Y:W:WC: ENGINEERING
KNIGHT + PIESOLD

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT

REPORT ON
PIT SLOPE STABILITY
(REF. NO. 1782/3)

JANUARY, 1993

Suite 1400
750 West Pender Street
Vancouver, British Columbia
Canada V6C 2T8
Telephone (604) 685-0543
Telefax (604) 685-0147
CIS: 72360,477

Knight Piésold Ltd.
CONSULTING ENGINEERS

Knight Piésold Ltd.
CONSULTING ENGINEERS

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT

REPORT ON
PIT SLOPE STABILITY
(REF. NO. 1782/3)

"THIS REPORT HAS BEEN PREPARED EXCLUSIVELY FOR WESTERN COPPER HOLDINGS LIMITED. NO THIRD PARTY SHALL BE ENTITLED TO RELY ON ANY OF THE INFORMATION, CONCLUSIONS, OPINIONS OR ANY OTHER MATTER CONTAINED IN THIS REPORT".

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT

REPORT ON
PIT SLOPE STABILITY
(REF. NO. 1782/3)

TABLE OF CONTENTS

FIGURES

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT

REPORT ON
PIT SLOPE STABILITY
(REF. NO. 1782/3)

EXECUTIVE SUMMARY

Knight Piesold Ltd. were appointed by Western Copper Holdings Limited to perform an evaluation of pit slope stability for the proposed Williams Creek Project Open Pit. The evaluation was based on geotechnical data collected from an oriented drill core and on geological structure data gathered in several trenches located throughout the deposit.

Stereographic techniques were used to determine the extent to which the stability of the slopes would be controlled by structural geology. Stability analyses were performed using both empirical and theoretical procedures. Parameters used in the analyses were based both on results of the oriented core and on previous experience from projects involving similar rock types.

The results of this evaluation suggest that an angle of 55 degrees is acceptable for all slopes. The slope angle between elevations El. 2200 and El. 2100 at the North, South and West Facing slopes may be increased to 65 degrees provided that in-situ rock mass characteristics are similar to those suggested by the presently available information. The slope angle should not be increased at the base of the East Facing slope. General guidelines for bench geometry are also proposed.

The presently available information is considered adequate for feasibility level design of the open pit. Further geotechnical information would be required to allow the refinement of the design of the pit slopes.

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT

REPORT ON
PIT SLOPE STABILITY
(REF. NO. 1782/3)

SECTION 1.0 - INTRODUCTION

Mining of the Williams Creek Deposit, Zone 1, has been proposed using open pit methods. At the present (feasibility) stage of development, the layout of the pit calls for ultimate faces inclined at 55 degrees for slopes above El. 2200 ft and 70 degrees for slopes between El. 2200 and 2100 ft. As shown on Figure 7.2, the slope height reaches 900 ft in the deepest part of the open pit.

This report presents an evaluation of the stability of the open pit slopes. The evaluation is based on results of an oriented diamond drillhole where geotechnical data was recorded and on structural geology data collected from existing geological trenches in the open pit area.

The report is divided in 10 Sections. Section 2.0 is a brief description of the location and access to the site. Section 3.0 summarizes the regional geology, Section 4.0 broadly describes the factors which influence pit slope stability and slope angle, and describes most common types of structurally controlled slope failures. The effects of groundwater on pit slope stability are briefly discussed in Section 5.0. Section 6.0 discusses the influence of blasting control near final walls on slope stability. Available geotechnical data is discussed in Section 7.0. The evaluation of the stability of the pit walls using both empirical and theoretical procedures is given in Section 8.. Overall slope angles and general guidelines for bench geometry are proposed. Finally, the conclusions of the study and recommendations for further geotechnical investigations are presented in Sections 9.0 and 10.0, respectively.

SECTION 2.0 - LOCATION, ACCESS AND SITE DESCRIPTION

The Williams Creek project area is located in the Yukon Territory, approximately 50 km northwest of the town of Carmacks. The site is presently accessible on a seasonal basis from Carmacks along the Freegold Road, an all weather gravel road for a distance of approximately 34 km, and then by a single lane dozer road for the final 13 km to site.

The property is situated on the northeast flank of the unglaciated Dawson Range, within the Klondike Plateau, an old uplifted erosion surface, dissected by narrow valleys. The topography of the Williams Creek project area is subdued with relief of about 300 m (1000 ft), and a maximum elevation of 915 m (3000 ft) above sea level. Drainages have a recti-linear pattern reflecting structural bedrock features (Abbott, 1971)[1]. Outcrop and areas of felsenmeer are generally rare and restricted to the ridge tops and slopes.

---

[1] Geology of the Williams Creek Copper Prospect, unpub. B.A.Sc Thesis, University of British Columbia

SECTION 3.0 - REGIONAL GEOLOGY

The Williams Creek site is located within the Klotassin Batholith in the Intermontane Belt, a 250 km wide northwest trending plutonic-metamorphic belt transecting older stratified rocks. The rock units are segmented into blocks by several northwest trending anastomizing fault structures. The predominant structure of the region is northwest trending and dipping steeply to the northeast.

The Williams Creek Deposit is hosted by a hornblende-biotite-quartz feldspar gneiss containing disseminated copper oxide mineralization. It is a northwest trending tabular body approximately 100 ft thick, 1600 ft long and dipping 70 degrees to the east. The gneiss is underlain mainly by biotite-hornblende granodiorite of the Klotassin Batholith. Strongly foliated to gneissic zones occur within the granodiorite. The geology of the open pit area is shown on Figure 3.1.

Test pitting throughout the project area has determined that thick overburden sequences overly bedrock in valley bottoms. A thin veneer of in-situ weathered bedrock is encountered at higher elevations. Permafrost was encountered at varying depths.

SECTION 4.0 - FACTORS WHICH INFLUENCE PIT SLOPE STABILITY AND SLOPE ANGLE

The most important factors which influence rock slope stability of open pit mines are geologic structure, groundwater conditions and seismic acceleration forces due to blasting.

Where geologic discontinuities, (joints, bedding planes, foliation, shears, faults, etc.) singly or in combination dip out of the slope at angles near or greater than the angle of friction of the discontinuities, a potential for failure exists. It is essential that the geologic model of discontinuities around the pit be determined and the kinematic potential for failure evaluated. Typical failure modes are shown in Figure 4.1. They include circular, planar, wedge, block and toppling modes.

Where multiple bench failure can occur along discontinuities, it is normally necessary to obtain samples to perform direct shear tests along these discontinuities. The surface roughness and waviness along the discontinuity must be evaluated in the direction of sliding. This may increase the effective angle of friction by ten degrees or more. Both conditions require assessment in order to evaluate the safety factor for the portion of the slope.

The presence of groundwater in the slopes may influence stability in a number of ways:

(i) Reduction in the frictional shear strength due to buoyancy.

(ii) Reduction in cohesion of clay gouge or clayey rock with increasing moisture content.

(iii) Development of seepage forces during drainage towards the pit slope.

(iv) Creation of hydrostatic forces in tension cracks during heavy rainfall or snow melt. This pressure increases with depth.

(v) An increase in hydrodynamic shock due to blasting below the water table.

As a result, it is important that the water table and groundwater pressures be controlled along pit slopes to increase slope stability. An effective means of controlling groundwater pressures in the pit slopes is by installation of horizontal drains. Any tension cracks that develop along pit walls as a result of slope instability or stress release should be monitored during pit development.

Seismic forces due to blasting must be controlled at the final pit face to allow the development of the steepest practical slope.

SECTION 5.0 - GROUNDWATER EFFECTS ON PIT SLOPE STABILITY

Control of water pressures in the pit walls will allow steep slopes to be excavated by developing the maximum effective shear strengths of discontinuities along potential failure planes and by decreasing hydrostatic groundwater pressures acting on potentially unstable blocks.

The most effective way to reduce water pressures along pit walls is by installation of horizontal drain holes. Horizontal drains act as pressure relief holes to reduce groundwater pressures which typically build-up in tension cracks and existing discontinuities or behind impervious zones such as fault gouge zones or impermeable rock layers. The number, location, orientation and length of such pressure relief holes would depend upon site specific conditions such as lithology and geological structure. These factors would be evaluated during on-going development of the open-pit based on piezometer records and on pit wall mapping.

SECTION 6.0 - BLASTING CONTROL NEAR THE FINAL FALLS

Where the pit slope angle is not controlled by structural geology, the use of controlled blasting techniques at the final slope face normally allows an increase of 5 to 7 degrees in the slope angle. Controlled blasting near final pit walls increases slope stability by reducing blast-induced damage generated by seismic forces. This involves the use of controlled blasting for the line holes, angle line holes, buffer holes adjacent to the line holes, numerous delays and blasting to a free face.

The best blast design will result from trial test blast patterns in the field during development of the initial pit. Test trial blasts will be required wherever the rock conditions change substantially.

SECTION 7.0 - GEOTECHNICAL DATA

The available data consist of the results of one oriented diamond drillhole where the following parameters were recorded:

- Discontinuity orientation
- RQD (Rock Quality Designation)
- Discontinuity infilling materials
- Discontinuity surface roughness description
- Discontinuity surface degree of weathering

Additional data of the structural geology of the area was obtained from previous geological trenching programs. Figure 3.1 shows the location of the holes and the trenches from which data was obtained.

The inclined drillhole enabled oriented drillcore to be obtained using an eccentrically weighted core barrel which obtained impressions of the core at the top of each drill run using a clay imprint. The drillcore was recovered in an NQ triple-tube core barrel. A computer program was used to transform field discontinuity orientation data into true orientation.

The predominant rock types encountered consisted of biotite-hornblende granodiorite, biotite-hornblende gneiss and pegmatitic aplitic dykes with quartz veining. Several fracture zones were identified and occasional clayey or sandy zones of fault gauge were also encountered. Generally the rock strength is moderate as indicated by the number of hammer blows required to break the core. Discontinuity surfaces were generally coated with carbonate, chlorite, hematite, biotite and zeolite. The degree of weathering of wall discontinuities was found to vary from fresh to highly weathered. Sections showing the rock type distribution as well as the RQD found along the oriented drillhole are presented on Figures 7.1 and 7.2.

SECTION 8.0 - SLOPE DESIGN

8.1 KINEMATIC ANALYSIS

The orientation of rock discontinuities (faults, shears, joints, dykes,contacts etc.) measured in the oriented core drillhole as well as in selected trenches located throughout the deposit were used to develop stereonet plots by the Schmidt Contouring method.

The entire deposit can be characterized as a single structural domain as indicated by the comparison of the drillhole data and the surface (trenches) data. Drillhole information is presented on Figures 8.1 and 8.2. Surface data is presented on Figures 8.3 and 8.4. Figures 8.5 and 8.6 present a combined plot of all discontinuity data.

