60001867

Mining District File Summary Sheet

DISTRICT	Rosebud
DIST_NO	4010
COUNTY If different from written on document	Pershing
TITLE If not obvious	The Winters Company RMI Audit 1995 – Evaluation of the Hecla Rosebud Project Ore Reserve Model
AUTHOR	Clayton R; Earnest D; Oppenheimer B; Sims R
DATE OF DOC(S)	1995
MULTI_DIST Y / (N?) Additional Dist_Nos:	
QUAD_NAME	Sulphur 7½'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Hecla Mining Co.; Winters Co.; Hecla Rosebud Project
COMMODITY If not obvious	gold, silver
NOTES	Correspondence; handwritten notes; assays 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)

SS: DP 8/1/08
Initials Date

DB:
Initials Date

SCANNED:
Initials Date

Revised: 1/22/08

TWC: EVALUATION OF HECLA ROSEBUD
PROJECT ORE RESERVE MODEL 5/31/95

60001867

4010

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To: Ron Clayton, Hecla Mining Company

From: Don Earnest, Bill Oppenheimer, Rick Sims DFE WLO

Date: May 31, 1995

Subject: Evaluation Of The Hecla Rosebud Project Ore Reserve Model

The Winters Company (TWC) has been asked, as part of its prefeasibility audit of the Hecla Rosebud Project, to evaluate the ore reserve model developed by the Hecla Rosebud geology staff and consultants from Mine Design Associates (MDA). The scope of the TWC ore reserve validation includes: a review of the methodology of ore reserve estimation, a review of the geology model, a comparison of model block grades and composite assays, and recommendations for improvement of the reserve model. In a previous memorandum dated April 25, 1995, TWC provided a preliminary review of the geologic model along with some recommendations for evaluating potential local biases in the block model gold grade estimates. This memorandum includes a more detailed discussion of the geologic model as well as some additional recommendations for improvement of the local gold grade estimates.

It is TWC's understanding that Hecla and MDA are in the process of completing some additional tasks recommended by TWC during the course of this review. In TWC's opinion, the most important of these is a thorough validation of the model by the Hecla geologists, which will include detailed comparisons between the grades of ore model blocks with drill hole composite assays in cross sections and on level plans. Also important will be a comparison of block group geometries within the mineral domains with the geologic interpretations in cross section and plan. Once Hecla has completed this validation and made any necessary changes to the model, TWC will follow this memorandum with a short final report.

clusters of hi-grade blocks within domain boundaries? Make sure geometry corresponds with geology?

?

Summary and Conclusions

Hecla and MDA have provided pertinent ore reserve model data in computerized files. The drill hole data base and ore reserve model were provided in MEDS format. Hecla also provided TWC with diskettes containing plot files for geologic cross sections and block model level plans in the South Zone. MDA provided TWC with plot files for composite assay level plans. For this study, TWC plotted 35 geologic cross sections on a 50 foot spacing, and 60 block model level plans with corresponding composite assay level plans on a 10 foot spacing.

TWC recognizes the complexity of the Rosebud gold deposit and appreciates the difficulty associated with modeling a multiply-faulted bonanza gold-silver deposit of this type. Due to high degree of structural influence on gold mineralization, the variability of gold grades is higher and requires more attention than in lower-grade bulk-tonnage gold deposits. In the previous memorandum, TWC was concerned about identification of any global bias in the Rosebud gold resource calculation. Based upon a detailed review of the ore model cross sections and level plans which included comparisons between individual model block grades and composite assays within mineral domains, TWC believes that in local areas, high grade drill hole composites have been extended beyond acceptable distances within domain boundaries, particularly in Domain 4. TWC is concerned that this condition is likely causing an overestimation of high grade tonnages within the defined domain boundaries, which will adversely affect local mine planning and short-range scheduling in these areas. The following sections describe several of these areas in greater detail. TWC emphasizes that the areas discussed are the more severe examples encountered which illustrate this concern. However, a number of additional areas where high grade composites appear to have contributed to an overestimation of high grade tons were found. TWC provides these observations and comments as a

guide to Hecla during its own validation process with the intent to improve the local accuracy of the Rosebud gold resource model.

Detailed Review of Geologic Model

TWC has inspected the cross sections in order to determine if the interpretation of the deposit geology is consistent with boundaries in the geology model. TWC reviewed detailed geologic sections at the Rosebud site and had no serious concerns with the current geologic interpretation. Based on that review and further work done off site, TWC believes that the location of the South Ridge Fault and other faults are consistent from section to section. TWC also feels that the interpretation of the volcanic stratigraphy has been done in a consistent and competent manner. TWC has noted, however, the lack of information regarding alteration type and intensity, brecciation, and structural deformation on the computerized cross section plot files provided by Hecla and MDA. Lacking this information, TWC could not verify geologic interpretation of alteration type or intensity of mineralization using anything more than assay grades from drill holes.

