 inch in diameter were observed in drill core). The overall silver-to-gold ratio of the deposit is 9.5:1, while the silver to gold ratio in the ore grade portion of the mineral occurrence is 6.2:1.

The deposit has been divided into three (3) distinct spatially separated zones, based on location and distinctly different styles of mineralization: the South, East, and North zones.

South Zone

The Rosebud South Zone is located entirely on the hanging wall of the South Ridge Fault and is hosted entirely in the LBT unit of the Kamma Mountain Volcanics.

Alteration associated with precious metal deposition within the LBT unit of the Kamma Mountain volcanics displays vertical and lateral zonation. In general, there is a core of moderate to intense argillic and potassic alteration within the ore zone itself. Extending upward (proximal to structures) and outward (along favorable stratigraphic horizons) is an intermediate zone of propylitic alteration (carbonate-chlorite dominant) which is overprinted by a 'halo' of a quartz/chalcedony-clay alteration assemblage. A hematite-carbonate assemblage comprises an extreme distal alteration package to the mineral deposit. The boundaries of these alteration assemblages are not sharp, as the different alteration zones clearly overlap, suggestive of alteration overprinting due to a fluctuating hydrothermal cell.

Alteration began with the diagenetic devitrification of glassy volcanic fragments to quartz, K-feldspar and albite. Early sericitic alteration of both feldspars appears to accompany the introduction of disseminated pyrite, marcasite, sphalerite, and galena. The sericite often contains minor amounts of iron, and therefore, can be classified as illite.

The earliest major mineralizing episode is characterized by stockwork and dissemination of quartz + pyrite + marcasite ± chalcopyrite ± electrum, with traces of arsenopyrite ± sphalerite ± galena ± pyrrhotite ± anatase ± tetrahedrite-tennantite. Fractures containing this mineral assemblage may be the same age of, and feeders for, the disseminated sulfides and sericitization.

A later set of fractures contain the mineralizing assemblage consisting chiefly of manganese- or iron-rich calcite + silver sulfosalts (pyrargyrite, miargyrite, stylotypite, proustite, and polybasite) + silver selenides (naumannite, aguilarite) + silver sulfide (acanthite) + native silver + auriferous silver (Au content < 30%) + and silver-rich electrum (Au content > 30%). Calcite in these veins appears to corrode earlier pyrite and marcasite. While alteration of marcasite to pyrite proceeded from the margins of the marcasite blades inward toward the center, calcite or kaolinite commonly replaces the core of the marcasite blades. The calcite-silver veining phase appears to often incorporate fragments of earlier quartz-sulfide mineralization.

The precious-metal stages of mineralization were followed by minor veining and open-space filling of barite, particularly on the hanging wall of

precious metal mineralization. This was followed by the latest stage of mineralization, consisting of veinlets of kaolinite which cut across calcite veins, and replace both the calcite and earlier marcasite; it is uncertain whether the kaolinite is hydrothermal or supergene. It is possible that a portion of the chlorite formed instead of kaolinite where iron was locally available.

In the south half of the South Zone, precious metals occur as a component of stratabound stockwork (the result of preferential brecciation of the more brittle volcaniclastic units) and disseminated within several stratigraphic members. Stratabound ore grade mineralization (stockworked and disseminated) ranges from ten (10) to locally 60 feet in thickness. Higher gold grades are normally associated with chloritized and pyritized planar- and convoluted-laminated tuff and vesicular, flow-banded tuff, and with potassic-altered (alunite-adularia) tuff breccia. There is also a region within one of the flow-laminated tuff/tuff breccia members in which high gold and silver grades are associated with carbon, occurring on fracture surfaces and as a portion of the breccia matrix. Metallurgical tests indicate the carbon is not active and therefore not detrimental to precious metal recoveries. It appears the carbon had been emplaced in the LBT unit as a result of remobilization from the underlying graphitic metasediment basement during the epithermal mineralizing process.