Two major discontinuity sets, Set No. 1 and Set No. 2, are evident in the above plots. Set No. 1 has an average strike of about 323 degrees and an average dip of about 75 degrees east. Set No. 2 strikes 199 degrees and dips 88 degrees west, approximately. The observed dispersion around these values is thought to be due both to the large number of discontinuities considered in the analysis and to random oriented discontinuities result of the very complex geological structure existing at the drillhole location. The difference in the number of poles defining each discontinuity set is due to the orientation of Set No. 2, which is subparallel to the drillhole, which in turn provided most of the data for the analysis.

The logged discontinuities reflect the general geological structure as can be seen in Figures 7.1 and 8.6. The two discontinuity sets are sub-parallel to the major structures presently identified.

The recorded faults generally dip steeper than 75 degrees. In general, the rock blocks defined by the intersection of any two of them and the pit slope faces are stable because:

◇ the line of intersection of the discontinuities dip into the slope
or,

◇ the plunge of the line of intersection of two discontinuities is steeper than the dip of the slope
or,

◇ even though the line of intersection of two faults daylight in the slope face, the block geometry and/or the pit plan geometry (North Facing slope) avoid movement of the block.

Blocks defined by the mean orientation of the discontinuity sets and the slope faces of the pit are stable as illustrated by the stereoplots shown on Figures 8.7 to 8.10. The trend of the intersection of the two discontinuity sets is approximately 014 degrees and its plunge is approx. 72 degrees. For the South and West Facing slopes, the line of intersection dips into the slopes eliminating all possibility of sliding. At the East and North Facing slopes the intersection would daylight into the slope face only if the slope angles are steeper than 75 degrees. The preliminary layout of the pit slopes, with 20 ft wide benches at 50 ft vertical spacing and an overall slope angle of 55 degrees, will result in interbench slopes of 73 degrees, approaching the limits of kinematic stability for single bench failures.

8.2 STABILITY ANALYSIS

The stability of the pit slopes was evaluated using a modification of the Rock Mass Rating (RMR) system (Bieniawski, 1989)[2]. The analysis indicates that as a result of the relatively low RQD values, the large percentage of discontinuities dipping steeper than 60 degrees (see Figure 8.11 and the dispersion of discontinuity orientation values, local wedge and block failures should be expected. The design must accommodate this potential.

---

[2] Engineering Rock Mass Classifications, A Complete Manual for Engineers and Geologists in Mining, Civil and Petroleum Engineering, 251 pgs., Wiley

The possibility of a general failure of the pit slope, where through-going discontinuities do not exist, was also evaluated. Such failure, which would be almost planar, would follow minor geological features and, in some places, would pass through intact material. The inclination of such a failure would depend primarily on the inclination of the slope face and on the angle of internal friction of the rock mass. Preliminary calculations indicate that a friction angle of approx. 45 degrees and a cohesion of approx. 25 psi would ensure the stability of a 900 foot high dry slope inclined at 65 degrees. The available geotechnical data indicate that these values are attainable for the rock mass existing at Williams Creek Project, given good drainage.

8.3 OVERALL PIT SLOPE ANGLES

The following general slope angles are proposed for the pit. They were defined based on the available data. It is understood that if the rock mass quality is found different as considered for the present evaluation of pit slope stability, slope angles must be accordingly changed. Local block and wedge failures should be expected in any case.

	SLOPE ANGLE	
Pit Slope	**Above El. 2200**	**Below El. 2200**
East Facing	55	55
West Facing	55	65
North Facing	55	65
South Facing	55	65

The proposed open pit and bench geometry is illustrated on Figure 8.12.

8.4 BENCH GUIDELINES

For final pit wall bench design, it is proposed that controlled blasting be used to develop a relatively steep bench face (up to 80 degrees) according to in-situ rock conditions, which should be scaled with excavating equipment and a drag chain or equivalent from the top. Double benching is recommended. The scaling will reduce subsequent ravelling and reduce the catch required for berms. Where the rock face stands up well a 15 to 20 ft wide bench is suggested. Where the rock is very fractured and considerable ravelling occurs, the bench may require widening to 25 feet.

If areas of heavily fractured rock or faulted rock are encountered in the final slopes, more stable bench faces can frequently be developed using bulldozers and rippers rather than blasting along the final line holes.

The optimum bench angle, however, will be defined by experience at the operating stage. The optimum will depend on the effects and costs of various blasting methods, the cost of extra waste excavation with lower angles, and the cost of scaling of steep faces.

SECTION 9.0 - CONCLUSIONS

A preliminary stability assessment of the pit slopes presently proposed for the Williams Creek Project was performed. The study was based on geotechnical information collected in an oriented drill core and on geological structural data gathered along several trenches located throughout the deposit.

The results of the analysis indicate that an angle of 55 degrees is acceptable for all slopes. The slope angle proposed for slopes between El. 2200 and El. 2100 should not exceed 65 degrees on the West, South and North Facing Slopes. The slope angle should not be increased at the East Facing Slope.

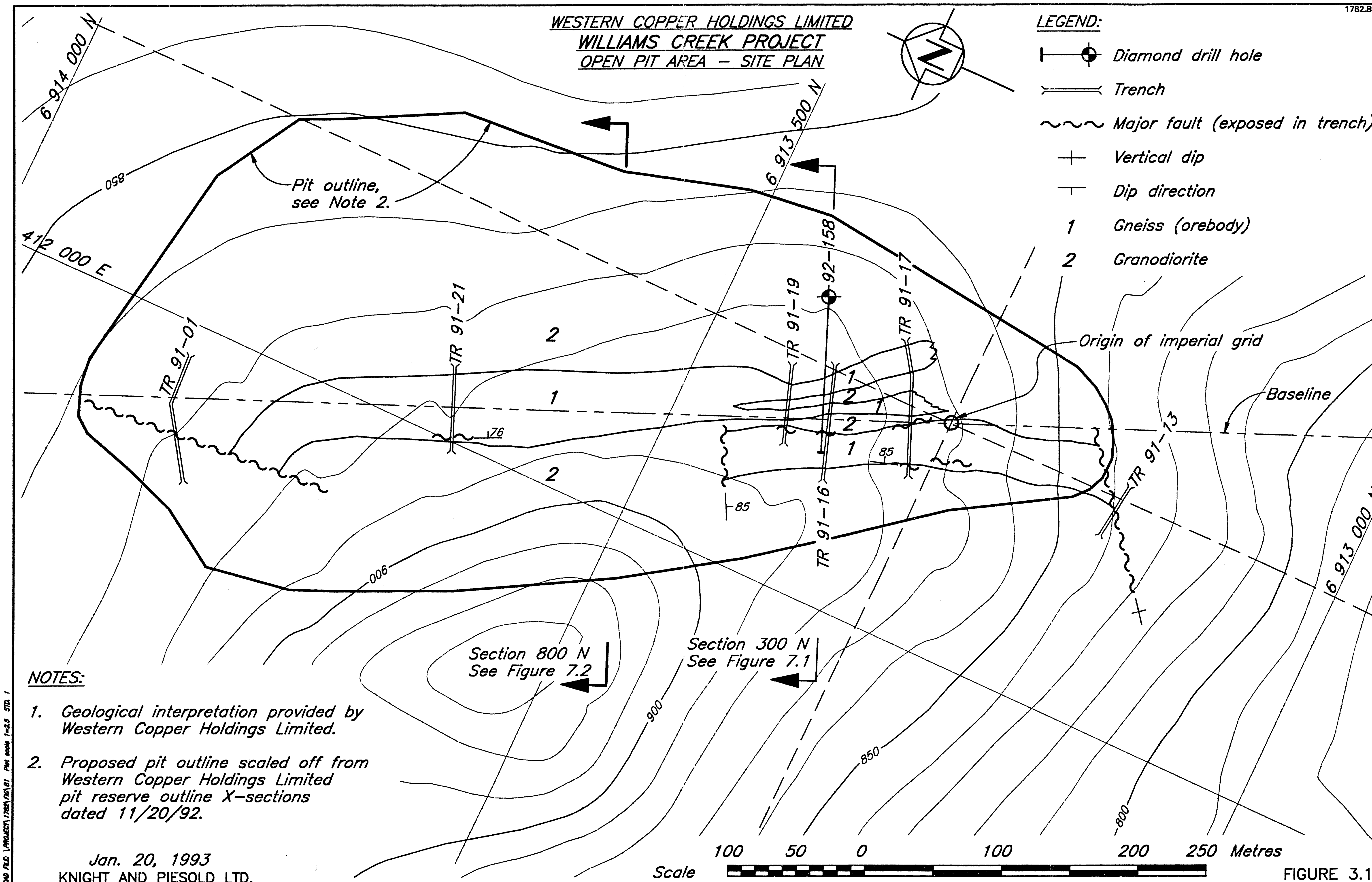
SECTION 10.0 - RECOMMENDATIONS FOR FURTHER GEOTECHNICAL INVESTIGATION

At the feasibility level, no further geotechnical investigations are required.

Upon commencement of mining, it is recommended that a geotechnical data collection program be implemented. This would include:

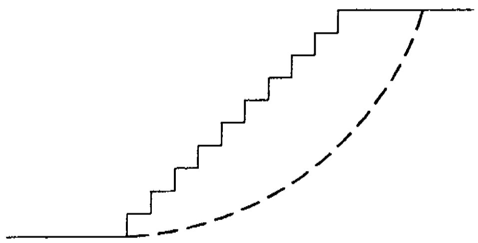
- ◇ discontinuity mapping on exposed pit slopes.
- ◇ installation and monitoring of piezometers, locations and number to be determined based on on-going review of results.
- ◇ oriented core drilling as and when required for design of final pit slopes.

Factors which influence slope stability include the location and orientation of discontinuities with respect to the pit slope, the overall rock mass strength parameters, including cohesion and friction angles, and the presence of groundwater pressures. Further geotechnical investigations are required to evaluate rock mass strength and persistence, orientation and characteristics of discontinuities. The results of these investigations would be used to refine pit slope design with respect to final slope angles and potential measures required to control stability.