Hecla geologists have divided the Rosebud deposit into 11 mineral domains due to its structural complexity and the wide variation in grade

(Table 1). Since the computer cross sections provided by Hecla and MDA do not contain each mineral domain outline in detail, TWC's review of the Rosebud mineral domains has been done mainly in plan, using the sectional drill hole for additional information. In particular, TWC concentrated on Domain 4, the highest grade mineral domain, which hosts the largest portion of the gold resource in the Rosebud deposit.

According to the MDA/Rosebud Resource Audit, January, 1995, mineral domains for the Rosebud deposit were constructed based on Hecla's geologic interpretation of structure, lithology, alteration, and grade. However, the geologic descriptions provided in Table 6-2 from MDA's report (reprinted as Table 1 in this memorandum), indicate that the first eight mineral domains are based on essentially the same criteria: 1) the gold grade and 2) the location of the mineralization relative to the South Ridge Fault. All of the first eight mineral domains contain gold mineralization in the hanging wall of the South Ridge Fault where the bulk of the Rosebud gold mineralization occurs. A note made at the bottom of MDA's Table 6-2 states that the increase in grades implies an increase in alteration, mineralization, or structural preparation. TWC is concerned that this statement suggests that the influence of grade may have been partially substituted for geologic criteria in determining the mineral domains. TWC

realizes that this type of interpretation is often unavoidable. Care should be taken, however, in controlling the influence of grade segregation during calculation of model block gold grades. To address this concern, TWC recommends that ongoing revisions to the Rosebud geologic model be based primarily on geologic criteria such as structural domain, lithology, alteration, brecciation, and other structural preparation, etc.

In reviewing the Rosebud level plans, TWC noted that the general orientation of mineral domain boundaries changes with depth. The orientation of Domain 4, which represents structurally-controlled high gold grades, shifts from north-south to east-west over a vertical distance of 150 feet. In our discussions with Charlie Muerhoff, we have learned that the orientation of Domain 4 boundaries changes vertically and laterally due to a shift from structural to stratigraphic control of ore deposition. Because of this change in direction, TWC suggests that Domain 4 be separated into sub-domains based on orientation and structural versus lithologic control. This separation should permit improved variography and grade estimation within the higher gold grades.

TWC has observed that the structural controls on certain high grade gold intercepts appear locally to be narrow, sheet-like, or steeply-dipping

in cross section. For example, Figure 1 shows that on cross section 800 North several drill holes cut intercepts of mineralization higher than 0.50 opt Au. The 50-foot long horizontal intercept in drill hole D-61-94 is crossed by drill hole RL-57 which indicates no significant mineralization is present at the point of intersection of the two holes. Likewise, a 20 foot-long high-grade intercept in drill hole RL-57 is not corroborated in adjacent holes D-63-94 and D-62-94. In TWC's opinion, this indicates that locally **within domain boundaries** high grade gold intercepts may not be projectable for distances greater than 20 feet.

TWC emphasizes that regardless of the correlation or interpretation between drill holes that is chosen, the assumed geometry of the high-grade gold mineralization has a critical impact on the final mineralization model. Even though domain restraints upon the estimation of block gold grades are in place, the distribution and extent of high grade blocks within a domain boundary must also be closely examined.

Review of Block Model Gold Grades

The Rosebud block model has been constructed along north-south and east-west axes using model blocks measuring ten feet by ten feet

horizontally and ten feet vertically. The cross sections on which the Rosebud geology was interpreted were constructed using a spacing of 50 feet and an orientation of N55W, perpendicular to the South Ridge Fault. Because of the lack of geologic information on the cross sections provided by Hecla and MDA, and since the sections and model blocks were not parallel, TWC chose to compare block model gold grades with the related composite gold grades in plan. TWC suggests that some method be devised for directly comparing the block model gold mineralization to the original geologic cross sections. If no method is immediately available for this comparison, rotation of the block model might be considered.

Block model level plans were compared with composite assay level plans to see how well gold grades matched at the same location. In general, the block model grades were true to the mineral domain boundaries. Where sharp grade breaks occurred between high grade composites and low grade composites, the Domain 4 boundary often separated the two grade zones. Locally, TWC found areas where individual model block grades are either significantly higher or lower than the nearest composite gold grade. Table 2 lists some selected examples of these discrepancies. In addition, TWC noted that the highest block model gold grade shown on the Surpac level plans was 2.045 ounces per ton, a

maximum which does not agree with the block model gold grades either in the MEDS block model data or those reported in the geologic resource summaries. MDA is currently investigating the cause of the truncated block gold grades.