Mineralization in the north half of the South Zone occurs strongly structurally controlled, with lesser stratabound control. Several mineralized, northeast-trending, high-angle structures coalesce and define a zone of intense shearing and alteration. High-grade gold (+1.0 opt) and silver mineralization occur within this zone over a vertical extent of 220 feet along the structures and within two preferentially mineralized lithologies. This zone, referred to as the 'chimney', also contains lower ore grades in stockwork and as a disseminated mineralized 'halo' in nearly all stratigraphic units of the host rock. As currently defined, the 'chimney' contains approximately 40% of the minable gold ounces contained within the entire Rosebud Deposit.

East Zone

The Rosebud East Zone, hosted entirely within the Dozer Tuff unit, is situated on the footwall of the South Ridge Fault and is characterized by pervasive silica replacement of the volcanic host rock. The majority of the high gold grades (>0.50 opt) occur on the immediate footwall of the fault, with thicknesses ranging from ten (10) to 40 feet. Overall gold mineralization above 0.10 gold ounces per ton reaches thicknesses of up to 100 feet in the East Zone.

Alteration within the Dozer Tuff unit of the Kamma Mountain volcanics is dramatically different from the assemblages observed in the LBT unit. In the deposit area, the top of the Dozer Tuff is fault-bounded by the listric-normal South Ridge Fault, which acts as an upper boundary to alteration and mineralization in the East Zone. Mineralization in the Dozer Tuff is associated with pervasive silicification; consisting of chalcedony and locally vein quartz. Protolith rock textures are commonly totally replaced by sulfide-bearing silica. Silicification persists downward from the South Ridge Fault from 30 to 120 feet, but does not extend upward into the hanging wall of the fault. There is a gradational boundary between the zone of silicification and a strongly propylitic to moderately argillic alteration package which occurs below the zone of silicification.

Like the alteration and mineralization within the LBT unit, alteration within the Dozer Tuff unit began with the diagenetic devitrification of glassy volcanic fragments to quartz, K-feldspar, and albite. The feldspars have been sericitized and the igneous quartz corroded, but not to the extent observed in the LBT unit. Wall rocks contain disseminated pyrite, marcasite, and sphalerite.

The main mineralizing event appears to be quartz veining and silica replacement followed by a sericite-illite-glauconite veining phase. Unlike the alteration and mineralization within the LBT unit, calcite veining associated with precious metals and sulfides is rare within the Dozer Tuff. Also, quartz stockwork veins and silica-replaced host rock contain very little native silver and only minor amounts of the silver-sulfosalts which are so abundant in the mineralized portion of the LBT unit. Gold dominantly occurs as gold-rich electrum, either within the silica or encapsulated within pyrite or marcasite. Silver occurs as pyrargyrite and freibergite (the silver-rich analogue of tetrahedrite), and as a minority electrum component. Associated sulfides include pyrite, with lesser amounts of marcasite $\pm$ arsenopyrite $\pm$ chalcopyrite $\pm$ sphalerite $\pm$ pyrrhotite $\pm$ and galena.

Later mineralizing events are similar to those of the LBT unit, in that precious metal mineralization is followed by deposition (commonly open-space) of barite and stibnite, which is in turn followed by kaolinite veinlets.

North Zone

The Rosebud North Zone displays mineralization styles and controls that appear to be a combination of those displayed in both the South and East Zones. Precious metal mineralization occurs on the hanging wall and footwall

of the South Ridge Fault,in the LBT and Dozer Tuff units, respectively. The structural and stratigraphic controls on mineralization seen in the South Zone persist down-plunge into the North Zone and are the dominant controlling features for mineralization on the hanging wall of the South Ridge Fault. However, like the East Zone, pervasive silica replacement, with associated ore grade mineralization is common on the footwall of the fault.

List of Common Ore Minerals & Formulas

Acanthite	Ag_2S	Native Silver	Ag
Aguilarite	Ag_2S / $Ag_2(S, Se)$	Naumannite	Ag_2Se
Anatase	TiO_2	Polybasite	$9Ag_2S.Sb_2S_3$
Argentite	Ag_2S	Proustite	Ag_3AsS_3
Arsenopyrite	FeAsS	Pyrargyrite	Ag_3SbS_3
Chalcopyrite	$CuFeS_2$	Pyrite	FeS_2
Electrum	Ag, Au	Pyrrhotite	$Fe_{1-x}S$
Freibergite	$(Cu, Fe, Ag)_{12}(Sb, As)_4S_{13}$	Sphalerite	(Zn, Fe)S
Galena	PbS	Stibnite	Sb_2S_3
Marcasite	FeS_2	Stylotypite	$(Ag, Cu, Fe)_3SbS_3$
Miargyrite	$Ag_2S.Sb_2S_3$	Tetrahedrite-Tennantite	$(Cu, Fe)_{12}(Sb, As)_4S_{13}$