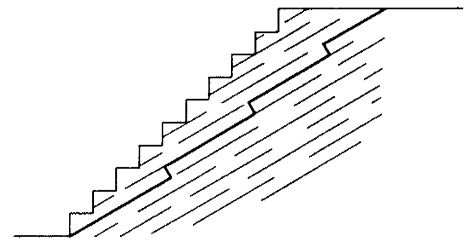

1782.B1
WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
OPEN PIT AREA – SITE PLAN
LEGEND:
Diamond drill hole
Trench
Major fault (exposed in trench)
Vertical dip
Dip direction
1 Gneiss (orebody)
2 Granodiorite
6 914 000 N
6 913 500 N
6 913 000 N
412 000 E
Pit outline, see Note 2.
Origin of imperial grid
Baseline
TR 91–01
TR 91–21
TR 91–19
92–158
TR 91–17
TR 91–16
TR 91–13
850
900
800
76
85
Section 800 N
See Figure 7.2
Section 300 N
See Figure 7.1
NOTES:
1. Geological interpretation provided by Western Copper Holdings Limited.
2. Proposed pit outline scaled off from Western Copper Holdings Limited pit reserve outline X–sections dated 11/20/92.
Jan. 20, 1993
KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS
Scale
100 50 0 100 200 250 Metres
FIGURE 3.1

1782.A15

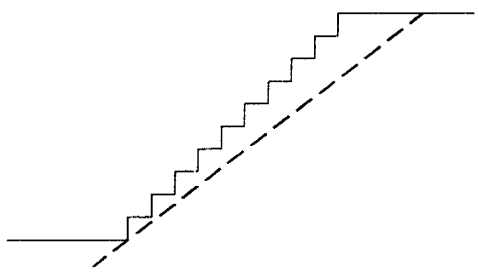
WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
OPEN PIT
TYPICAL FAILURE MODES



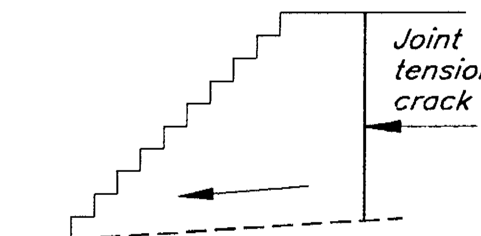
Failure geometry in homogeneous extreme weak rock or rock with random localized jointing.



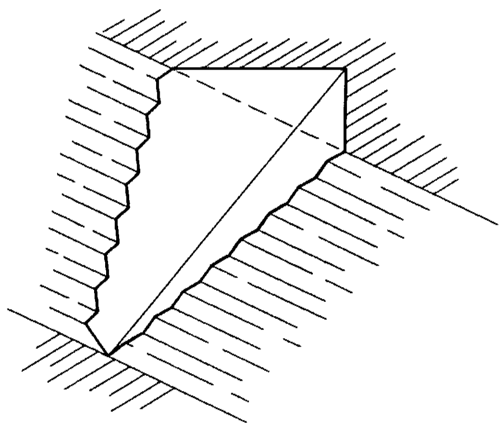
Failure combining movement along discontinuous joints and through intact rock.



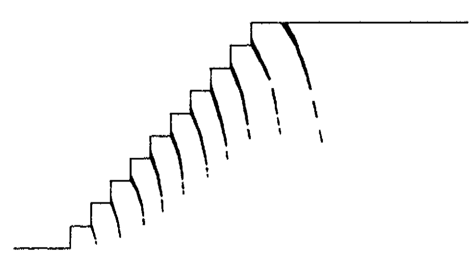
Failure on the plane of a continuous fault, shear zone or joint.



Failure as a block on a weak layer bounded at the back by a joint or tension crack.



Failure as a wedge on two or more intersecting discontinuities.



Failure by toppling. Most frequent where major structure dips steeply.

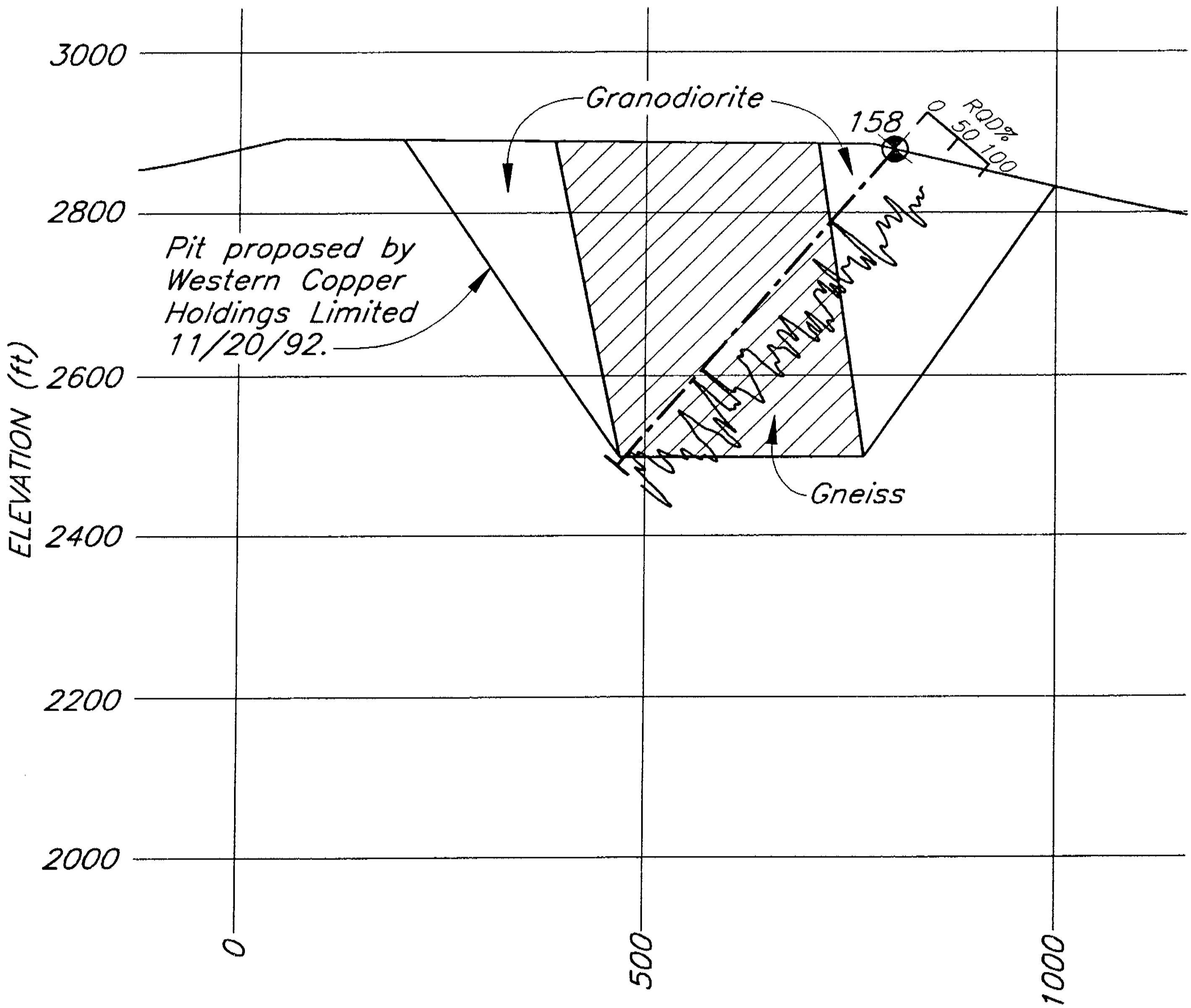
CAD FILE: \PROJECT\1782\FIG\A15 Plot 1=1

Jan. 20, 1993

KNIGHT PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 4.1

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
SECTION 300 N
ROCK TYPE DISTRIBUTION



NOTES:

1. For details of recommended bench geometry see Figure 8.12

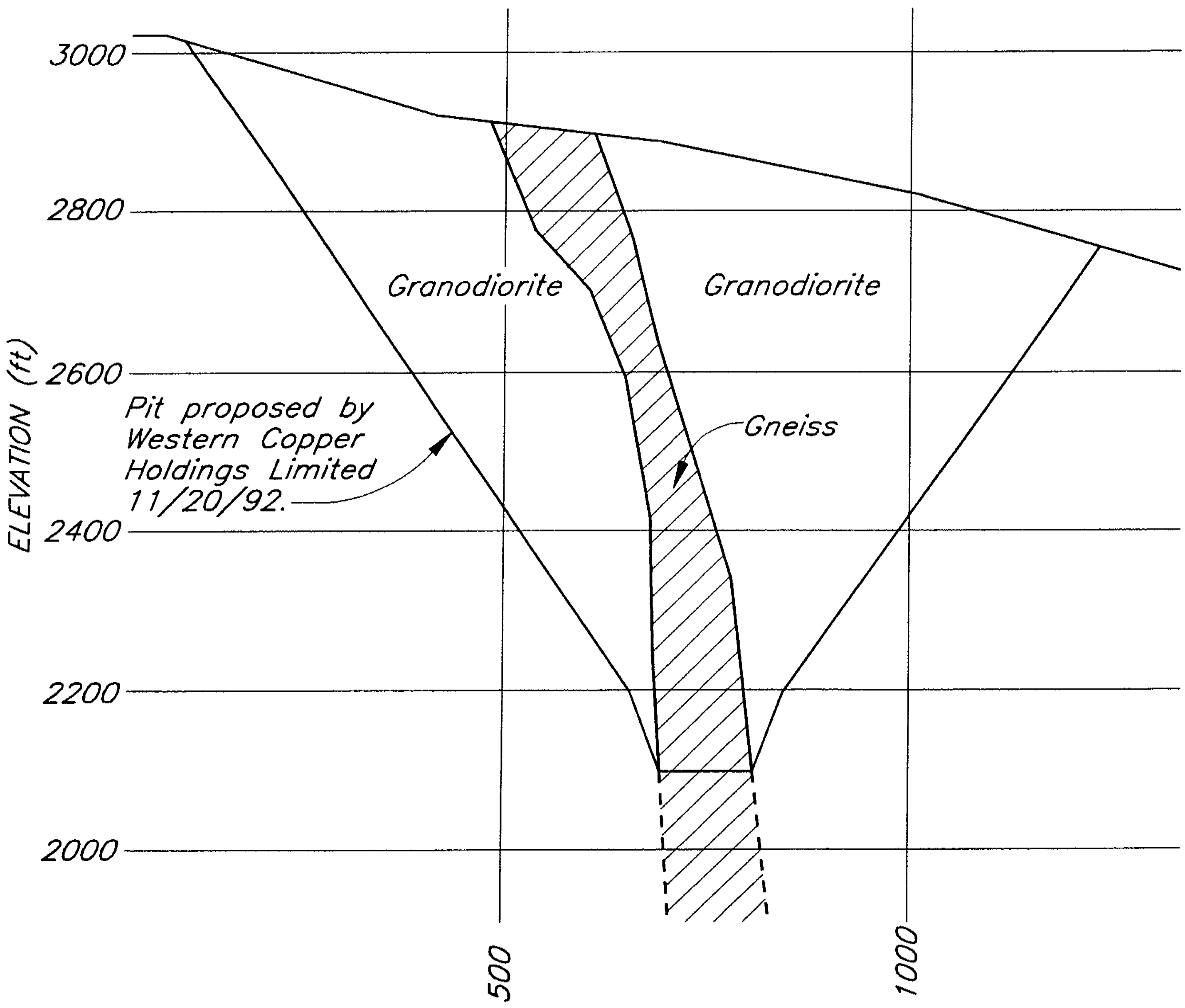
Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 7.1