The level plan comparisons also indicated areas where a small number of high-grade intervals appear to account for disproportionate high grade ore tonnages. On level 4600 at coordinates 2,203,850 north and 481,850 east, 38 contiguous model blocks contain gold grades of at least 2.045 ounces per ton (Figure 2). There are only three composite assays within 60 feet vertically (+/- 30 feet) from the 4600 level with gold grades higher than 2.045 opt that could contribute to the high grades estimated for these 38 blocks. These composites are immediately adjacent to composites of substantially lower grade in the same drill holes. In this example, the number of high grade blocks appears to be heavily influenced by the small number of high grade composites. TWC believes that in this case, the isolated high grade composites must be more tightly restricted to limit their influences upon ore block estimations within the domain boundary. The drill hole spacing within the domain boundary in this area is approximately 50 feet. TWC believes that in local areas containing extremely high grade intercepts such as this one, Hecla geologists must further restrain the allowable

projection limits of this high grade material either by manual editing or empirical judgment.

Similarly, on cross section 450 North on the 4850 level, drill hole D-26-94, contains an interval of 15 feet with a gold grade of 5.2 ounces per ton (Figure 3). During composite calculation, this interval was split between two contiguous composites with gold grades of 8.0 and 2.0 ounces per ton (Figure 4). The 15 feet long interval directly above the high grade intercept averages 0.075 ounce gold per ton. The 40 feet below the high grade intercept average 0.003 ounce gold per ton. The nearest drill hole, RL-35, is 40 feet to the northwest and contains one interval measuring five feet with a gold grade of 0.250 ounce per ton. To the southeast the nearest hole is 80 feet away and contains no significant gold mineralization. On the 4830 level near the high grade interval in drill hole D-26-94, TWC notes that 21 out of 25 model blocks in Domain 4 contained gold grades above 2.045 ounces per ton. On the 4840 level, 22 out of 24 model blocks in Domain 4 contained gold grades above 2.045 ounces per ton (Figure 5). As in the previous example, TWC is concerned about the possible local overestimation of high grade ore tonnage around this high-grade drill intercept.

In the previous reserve review, TWC noted that global comparisons of model block gold grades to composite gold grades in Domain 4 showed that model block gold grades occurred more frequently than the supporting composite gold grades mainly in two gold grade ranges, one centered around 0.7 ounce per ton, and the other centered around 3.0 ounces per ton. It was recommended that the MEDS utility M619V1 be used to identify model block gold grades which are not supported by the nearby composite gold grades. The local checks of the block model described above further support the urgent need to recognize over-smoothed blocks in the Rosebud mineralization model. TWC's primary concern in this regard is to determine what percentage of the gold resource tonnage falls in this over-smoothed category.

TWC's detailed block model review also suggests that additional methods be investigated to control the influence of high-grade gold assays. The current search parameters were developed for each geologic domain based on gold grade variography using all data from a given domain. The search limits and grade thresholds for restricting higher gold grades, however, were not based on variogram calculations. TWC suggests that additional indicator variography be attempted in order to better define the continuity of the higher gold grades. In addition, more severe geometric

anisotropy corresponding to the local structural orientation might be appropriate in the higher grade ranges. Adjustments to the strategy for limiting the influence of higher gold grades will require a trial and error approach with considerable block model-to-composite gold grade comparisons as a guide. These comparisons may indicate that in some areas the highest local composite gold grades must be reduced to create a more reliable local estimate of gold grade. If this is necessary, TWC suggests that cumulative frequency plots of the raw drill hole gold assays and the composite gold assays be used to determine high grade gold thresholds. Another useful tool in identifying local high grade outliers is cross-validation. By using surrounding composite gold grades to estimate each known composite gold grade, high grade gold composites which are not supported with nearby high grade composites can be identified and adjusted individually where necessary.

this was done

TWC also suggests that inconsistent data spacing be handled by performing two grade estimation passes. In the first pass, a short search distance is used to estimate block grades in areas where sample spacing is adequate. A second pass is then performed to fill in the remaining blocks and identify their grade estimates as being less reliable than those done in the first pass. It should be noted that many of the blocks estimated in the

second pass are likely to be the same blocks flagged as being over-smoothed by using the MEDS utility M619V1 discussed above and in TWC's previous ore reserve memorandum.

Drill Spacing

As discussed in TWC's April 25, 1995 memorandum to Ron Clayton, TWC believes that Hecla was correct in deciding to drill the Rosebud deposit on close-spaced centers (150 feet or less). Based upon the concerns encountered in local areas such as those described above, TWC feels that limited additional underground drilling may be advisable in certain areas. TWC encountered local areas within Domain 4 where the drill spacing is as wide as 80 feet. Also, because most of the holes have been drilled in a southeasterly azimuth across the trend of the South Ridge Fault, except for the exploration decline there has been limited testing for mineralized or post-ore structures which could strike parallel or subparallel to this orientation. However, TWC recommends that the design and drilling of any additional holes be delayed until Hecla has completed its own validation of the Rosebud model. If additional drilling is necessary, these holes could be designed to improve the resolution of high grade composite assays in

Domain 4 and also solve the question about the possibility of mineralized cross structures.