While not the target of the 1994 drilling campaign, sporadic, anomalous gold values, some exceeding 0.10 opt, were also intersected below the East and North zones within the Auld Lang Syne metasediments. The Auld Lang Syne Group represents an attractive proximal exploration target, as economic gold mineralization is known to occur within the metasediment package elsewhere in northwestern Nevada. At the Rosebud Deposit, where drill-intersected beneath the volcanics, this metamorphic package contains sporadic gold and silver mineralization associated with carbon, quartz veinlets, and small lenses of massive sulfide, particularly in the North Zone.

Resource Estimation

Database for Resource Estimation

The January, 1995 Rosebud Mineral Inventory was compiled using data acquired from approximately 204,000 feet of reverse-circulation and core drilling performed prior to Hecla's acquisition of the property, primarily by Lac Minerals, and from Hecla's 1994 drilling and development program, which consisted of approximately 3,000 feet of underground development and 59,000 feet of underground and surface core drilling.

At the time of Hecla's acquisition of Equinox Resources, Ltd., the Rosebud Deposit had been drilled out from the surface on nominal 100-foot centers in the South Zone and 150- to 200-foot centers in the North and East Zones. In 1994, Hecla designed and completed surface and underground drilling programs to fill-in between the more widely-spaced drill patterns completed earlier by LAC and the LAC/Equinox joint venture. Forty-six (46) HQ-size (2.5 inch diameter) surface core holes were completed in the South (11 holes), North (13 holes), and East (22 holes) zones, totalling 34,411 feet. All holes drilled in the North and East zones were pre-drilled with reverse-circulation (RC) through a portion of the unmineralized strata overlying the ore body (maximum RC depth of 500 feet), then core drilled through the remainder of the hole. From the decline, a total of 24,999 feet were completed in 92 core holes in the South Zone; 65 NDBGM-size (2.2 inch diameter) core holes, totalling 18,339 feet, and 27 NQ-size (1.9 inch diameter) core holes, totalling 6,660 feet were completed from underground. In the mineralized zones intersected by drilling, core recovery averaged 94 percent. The 1994 drilling campaign resulted in the delineation of the South Zone to approximate 50-foot centers and the North and East Zones to 75- to 100-foot centers. In addition to data collected from drill core, the decline ribs were sampled on ten-foot intervals and the cross-cut through the "chimney" area of the South Zone was sampled on five-foot intervals.

Rosebud Database

Operator	Type	Sample	Number of Holes	Footage
LAC, LAC/Equinox	Surface Drilling	RC & Core	304	203,780
Hecla	Surface Drilling	Core (& RC)	46	34,411
Hecla	Underground Drilling	Core	92	24,999
Hecla	Underground Channel	Rock Chip	n/a	1,830

A total of 75,836 samples were obtained from these programs.

All core was photographed prior to detailed geologic logging by the members of the Rosebud geology staff. Core intervals were sampled based on lithology, structure, and mineralization/alteration and rarely exceeded five (5) feet in length. In addition, approximately 50% of the core was also logged for geotechnical data (e.g. RQD measurements, core recovery, fracture density, etc.) and density data.

Specific gravity measurements were taken from 959 core samples in order to calculate tonnage factors. Of these, 107 had grades greater than 0.05 gold ounces per ton and 59 had grades greater than 0.10 gold ounces per ton.

Specific Gravity

Zone	All			>0.05 Au opt		
	Number of Samples	Mean (g/cm^3)	2 x Standard Deviation	Number of Samples	Mean (g/cm^3)	2 x Standard Deviation
South	480	2.40	0.18	78	2.39	0.22
North	127	2.47	0.25	8	2.48	0.20
East	352	2.45	0.20	21	2.49	0.17

The tonnage factors used for the resource calculations were 13.4 ft^3/ton for the South Zone and 12.9 ft^3/ton. There appears to be no significant correlation between grades and specific gravity.