CAD FILE: \PROJECT\1782\FIG\A5 Plot scale 1=1

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
SECTION 800 N
ROCK TYPE DISTRIBUTION



NOTES:

1. For details of recommended bench geometry see Figure 8.12

CAD FILE: \PROJECT\1782\FIG\A4 Plot scale 1=1

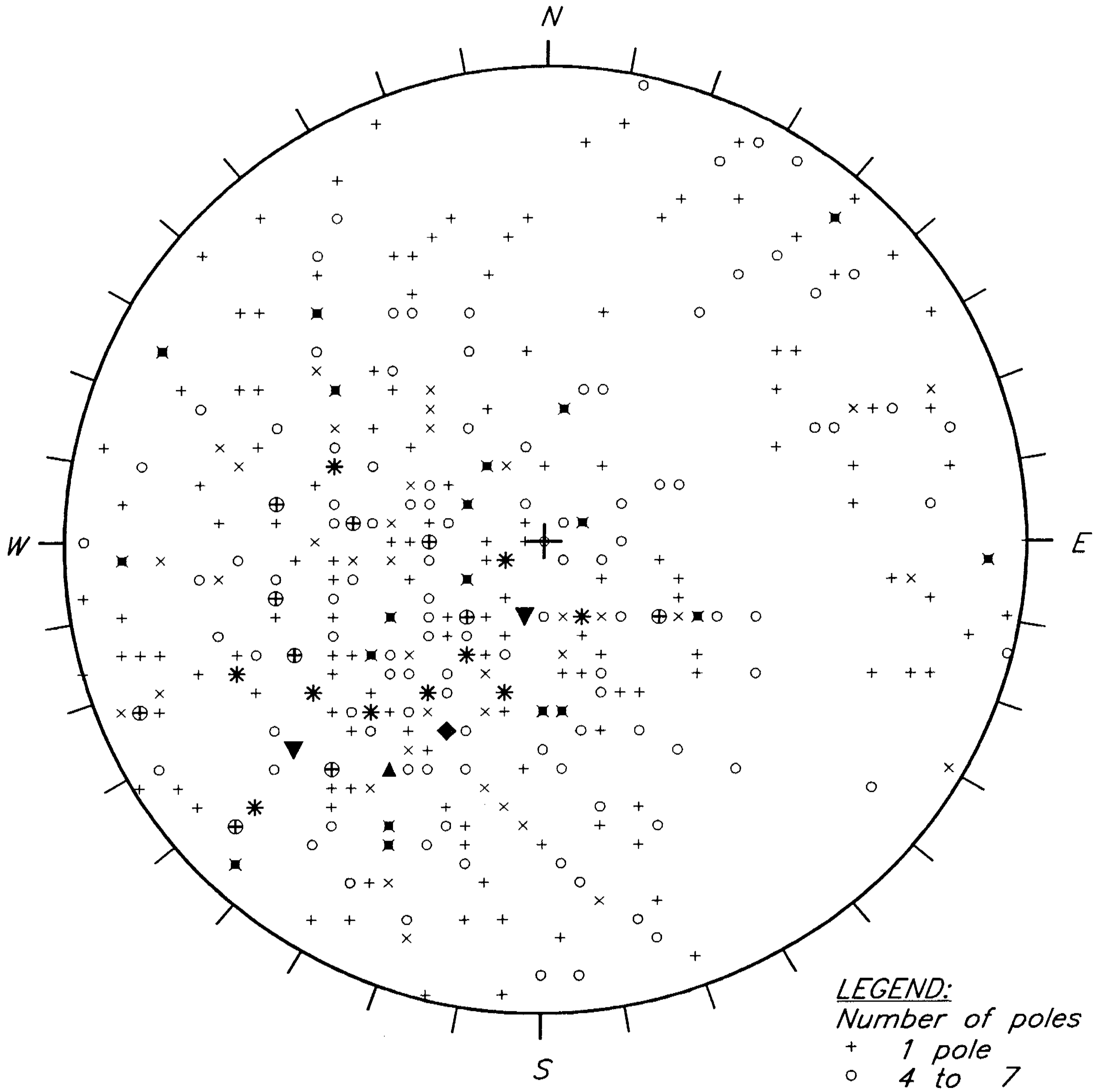
Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 7.2

1782.A16

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
STEREONET PLOT OF DRILLHOLE DATA – POLES



LEGEND:
Number of poles
+ 1 pole
○ 4 to 7
× 8 to 11
12 to 15
⊕ 16 to 19
✱ 20 to 23
▲ 24 to 27
◆ 28 to 31
▼ 32 to 35

Equal angle
lower hemisphere
1414 poles.

CAD FILE: \PROJECT\1782\FIG\A16 Plot scale 1=1

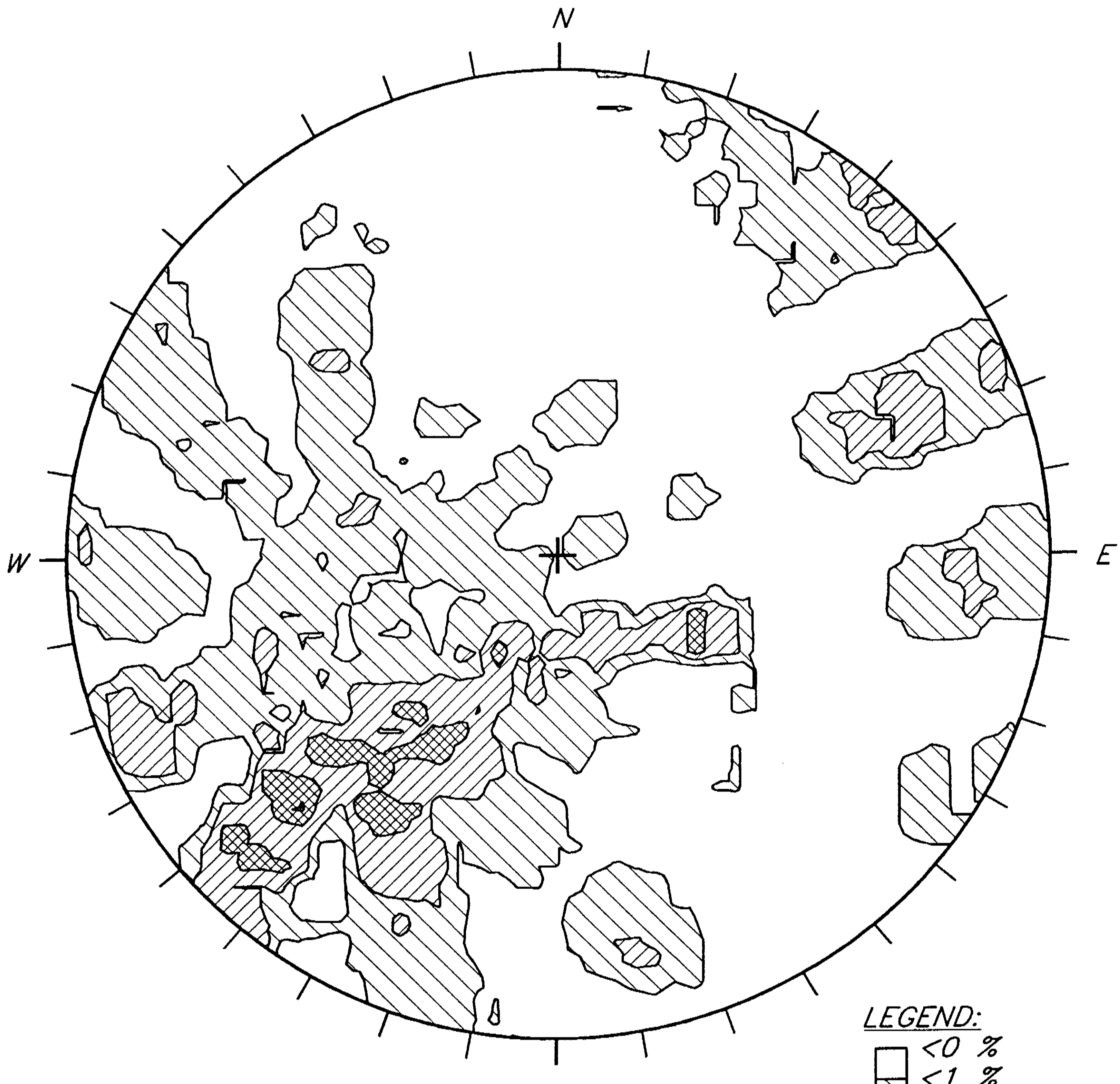
Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.1

1782.A8

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
STEREONET PLOT OF DRILLHOLE DATA – CONTOURED



LEGEND:

- <0 %
- <1 %
- <2 %
- <3 %
- <4 %
- <5 %
- <6 %

Equal angle
lower hemisphere
1414 poles.

NOTE:

Contour plot corrected using Terzaghi weighting procedure.