Table 2

Hecla Rosebud Project

Selected Comparison of Block Model Grade versus Composite Assay Grade

Domain #	Location Northing	Location Easting	Elevation	Block Model Grade	Composite Assay Grade
4	2,203,510	481,561	4845	2.045* 2.045* 1.036	0.105
4	2,203,495	481,555	4825	2.045*	0.010
4	2,203,775	481,715	4765	1.198	1.705 0.055
4	2,203,850	481,845	4695	1.875 1.408	0.077
4	2,203,835	481,867	4665	1.586	0.400
4	2,203,865	481,860	4665	0.861 0.562	0.143
4	2,203,835	481,863	4605	2.045*	0.155
4	220,883	481,850	4605	2.045*	0.422
4	2,203,629	481,842	4865	0.977 1.376	1.099 2.270
4	2,203,870	481,864	4635	0.689	0.815
3	2,203,886	481,841	4635	0.215	0.149
2	2203948	481879	4635	0.201 0.279	0.124
1	2203835	481865	4635	0.252	0.011

* 2.045 opt Au is the highest grade reported on the block model level plans.

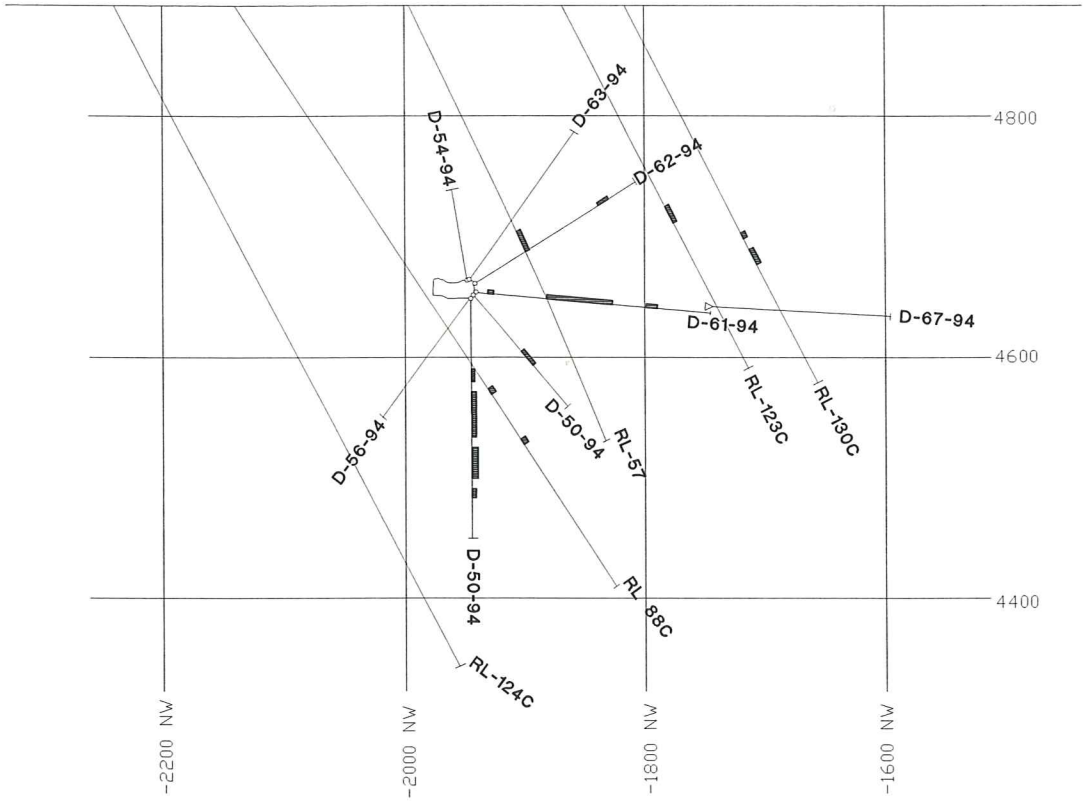
Table 1[1]

Mineral Domains

Domain	Grade oz Au/ton	Geologic Description [2]
1	0.01-0.05	Halo of disseminated mineralization (mzn) in the hanging Wall of the South Ridge Fault (SRF)
2	0.05-0.25	Structurally- and lithologically-controlled mzn in the hanging wall of the SRF
3	0.25-0.60	Restricted structurally- and lithologic-controlled mineralization in hanging wall of the SRF
4	>0.60	Predominantly structurally-controlled mineralization in hanging wall of SRF
5	0.01-0.05	Halo of disseminated mineralizaiton in the hanging wall and footwall of SRF
6	0.05-0.25	Structurally- and lithologically-controlled mzn in the hanging wall and footwall of the SRF
7	0.25-0.60	Restricted structurally- and lithologic-controlled mzn in hanging wall and footwall of the SRF
8	>0.50	Predominantly structurally-controlled mineralization in hanging wall and footwall of SRF
9	n/a	Quaternary Alluvium: segregated for open pit optimizations
10	<0.01	Unmineralized rock; preliminary suggestions are that his unit need not, or presently cannot, be segregated for specific gravity or geotechnical reasons. Mineralization can occur but is not considered in the resource (10) if there is no continuity.
11	>0.01	Mineralization in the hanging wall of the SRF; spatially separate and poorly understood geologically. None of this material is placed in the Measured category.