Upon completion of the geological and geotechnical logging, core samples were submitted to American Assay Laboratories, Inc. (AAL), of Reno, Nevada for analysis. In order to provide the most representative sample possible, whole core intervals were submitted to AAL. Sample preparation and assay protocol was designed to minimize the total variance of the fundamental sampling error, as per statistical methods formulated by Pierre Gy and Francis Pitard. The total analytical variance per sample was calculated to be 4.6 percent.

Rosebud Sampling Preparation & Assay Protocol

1. Submit 5-foot whole core samples
2. Dry samples @ 100° C
3. Jaw crush entire sample to 6-8 mesh
4. Coarse pulverize entire sample to 40-60 mesh
5. Split sample to minimum of 2.0 lbs. (save reject)
6. Pulverize sample to 100% passing 80 mesh
7. Split sample to 0.5 lbs. (save reject)

8. Ring & puck 0.5 lbs. sample to 100% passing 120 mesh
9. Fire assay 60-gram subsample with atomic absorption finish
10. If Au >= 0.05 Au opt, fire assay second 60-gram subsample and complete with gravimetric finish

Samples which fire-assayed 0.05 gold ounces per ton or greater with an atomic absorption finish (AA) were re-assayed using a gravimetric finish as a check. Comparison of the original fire assays with AA finish to the check assays with gravimetric finish resulted in a 98% correlation. These two assays, along with internal check assays performed by AAL, were averaged to derive the final assay values used in the database and subsequent resource estimation.

Sample reduction reject material (120 mesh grain size) from approximately 1000 core samples were also submitted for cyanide (CN) soluble tests. These samples included ore grade intervals (representing all zones and styles of mineralization), low grade 'halo' material, and internal and external dilution, representing all the differing styles of mineralization within the various host rocks. A comparison of the cyanide solubility data versus the original fire assay results shows there a 96% correlation between the fire assay results (average of fire assays with AA and gravimetric finishes) and the calculated head grade derived from the CN testing (recovered Au + tail assay).

In addition to the two assay procedures and cyanide solubility tests, approximately 150 ore grade samples, taken from the original 40-60 mesh split fraction, were submitted for metallic screen analysis. The metallic screen analyses results on average varied only four percent (4%) from the original fire assays.

All analytical data, including fire assays, cyanide solubility results + tail assays, and metallic screen assays, are included in the appendix.

3.3.2 Orebody Modelling

Upon completion of the drill core logging, a set of cross-sections (at one inch equals 50 feet), spaced 50 feet apart, were constructed through the entire deposit along an axis of N35°E. All pertinent geological (formational/lithologic units, structure, alteration, mineralization, etc.) and analytical data was plotted on each cross-section, with corresponding interpretations. These detailed geologic cross-sections formed the basis for all of the resulting resource modelling.

Statistical evaluation of the analytical data revealed four (4) gold grade populations; identified by breaks which occur in the sample population distribution at 0.01, 0.05, 0.25, and 0.60 ounces per ton. The 0.60 gold ounce per ton break was less distinct than the others, but was used to limit the influence of extreme high gold grades. These gold grade populations were further divided in *grade domains* to reflect the different styles and occurrences of mineralization associated with each particular grade population.

A second set of cross-sections (at one inch equals 50 feet), identical to those generated for the geologic sections, were constructed to model the gold grade distribution. The mineral boundaries of the gold grade domains were contoured and modelled on cross-section to reflect the unique lithologic and structural controls/boundaries on mineralization as interpreted from the geology cross-sections. These mineral boundaries of the gold grade domains that adhere to geologic features were used for the subsequent block modelling of the deposit.