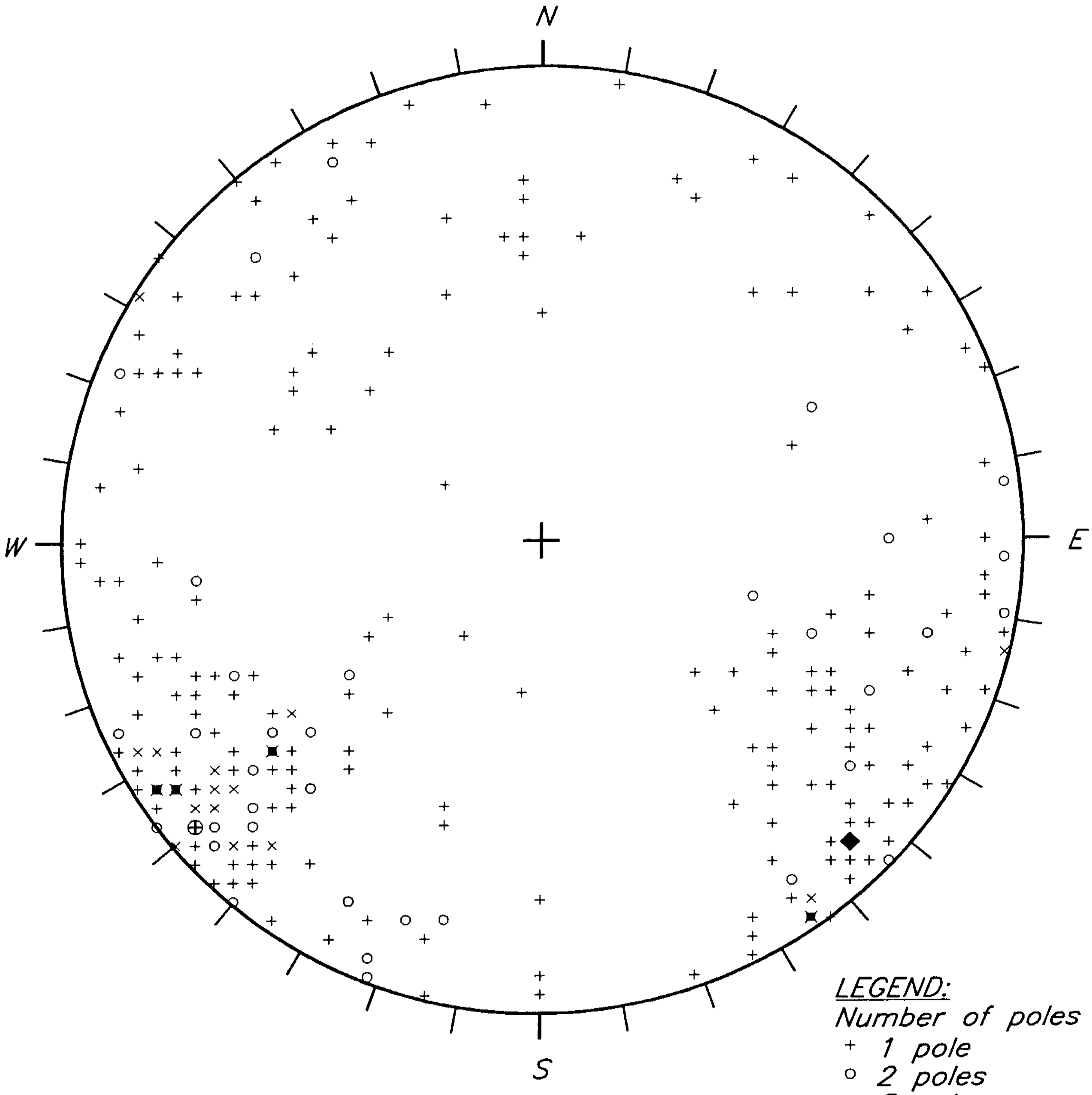
Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.2

CAD FILE: \PROJECT\1782\FIG\A8 Plot scale 1=1

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
STEREONET PLOT OF SURFACE (TRENCH) DATA – POLES



LEGEND:
Number of poles
+ 1 pole
○ 2 poles
× 3 poles
4 poles
⊕ 5 poles
✱ 6 poles
▲ 7 poles
◆ 8 poles

Equal angle
lower hemisphere
321 poles.

CAD FILE: \PROJECT\1782\FIG\A17 Plot scale 1=1

Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.3

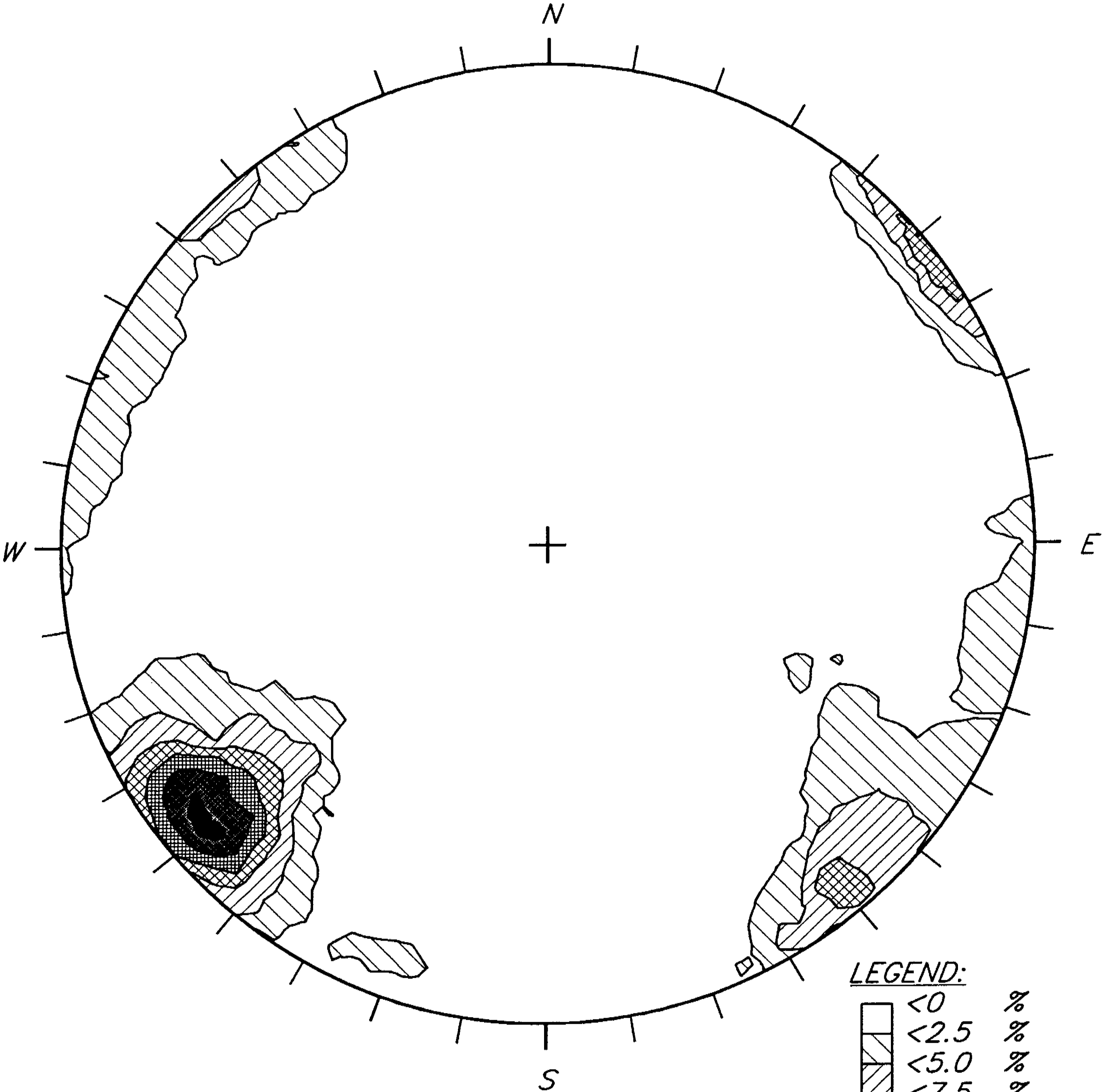
1782.A12

WESTERN COPPER HOLDINGS LIMITED

WILLIAMS CREEK PROJECT

STEREONET PLOT OF

SURFACE (TRENCH) DATA – CONTOURED



LEGEND:

	<0 %
	<2.5 %
	<5.0 %
	<7.5 %
	<10.0 %
	<12.5 %
	<15.0 %
	<17.5 %

Equal angle
lower hemisphere
321 poles.

NOTE:

Contour plot corrected using Terzaghi weighting procedure.

Jan. 20, 1993

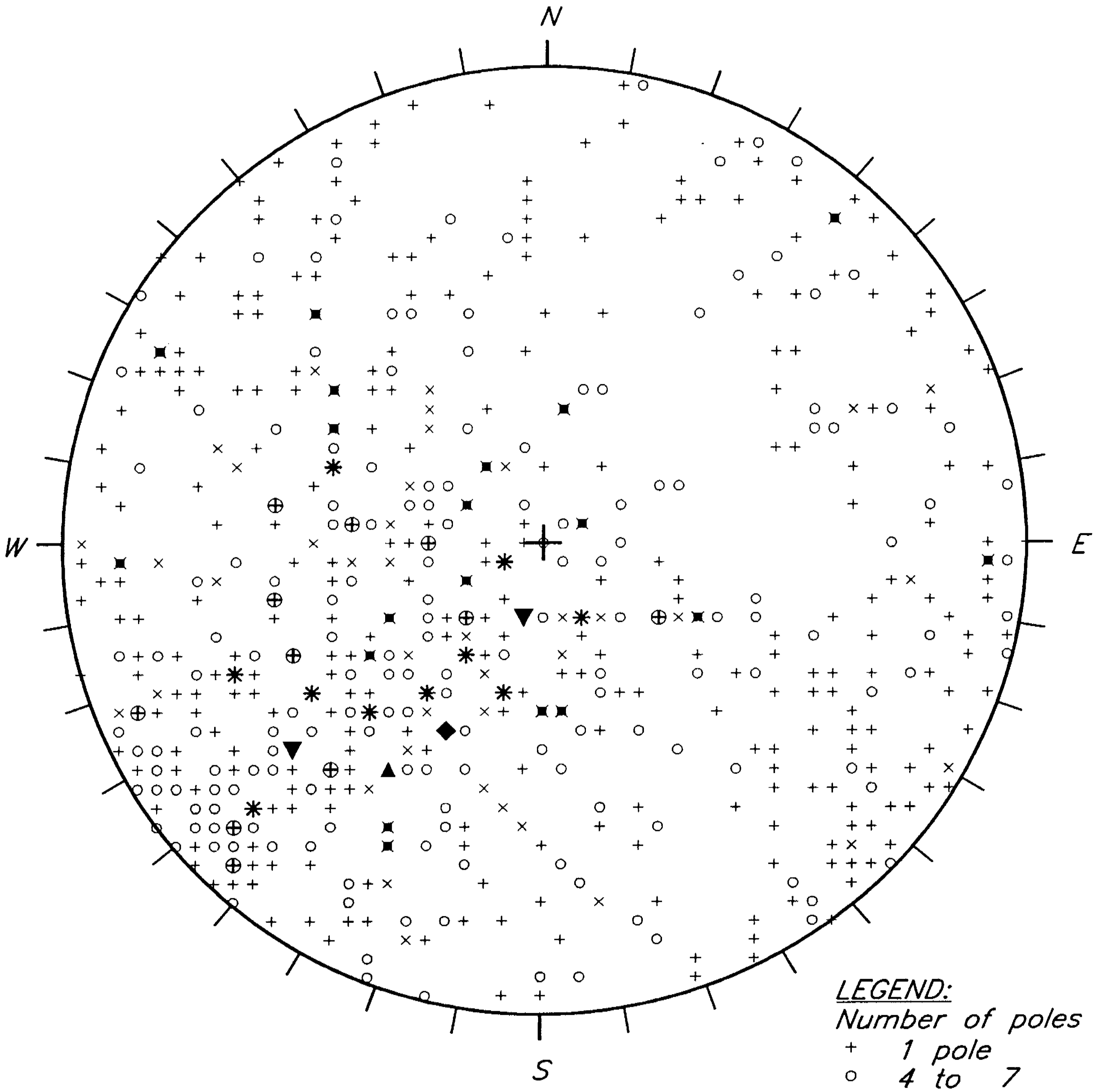
KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.4

CAD FILE: \PROJECT\1782\FIG\A12 Plot scale 1=1

1782.A14

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
COMBINED STEREONET – ALL DATA – POLES



LEGEND:
Number of poles
+ 1 pole
○ 4 to 7
× 8 to 11
12 to 15
⊕ 16 to 19
✱ 20 to 23
▲ 24 to 27
◆ 28 to 31
▼ 32 to 35

Equal angle
lower hemisphere
1735 poles.