1 Table 6-2, MDA/Rosebud Resource Audit - January 1995

2 Increase in grades implies an increase in any on of argillization, silicification, pyritization, fracturing, rebrecciation, and/or the existence of organic carbon.



Explanation

- DRILL HOLE SHOWING COLLAR AND HOLE LABEL
- DRILL HOLE PIERCING SECTION
- DRILL HOLE SHOWING HIGH GRADE INTERCEPT OF 0.50 opt Au OR GREATER

50 0 50 100

GRAPHIC SCALE

REVISIONS			
	NO.	DATE	DESCRIPTION

THE WINTERS CO.

6125 E. GRANT RD.
TUCSON, AZ 85712

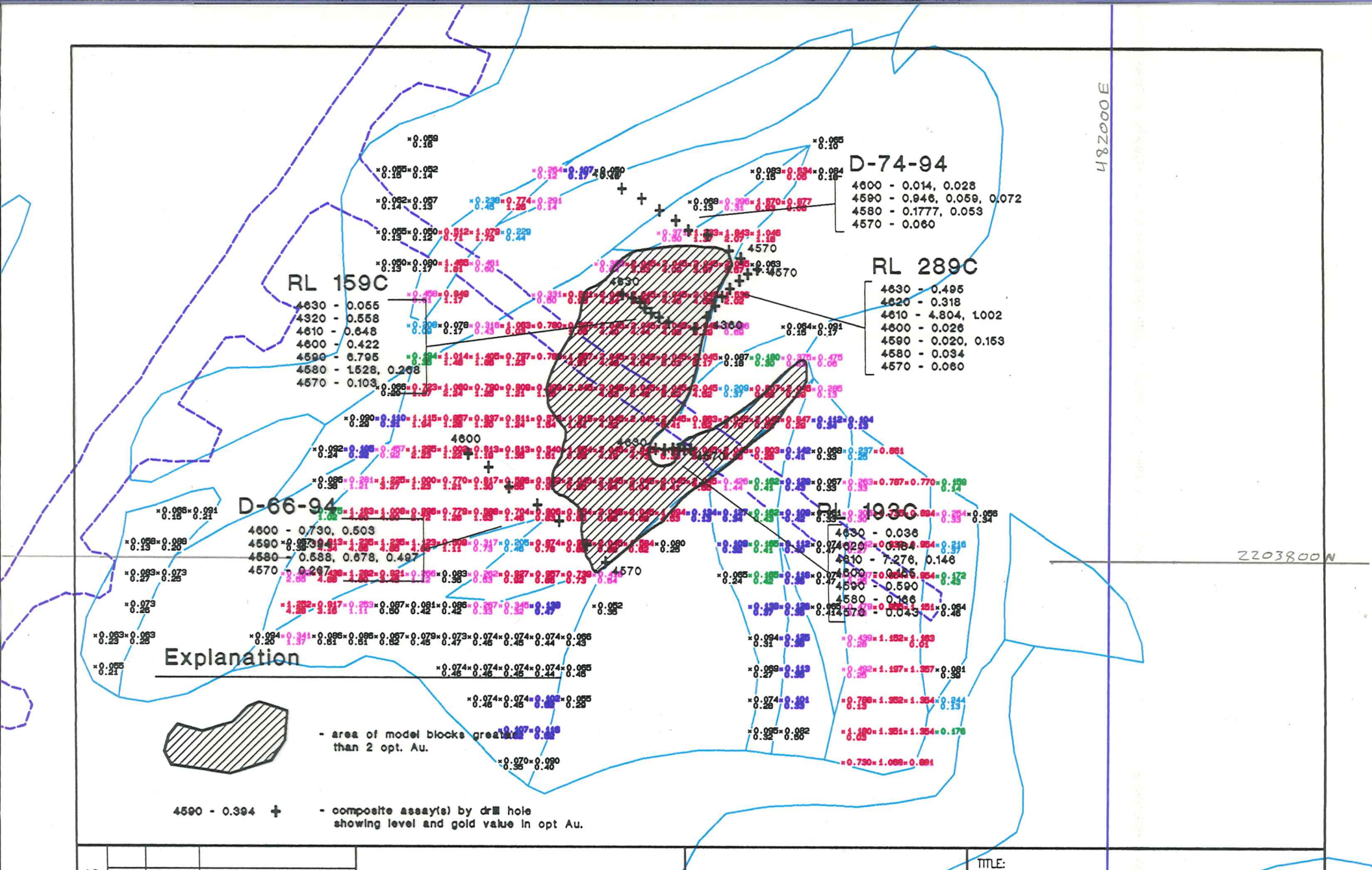
HECLA ROSEBUD PROJECT

TITLE:

A PORTION OF CROSS SECTION 800 N
HIGH GRADE GOLD INTERCEPTS

DOCUMENT NO.