Gold Grade Domains

Domain	Au Grade Range (opt)	Mineral Occurrence
1	0.010 - 0.049	disseminated 'halo' in HW of South Ridge Fault (South & North zones)
2	0.050 - 0.249	disseminated, stratabound-stockwork, & high-angle structure-controlled in HW of South Ridge Fault (South & North zones)
3	0.250 - 0.599	stratabound-stockwork & high-angle structure-controlled in HW of South Ridge Fault (South & North zones)
4	0.600 +	stratabound-stockwork & high-angle structure-controlled in HW of South Ridge Fault (South & North zones)
5	0.010 - 0.049	disseminated 'halo' in FW of South Ridge Fault (East & North zones)
6	0.050 - 0.249	disseminated, stratabound & low-angle structure-controlled in FW of South Ridge Fault (East & North zones)
7	0.250 - 0.599	stratabound & low-angle structure-controlled in FW of South Ridge Fault (East & North zones)
8	0.600 +	stratabound & low-angle structure-controlled in FW of South Ridge Fault (East & North zones)
9	n/a	alluvium
10	< 0.010	below modelling cut-off
11	0.01 +	Far East Zone

A global resource grade model was constructed using the Mintec MEDSYSTEM mineral evaluation computer software system (MEDS). The overall dimensions of the block model were:

Minimum Easting (x)	480,700	
Maximum Easting	484,000	(number of columns = 330)
Minimum Northing (y)	2,203,000	
Maximum Northing	2,205,000	(number of rows = 200)
Minimum Elevation (z)	4,200	
Maximum Elevation	5,500	(number of levels = 130)
Block Dimensions	10 x 10 x 10 ft.	

The area encompassed by the above listed dimensions incorporates the known extent of the Rosebud South, East, North zones, and the majority of the Far East, as defined by drilling to date. The relatively small block dimension was used to address the requirements of mine planning and was based on the anticipated selective mining unit.

The drill hole and underground rib sample gold assays were assigned domain codes (i.e., 1-11) directly from the grade domain cross-sections. After the domain assignments were entered into MEDS, the assay data was then composited into ten-foot lengths which were calculated downhole from the hole collar and honored the domain boundaries, such that no composites were allowed to cross domain boundaries. Silver assays were composited along with the gold using the domain boundaries established for the gold grade distribution.

The gold grade domains were digitized from cross-sections into the MEDS and a series of 109 plan maps, on ten-foot vertical increments, were generated showing domain boundary intersections and drill hole composite locations. Controlling geologic features and mineral domains were then manually drawn on each plan map. These plan maps were digitized into MEDS and the resulting three-dimensional domain boundaries were used to calculate the percentage of each model block contained within the various domains. A final edit was performed on each level plan to ensure consistency of gold grade composites within each domain. Composite statistics were summarized by domain and the resulting distributions were reviewed to identify and confirm outlier data.

Length-Weighted Composite Statistics
Gold (opt)

Domain	Number of Composites	Mean	Standard Deviation	Coefficient of Variation	Minimum Value	Maximum Value
1	1520	0.021	0.019	0.905	0.000	0.221
2	575	0.091	0.084	0.923	0.000	1.106
3	189	0.297	0.215	0.724	0.020	2.423
4	154	1.238	1.314	1.061	0.143	7.981
5	833	0.022	0.016	0.727	0.002	0.231
6	188	0.101	0.065	0.644	0.007	0.718
7	46	0.382	0.245	0.641	0.054	1.506
8	31	1.218	2.052	1.685	0.307	15.07
11	247	0.029	0.074	2.552	0.000	0.745

Length-Weighted Composite Statistics
Silver (opt)

Domain	Number of Composites	Mean	Standard Deviation	Coefficient of Variation	Minimum Value	Maximum Value
1	1492	0.25	0.49	1.96	0.00	7.54
2	548	1.01	2.07	2.05	0.00	21.07
3	180	2.89	4.59	1.59	0.39	33.50
4	146	5.85	8.19	1.40	0.25	45.83
5	833	0.70	3.36	4.80	0.00	87.82
6	188	1.94	9.04	4.66	0.00	117.50
7	46	1.53	4.11	2.69	0.11	26.75
8	29	1.64	1.22	0.74	0.22	5.03
11	160	0.81	3.66	4.52	0.00	37.43