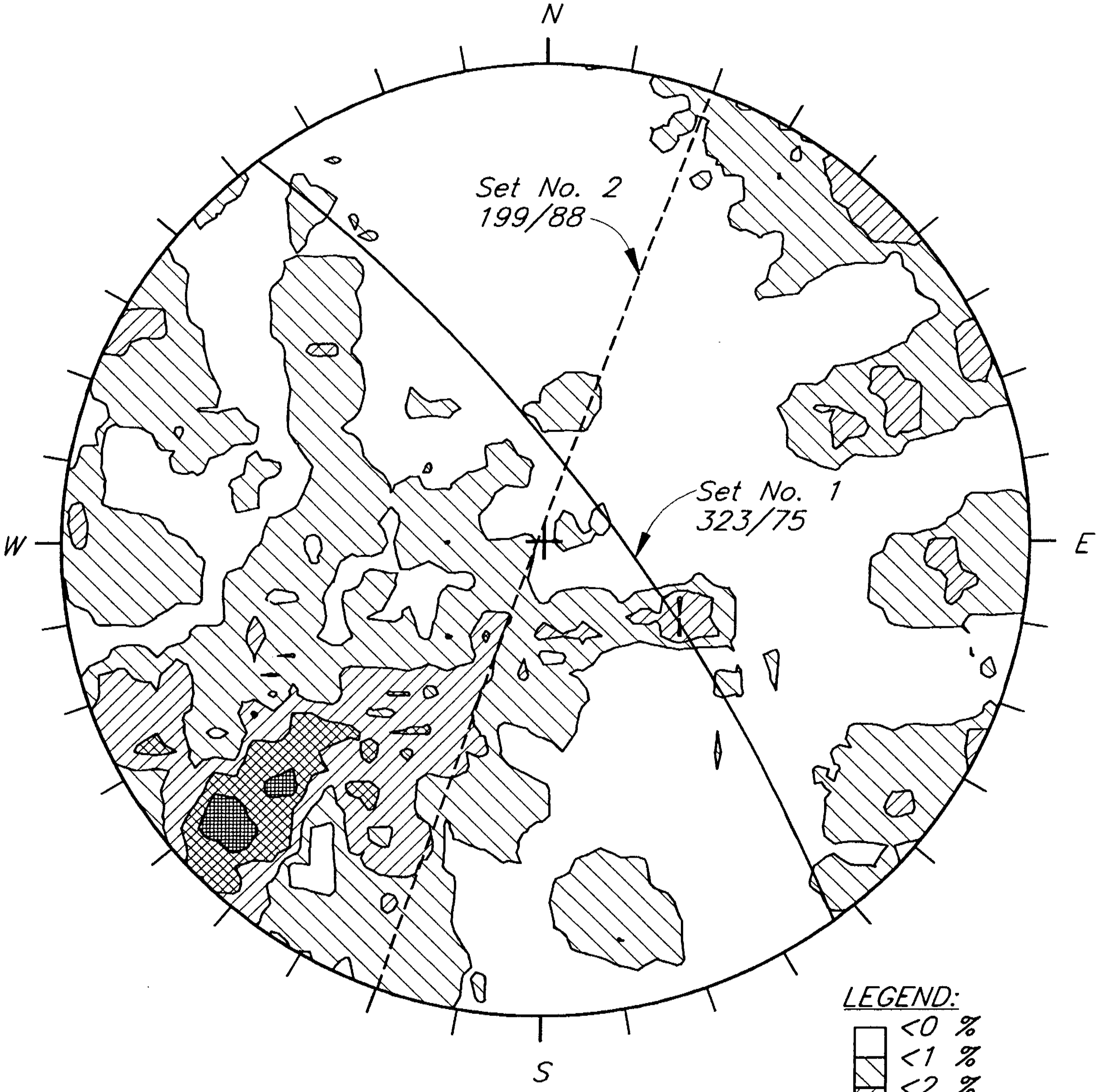
CAD FILE: \PROJECT\1782\FIG\A14 Plot scale 1=1

Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.5

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
COMBINED STEREONET – ALL DATA – CONTOURED



NOTE:

Contour plot corrected using Terzaghi weighting procedure.

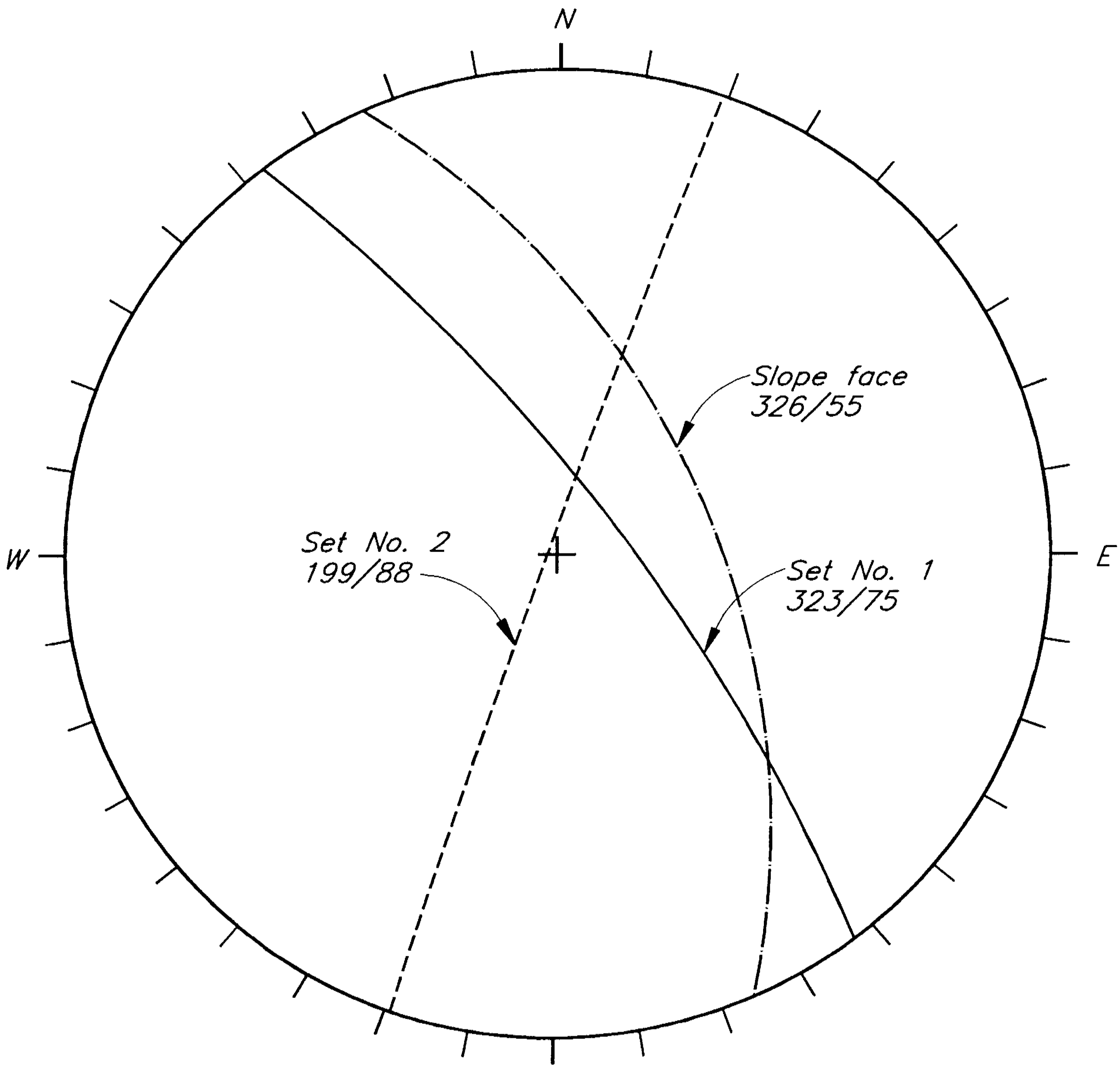
Equal angle lower hemisphere 1735 poles.

Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.6

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
EAST FACING SLOPE



NOTES:

1. Planes shown on equal angle lower hemisphere.
2. Discontinuity orientation strike/dip.

Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.7

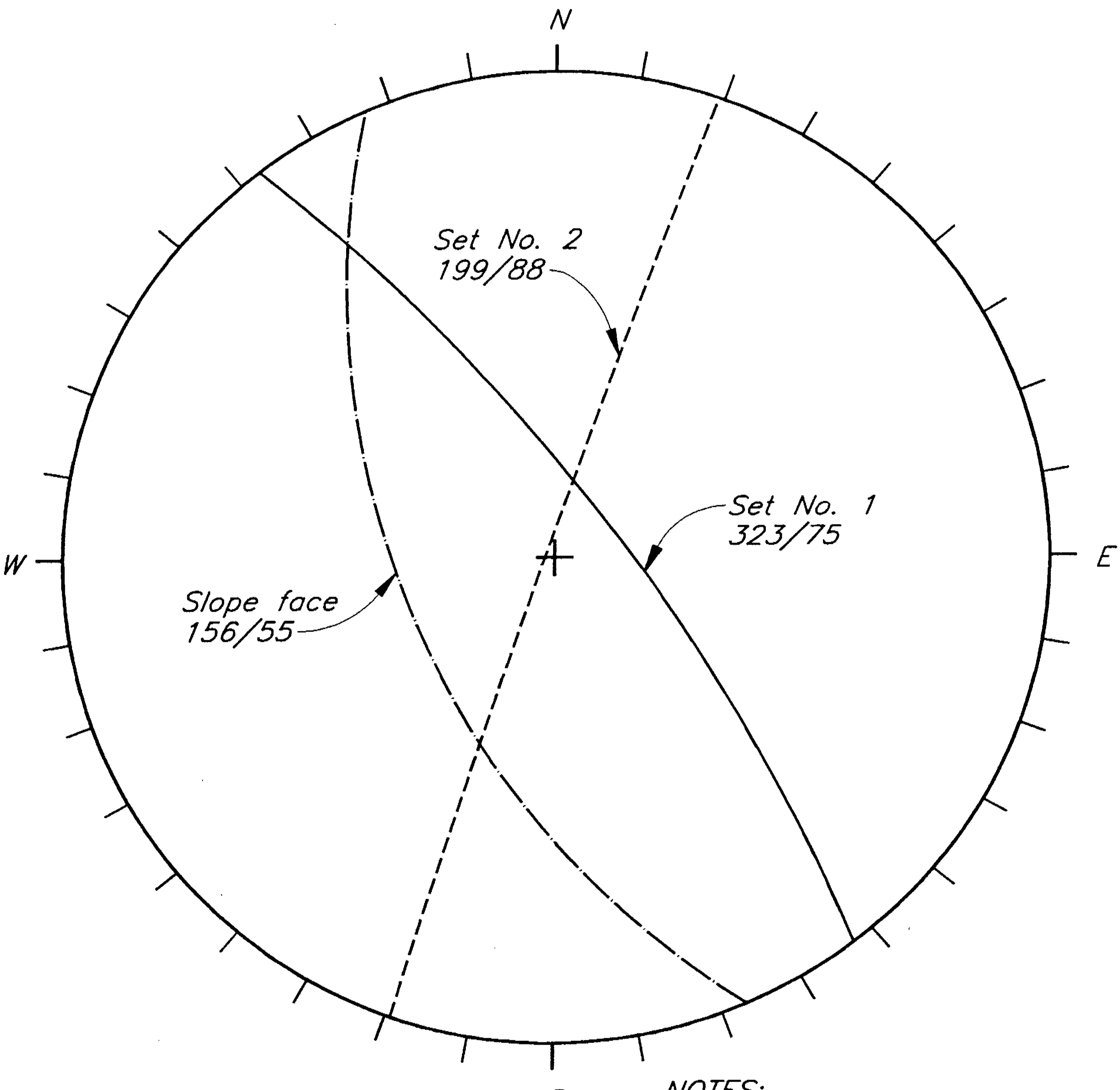
CAD FILE: \PROJECT\1782\FIG\A7 Plot scale 1=1

1782.A11

WESTERN COPPER HOLDINGS LIMITED

WILLIAMS CREEK PROJECT

WEST FACING SLOPE



NOTES:

1. Planes shown on equal angle lower hemisphere.
2. Discontinuity orientation strike/dip.

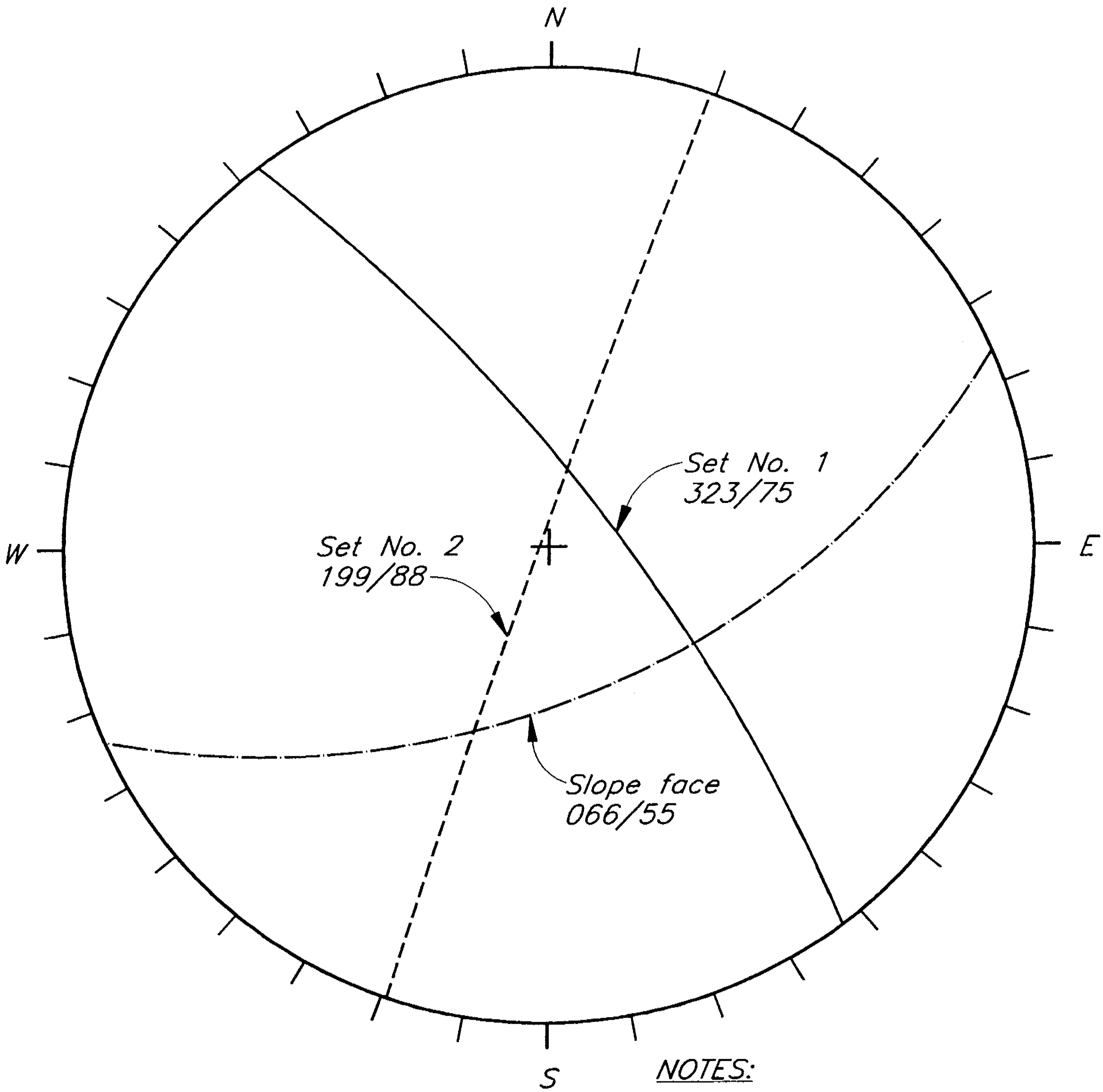
Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.8

CAD FILE: \PROJECT\1782\FIG\A11 Plot scale 1=1

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
SOUTH FACING SLOPE



NOTES:

1. Planes shown on equal angle lower hemisphere.
2. Discontinuity orientation strike/dip.

CAD FILE: \PROJECT\1782\FIG\A10 Plot scale 1=1

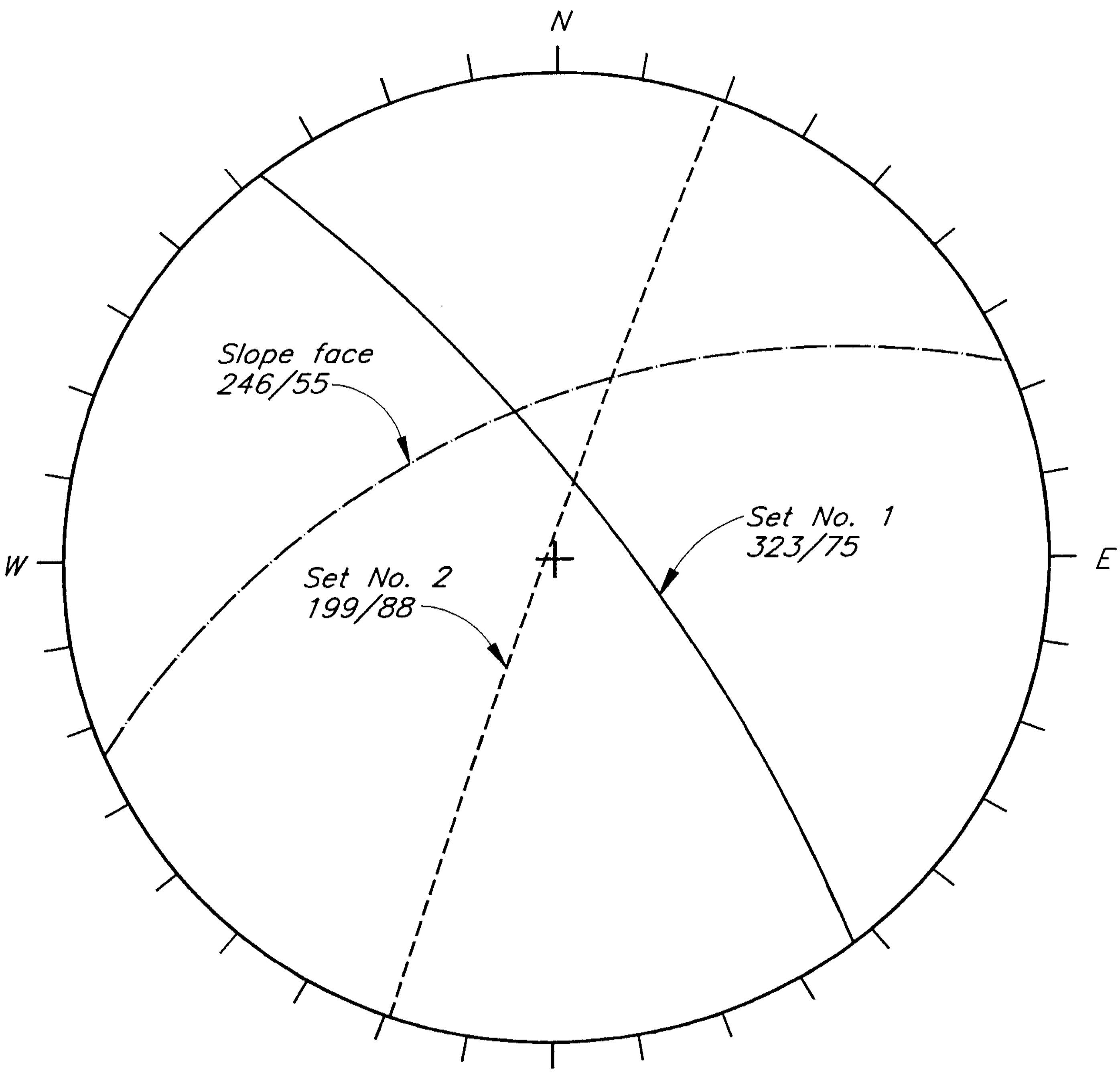
Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.9