Figure 1



REVISIONS			
NO.	DATE	DESCRIPTION	

THE WINTERS CO.

6125 E. GRANT RD.
TUCSON, AZ 85712

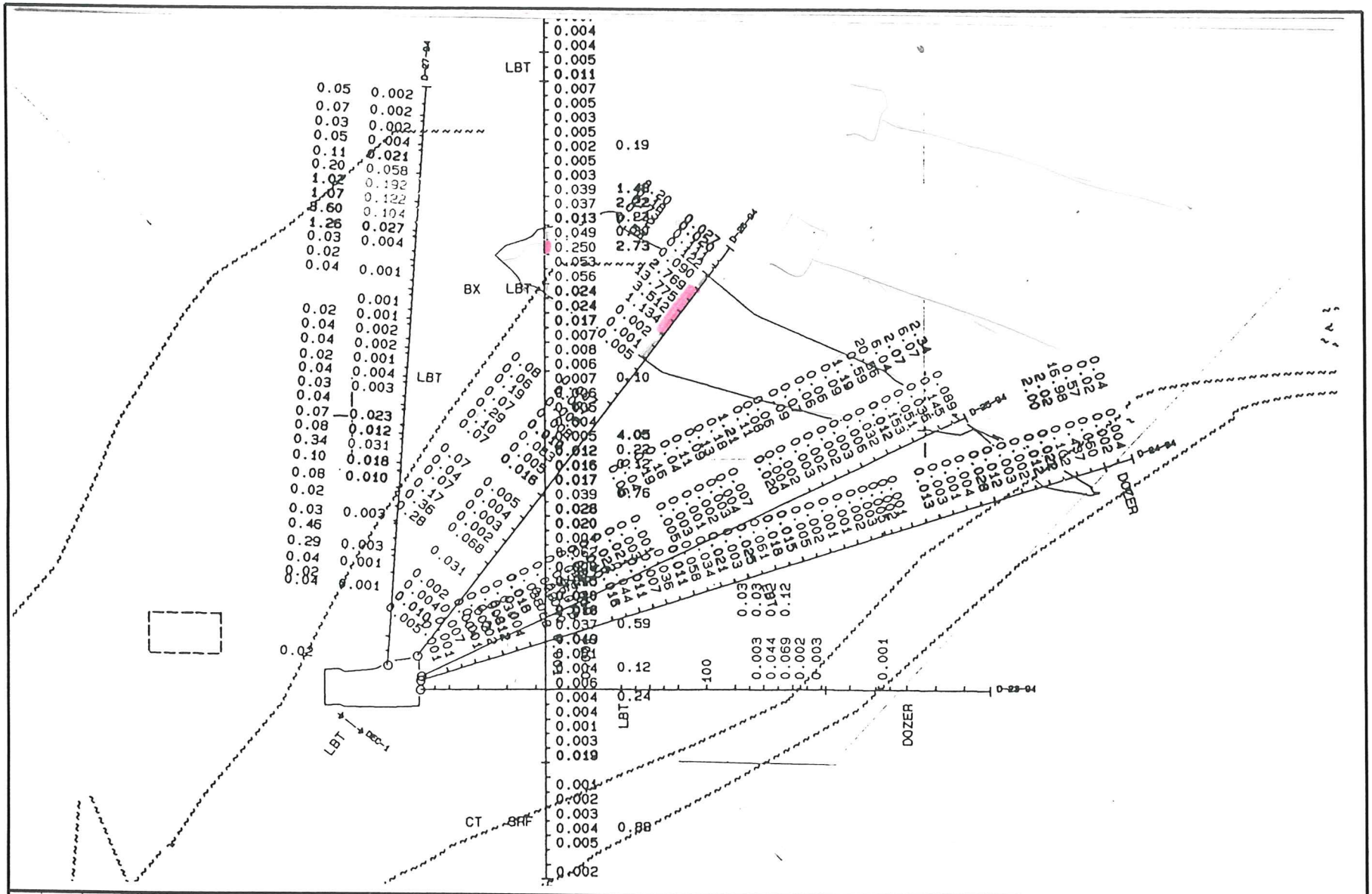
HECLA ROSEBUD PROJECT

TITLE:
A PORTION OF THE 4605 BLOCK MODEL LEVEL PLAN SHOWING THE LOCATION OF COMPOSITE ASSAYS

SCALE: 1"=40'-0"

DOCUMENT NO.

Figure 2



REVISIONS			
NO.	DATE	DESCRIPTION	

THE WINTERS CO.