Variograms were generated and modelled for gold and silver for each domain individually, or when pertinent or necessitated by the limited number of samples, on multiple domains if they had similar styles of mineralization. Several directions were tested for each grade domain to determine the anisotropy, or directionality, of the mineralization. Although no anisotropy was found in the higher grade zones, anisotropy paralleling the structural fabric was placed on the estimation. Not surprising, the predominant direction of the

lower grade zones was an azimuth of 150° and a dip of -30°, which is the general strike and dip of the volcanic stratigraphy which hosts the deposit. The resulting estimates of interpolation parameters for gold were validated using a procedure known as 'jack-knifing' or 'back-estimation' which interpolates each composite from its neighboring composite by both kriging and inverse distance weighting. The program then summarized the differences between the known composite values and the estimates to confirm input parameters. It was often necessary to limit the distribution to exclude extreme high grades in order to obtain reasonable variograms. This limiting of the distribution was addressed in the grade interpolation procedure by use of a high-grade search distance cut-off to limit the search distance of the outlier data.

Results of Variography from Covariograms
Gold

Domain	Nugget	Sill	Range	Azimuth	Dip	Tilt	Comments
1	0.00009	0.00012	132 ft. 118 ft. 58 ft.	150°	-60°	-30°	Major Semi-major Minor
2	0.00244	0.00046	96 ft. 75 ft. 48 ft.	150°	-60°	-30°	Major Semi-major Minor
3,7	0.01190	0.00341	100 ft. 50 ft. 50 ft.	50°	-60°	0°	Major Semi-major Minor
4,8	0.33759	0.03950	90 ft. 45 ft. 45 ft.	50°	-60°	0°	Major Semi-major Minor
5	0.00010	0.00001	200 ft. 135 ft. 75 ft.	60°	30°	-60°	Major Semi-major Minor
6	0.00220	0.00054	80 ft.	n/a	n/a	n/a	Spherical
11	0.00032	0.00010	75 ft.	n/a	n/a	n/a	Spherical

Results of Variography from Covariograms
Silver

Domain	Nugget	Sill	Range	Azimuth	Dip	Tilt	Comments
1	0.16595	0.07352	58 ft.	n/a	n/a	n/a	Spherical
		0.03797	313 ft.	n/a	n/a	n/a	Nested
2	3.15491	1.24843	134 ft.	n/a	n/a	n/a	Spherical
3,7	4.80598	4.63894	170 ft.	n/a	n/a	n/a	Spherical
4,8	7.40320	8.84014	35 ft.	n/a	n/a	n/a	Spherical
5	0.39947	0.20185	140 ft.	n/a	n/a	n/a	Spherical
6	14.90573	4.78211	65 ft.	n/a	n/a	n/a	Spherical
11	0.00475	0.00181	75 ft.	n/a	n/a	n/a	Spherical

Ordinary kriging was selected for the actual assignment of grade to the model blocks within each grade domain. Kriging was performed internal to each domain boundary separately. Grades estimated and assigned to model blocks within a domain were derived only from composited data which was located in that domain (i.e., data from high-grade structures were not allowed to influence stratabound, disseminated mineralization, etc.). With very few exceptions, the search ranges prescribed by the variography exceeded the geometry of the domain boundaries. However, the domain boundaries (which were derived from the geologic/mineralogic model) always took precedence over the statistically-derived search ranges and provided much tighter controls on grade extrapolation. Since the domain boundaries adhere to the controlling geologic feature for each particular style of mineralization, smearing grades outside their geologic/mineralogic boundary was eliminated.

The number of samples used for estimation was kept to a minimum to better honor local grade variations; this was set at a maximum of five (5) composites and a minimum of either one (1) or two (2) composites depending on the domain. As there are numerous similar styled zones of mineralization (e.g., disseminated, stockwork, silicification) that are distinctly separate spatially, and of similar grades, projection of these grades to other similar domains was reduced by this limiting of sample composites used to estimate individual block grades. Further, the search was allowed to be spherical in order to increase the chances of finding composites for estimation while the weighting was oriented to variography. The range projection of the high-grade outliers was limited to 50% or 75%, depending on the domain.