1782.A9

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
NORTH FACING SLOPE



NOTES:

1. Planes shown on equal angle lower hemisphere.
2. Discontinuity orientation strike/dip.

CAD FILE: \PROJECT\1782\FIG\A9 Plot scale 1=1

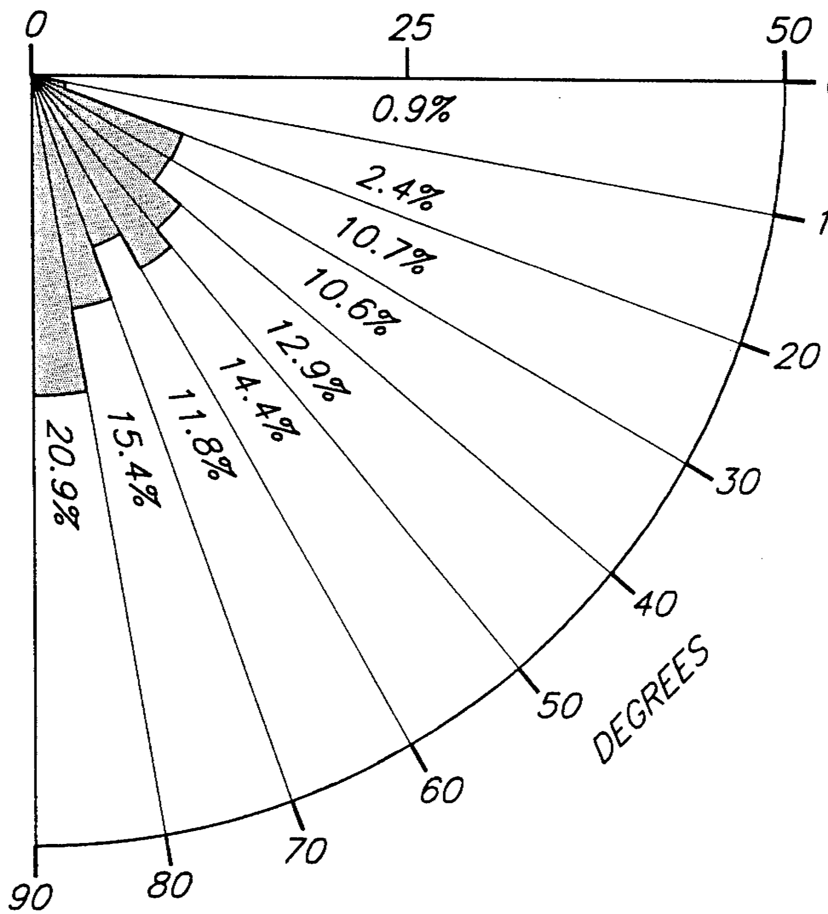
Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

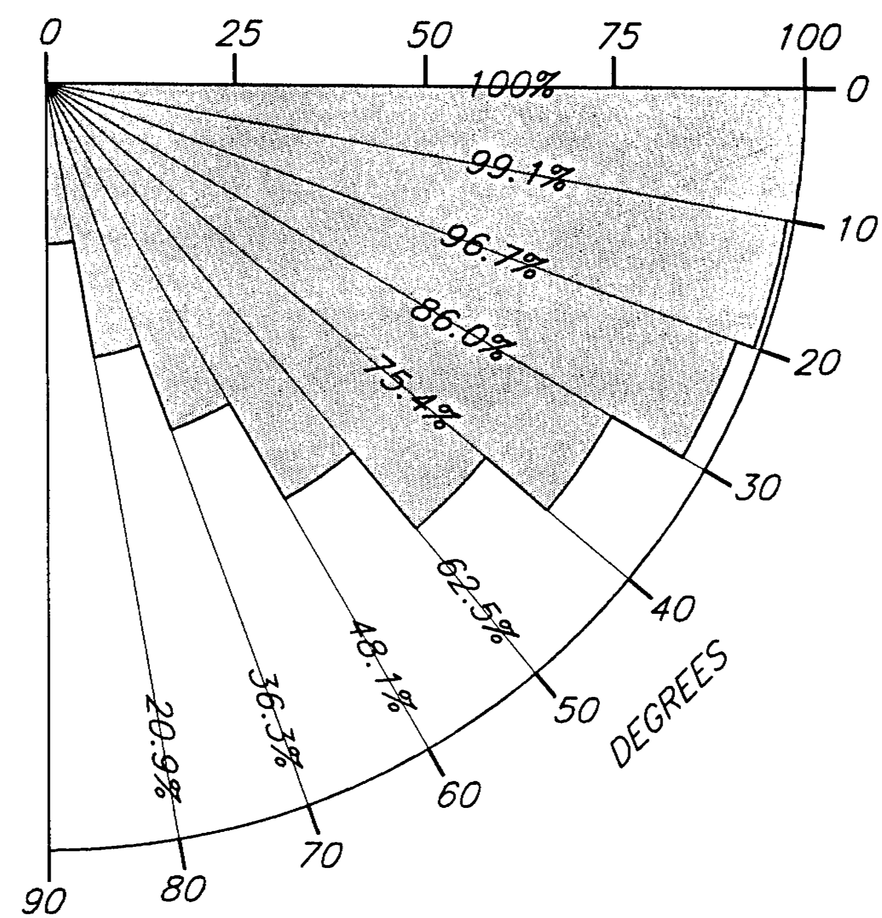
FIGURE 8.10

CAD FILE: \PROJECT\1782\FIG\A6 Plot scale 1=1

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
DISTRIBUTION OF DIP DATA



DISTRIBUTION OF
MEASURED DIPS IN INDICATED RANGE
(1735 POLES)



CUMULATIVE DISTRIBUTION OF
MEASURED DIPS STEEPER THAN ANGLE SHOWN
(1735 POLES)

Jan. 20, 1993

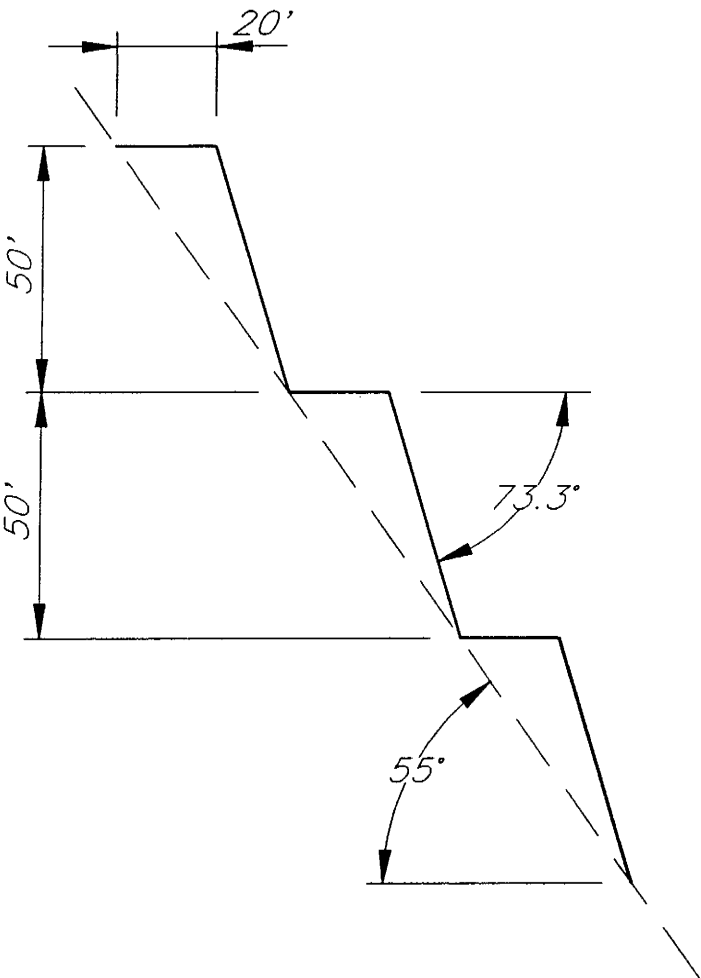
KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.11

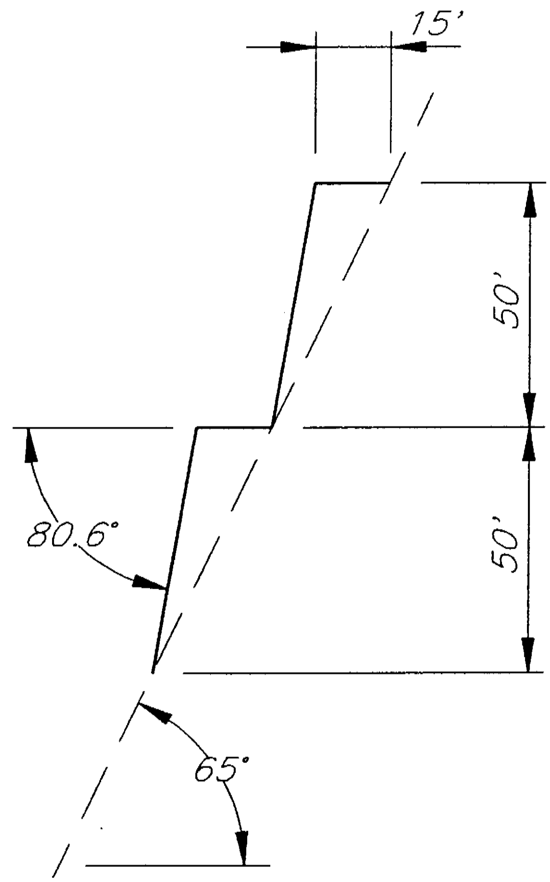
1782.A6

1782.A18

WESTERN COPPER HOLDINGS LIMITED
WILLIAMS CREEK PROJECT
OPEN PIT SLOPES
RECOMMENDED BENCH AND SLOPE GEOMETRY



a) Overall Pit Slope



b) Base of West–facing, North–facing and South–facing Slopes

CAD FILE: \PROJECT\1782\FIG\A18 Plot scale 1=1

Jan. 20, 1993

KNIGHT AND PIESOLD LTD.
CONSULTING ENGINEERS

FIGURE 8.12