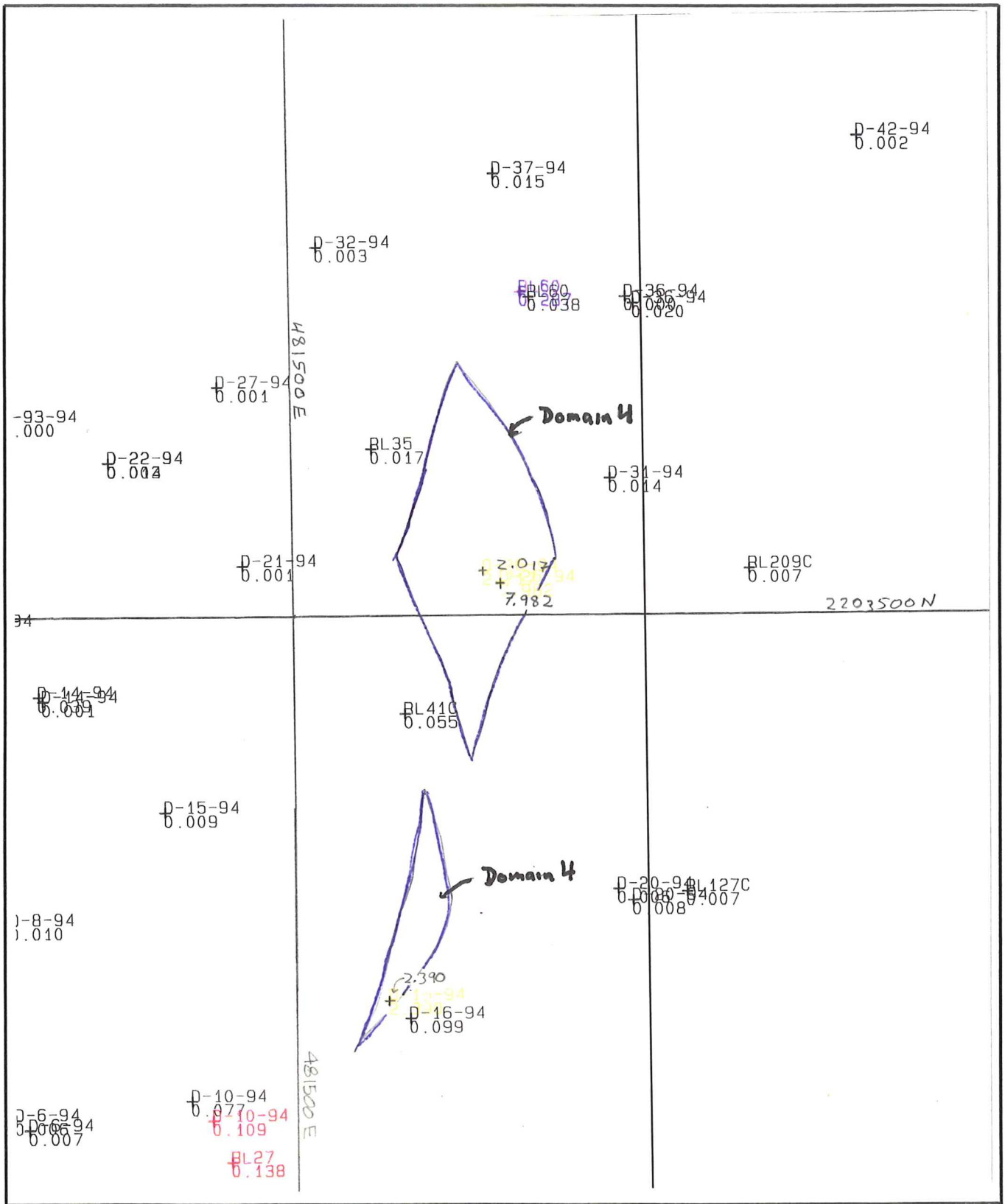
6125 E. GRANT RD.
TUCSON, AZ 85712

HECLA ROSEBUD PROJECT

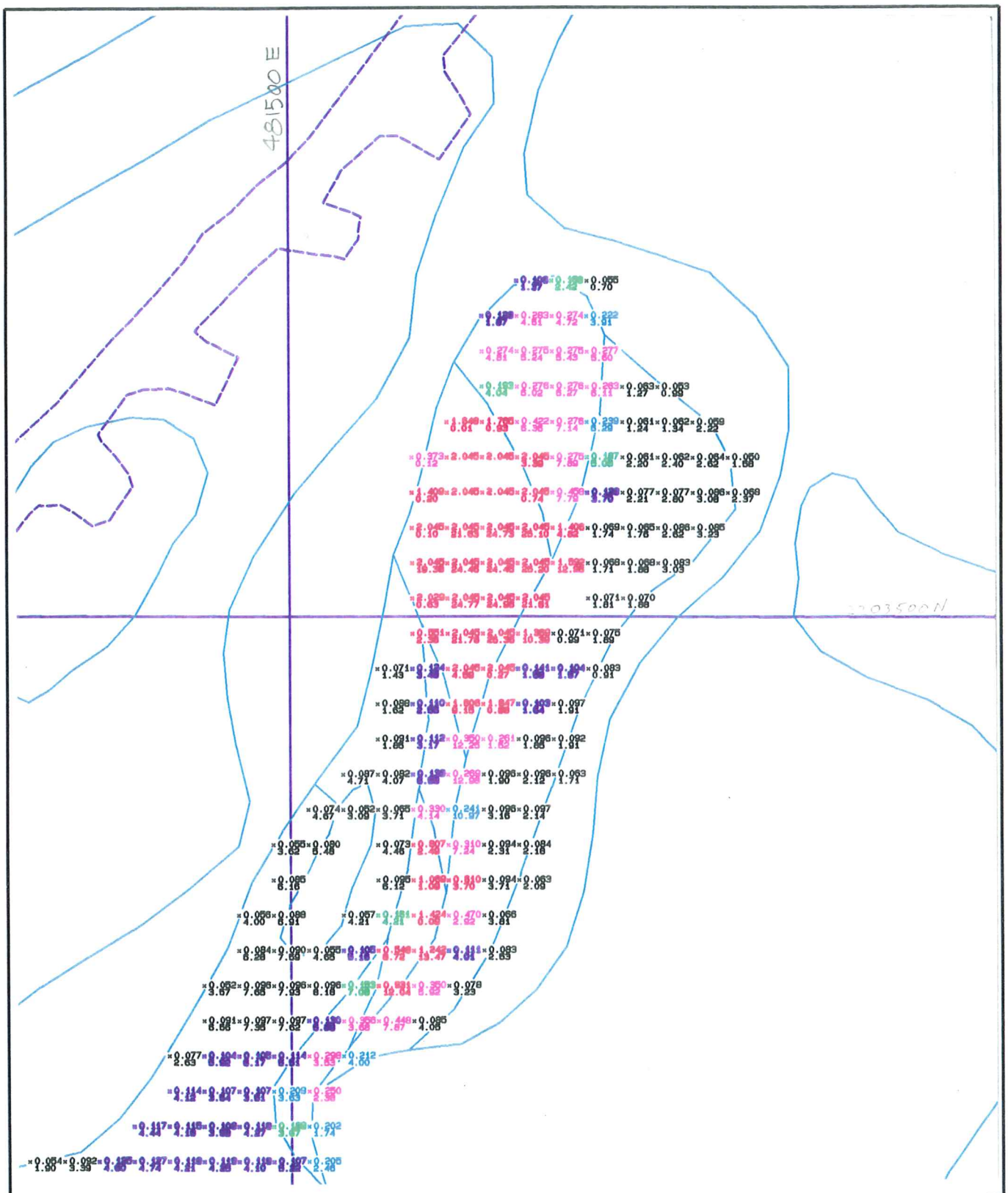
PART OF CROSS SECTION 450 N

SCALE: 1"=40'-0"

Figure 3



THE WINTERS CO. 6125 E. GRANT RD. TUCSON, AZ 85712	HECLA ROSEBUD PROJECT	A PORTION OF THE 4830 COMPOSITE ASSAY LEVEL PLAN SCALE: 1"=40'-0" all composite assays are in ounces per ton Au Figure 4



THE WINTERS CO. 6125 E. GRANT RD. TUCSON, AZ 85712	HECLA ROSEBUD PROJECT	A PORTION OF THE 4935 BLACK MODEL LEVEL PLAN SCALE: 1"=40'-0" assays are in ounces per ton Au (upper) and Ag (lower) Figure 5

Winters Company Memo 5/31/95

- need to contact S. Ristorelli → for copy of TWC report

pg 3 "TWC believes that in local areas, high grade drill hole composites have been extended beyond acceptable distances within domain boundaries, particularly in Domain 4."

pg 4 alteration, brecciation, structural deformation not included in TWC's model.

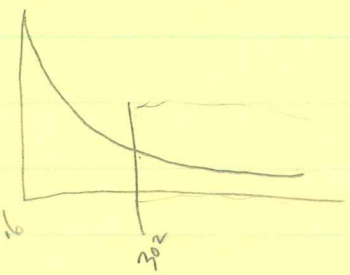
pg 5 TWC is concerned ... the influence of grade may have been partially substituted for geologic criteria in determining mineral domains?

pg 6 sub-divide domain 4 based on orientation & structural vs. lithologic control.

pg 7 We threw out RL-57: could not verify coordinates; 2552ys & geology didn't match surrounding drill holes.

TWC wants us to re-orient the block model.

highest Au = 2.045 opt → talk to Ristorelli



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Pg. 9 "@ 4600 level....."
There may be a considerable # of high-grade intercepts immediately below or above 4600 level.
Check on this.

Pg 11 additional indicator variography within domains.
Pg 12 Trivl ± Error? could take along time.

Craig – NZ AFE
MDA's report
plan of action for resource model
hydrology – call Dow / drill pads /). From here Wed 7th
Mike Sheen – short hike map to Row.
land/claim post replacement
geotech/void/condemnation drilling
sample protocol for trucks & feces
assay labs for production / accuracy/precision for on site XRF machine.
port screens

send mat screen data to Ristorelli