Estimation Parameters

Domain	Minimum Number of Composites	Maximum Number of Composites	Major Search Axis (ft.)	Outlier Cut Grade (Au opt)	Outlier Range Restriction (ft.)	Maximum Distance for 1 composite (ft.)
1	2	5	132	0.05	100	100
2	1	5	96	0.25	72	72
3	1	5	100	0.60	75	75
4	1	5	90	2.00	45	45
5	2	5	200	0.05	150	150
6	1	5	80	0.25	60	60
7	1	5	100	0.60	75	75
8	1	5	90	2.00	45	45
11	2	5	75	0.15	56	56

As the deposit is intricate and the 10^3 foot block size may not be sufficiently detailed to reflect the metal distribution based solely on whether the block centers were in or out of a particular domain, domain volumes were assigned to each block from the digitized bench domain boundaries. Thus, each block has a grade value for each domain accompanied by a percentage from zero to 100 representing the proportion of the block that is within that domain. Then during estimation, each domain's composites were used to estimate the appropriate values in any block. Following all the estimation passes, the average gold and silver grades per block were calculated from the weighted average of each domain grade and percent; no block with a percentage of zero would be tabulated. This more accurately reflects the true tonnages of each domain and also has the effect of making the boundaries more gradational (e.g., on a scale of about ten feet which more closely simulates actual mineral boundaries).

Resource Inventory

The number of sample composites used to estimate the gold grade for each domain were tabulated and served as the basis for dividing the resulting mineral inventory into *Measured*, *Indicated*, and *Inferred* categories, as per SME guidelines and criteria for the classification of resources (in Appendix). Blocks with grades derived from three or more composites used for estimation were considered Measured. Any block with one or two composites used for estimation were considered Indicated. No more than two samples could come from any one hole. All material lying within the mineral domains that were too far from the required minimum number of points are considered Inferred.

The entire Rosebud Deposit was modelled to a lower limit gold grade of 0.001 gold ounce per ton. Adherence to the geologic/structural controls associated with the different mineralization styles and their relationship to grade populations was strict. The **global resource** for the Rosebud Deposit is 13,885,404 tons grading 0.064 gold ounces per ton, 0.40 silver ounces per ton (885,234 AuOz, 5,488,452 AgOz). A detailed tabulation by cut-off grade of tonnage, gold and silver grades, and gold and silver ounces is included in the appendix.

Measured and Indicated Resource (at 0.14 opt Au cut-off)

The **Measured and Indicated Resource** for the Rosebud Deposit using a 0.14 gold ounce per ton cut-off is 918,735 tons grading 0.555 gold ounce per ton, 3.44 silver ounces per ton (509,524 AuOz, 3,159,046 AgOz). This resource number represents the estimated in-place, undiluted material that grades better than, or equal to, 0.14 gold ounces per ton. The measured and indicated resource is the basis upon which the mine plan was developed and project economics were applied to determine the proven and probable reserve.

Rosebud Deposit - Measured Resource Totals by Zone
0.14 Au opt cut-off

	Tonnage	Au (opt)	Ag (opt)	Au Oz	Ag Oz
South Zone	440,171	0.677	4.20	297,912	1,847,056
East Zone	136,914	0.518	3.21	70,976	440,050
North Zone	104,025	0.385	2.39	40,029	248,179
Far East	0				
TOTALS	681,110	0.600	3.72	408,917	2,535,285

Rosebud Deposit - Indicated Resource Totals by Zone
0.14 Au opt cut-off

	Tonnage	Au (opt)	Ag (opt)	Au Oz	Ag Oz
South Zone	33,727	0.687	4.26	23,167	143,636
East Zone	115,207	0.301	1.87	34,699	215,135
North Zone	63,448	0.491	3.04	31,153	193,151
Far East	25,243	0.459	2.85	11,587	71,839
TOTALS	237,625	0.423	2.62	100,606	623,761

Rosebud Deposit - Measured & Indicated Resource Totals by Zone
0.14 Au opt cut-off

	Tonnage	Au (opt)	Ag (opt)	Au Oz	Ag Oz
South Zone	473,898	0.678	4.20	321,079	1,990,692
East Zone	252,121	0.419	2.60	105,675	655,185
North Zone	167,473	0.425	2.64	71,182	441,330
Far East	25,243	0.459	2.85	11,587	71,839
TOTALS	918,735	0.555	3.44	509,523	3,159,046

Inferred Resource (at 0.14 opt Au cut-off)

In addition to the Measured and Indicated Resource, there is an additional 48,336 tons grading 0.426 gold ounces per ton, 2.64 silver ounces per ton (20,575 AuOz, 127,564 AgOz) that is classified as an **Inferred Resource**, using a 0.14 gold ounce per ton cut-off grade. The material classified as inferred is located within domain boundaries, developed from the geologic model, but outside the search ranges derived from the variography due to limited sample data. The inferred material grade was approximated from the distribution of grades in the Measured and Indicated categories. There is confidence that much of the inferred material will become measured or indicated during further development.

In 1995, review of the Rosebud resource model by independent consultants and internal auditors identified between 30,000 and 50,000 gold ounces in the South Zone (domain 4) that they considered to be *unconfirmed* ounces due to an overestimation of block grades. In order to address this concern, an underground core drilling program was initiated in October, 1995, designed to test the resource model in those specific areas of concern to the resource auditors. A total of 7,093 feet in 37 NDBGM (2.2 inch diameter) core holes were drilled along fences spaced 25 feet apart, encompassing the entire South Zone "chimney" area, as well as a portion of the South Zone stratabound ore zone. While the final analytical data for 20% of the drilling is still pending, the in-fill drilling appears to have confirmed the majority of the material considered *unconfirmed* and has substantiated both the geologic and resource models.

Potential for Additional Resources

There is excellent potential for the discovery of additional resources within Hecla Mining Company's land package in the Rosebud District. Hecla's land position encompasses approximately two-thirds of the volcanic range block which hosts the Rosebud Deposit and extends to the western range front. The potential exists for both deep, structurally-controlled, high-grade deposits (i.e., Rosebud) and shallow, disseminated, bulk-minable deposits (i.e., Hycroft Resources' Crofoot-Lewis mine).

On a regional scale, there is a distinct alignment of intrusive activity with the major mineralized areas within the Kamma Mountains along a N20°W trend. Age-equivalent Chocolate Tuff and Dozer Tuff volcanic vents occur at the southeastern portion of the district, with the Rosebud Deposit directly on trend to the northwest. Continuing to the northwest is the historic Dreamland/White Alps mine, then an intrusive complex (rhyolite dome) in the Wildrose exploration target area, then finally the Crofoot-Lewis mine, which is located on the range front structural system. This alignment apparently reflects the presence of a deep-seated zone of structural weakness.

Compilation of district geological, geochemical, and geophysical data acquired by previous exploration efforts, in conjunction with on-going surface exploration by Hecla, has identified 14 distinct surface anomalies. Five exploration areas along the northwest trend have returned gold values in surface rock chip samples greater than 1000 parts per billion. The highest rock chip sample collected to date returned gold and silver values of 0.088 and 8.83 ounces per ton, respectively.

Proximal to the Rosebud Deposit, gold grades exceeding 0.10 ounces per ton have been intersected by drilling along two east-west, high-angle, structural trends (Far East and Southeast targets). Also, as previously stated, anomalous gold values, some exceeding 0.10 opt, were also intersected below the East and North zones within the Auld Lang Syne metasediments. The metasediment basement represents an attractive proximal exploration target, as economic gold mineralization is known to occur within the metamorphic package elsewhere in northwestern Nevada. Other untested proximal targets include the down-plunge extension of the Rosebud North Zone and the deep potential on the immediate footwall of the Rosebud Shear in the South Zone area.

Mineralization in the Dreamland/White Alps area occur within or along the margins of small rhyolite intrusives in the Chocolate Tuff unit of the Kamma Mountain Volcanics. Historic mining in the area was limited to only

approximately two hundred vertical feet. The area is very analogous to the Rosebud Deposit in that gold and silver mineralization is confined to narrow fractures within the Chocolate Tuff, much like the mineralization in the Chocolate Tuff which lies several hundred feet directly above the Rosebud North and East zones. The potential at Dreamland/White Alps occurs well below the historic workings, where the intrusives and related mineralized structures intersect the more receptive LBT unit. LAC Minerals completed eight shallow reverse-circulation in the Dreamland/White Alps area to test for the down-dip extension of mineralization below the historic workings, but never penetrated stratigraphy below the Chocolate Tuff.

Several of the proximal and distal targets are scheduled to be advanced to the drill test stage in 1996.