NORTH WEST SURVEY CORPORATION (YUKON) LIMITED

LAND, AERIAL AND PHOTOGRAMMETRIC SURVEYORS

Area Code 403
Telephone 667-6258

Box 4418
Whitehorse, Yukon, Y1A 3T5

REPORT ON THE

CYPRUS ANVIL OPEN PIT CONTROL SURVEY

ANVIL AREA

MAP SHEETS 105 K/5 & 6, Y.T.

FEBRUARY, 1982

TABLE OF CONTENTS

INTRODUCTION

On December 10 and 11, 1981, a survey seminar was held at the Faro Mine for Cyprus Anvil Mine personnel. The course was conducted by Art Petersen and Fred Welter of North West Survey Corporation (Yukon) Ltd. and dealt with both the field procedures, reduction techniques and adjustments for higher order surveys. A field program in which five new stations would be positioned was slated as a "hands-on" demonstration for February 8 through 12, 1982, and is the subject of this report.

FIELD PROCEDURES

Arrangements for the field program were made by Jack Bowers, Assistant Mine Engineer, in late January, 1982. The field program commenced with the arrival of Fred Welter of North West at the mine on February 8, 1982. Five stations had been installed by Cyprus Anvil in optimum locations for future pit expansion, visibility, etc. Those stations were 5 cm x 2 m drill steel drilled into place by an "air-track" and were numbered 20016, and 81063 to 81067 incl. Three stations 1485 (Tri 18), 1483 (Pri 7) and 1486 (Pri 6) in the immediate mine area from the 1979 open pit control survey were used for primary control. 1487 (Pri 4) was not used or checked as it had been disturbed and will be removed by pit expansion.

Two Cyprus Anvil staff surveyors, Darrel Armsworthy and Michelle Cassiede were trained on the use and recording procedures of the Wilde T2 Transit and DI4-L Distance Meter. Second order field procedures in accordance with "Specifications and Recommendations for Control Surveys and Survey Markers - Geodetic Survey of Canada - 1978" were used for the horizontal control. Simultaneous and/or reciprocal vertical angles were observed for elevation differences. Most of the stations were intervisible and all possible horizontal angles and distances were observed. This provided a considerable amount of redundant data but was completed for training, demonstration and testing purposes.

PRELIMINARY REDUCTIONS

All horizontal angles were reduced in the field to ensure they approached second order specifications. The vertical angles were reduced and after correction for curvature and refraction were used to compute elevation differences between the various stations. Distances were corrected for observed meteorological conditions and reduced to the horizontal through elevation differences and further reduced to the elevation of 1485 (Tri 18) of 4356.34'. When extending or working within the control net all measured distances must be reduced to the horizontal and corrected to the grid projection datum of 1485 (Tri 18) as follows:

$$S = \left[D - \left[\frac{DH}{2.095 \times 10^7} \right] - \left[\frac{h^2}{2D} + \frac{h^4}{8D^3} \right] \right] \times 1.000208$$

Where **S** = projection distance in feet.

D = slope length of line in feet.

H = mean elevation of line in feet.

h = elevation difference of line in feet.

1.000208 = factor to adjust sea level distance to datum elevation of Tri 18 - 4356.34'.

When using electromagnetic measuring equipment care must be taken to ensure **H** and **h** values are to the measuring device electrical centre and reflector.

Distances were not reduced for scale factor because of the local grid used.

Some delays due to cold temperatures, wind and fog were experienced in obtaining all of the field data. The field work was completed on February 12, 1982. Preliminary horizontal control coordinate checks were completed in the

field through several test traverses that were angularly balanced from the primary stations and then adjusted by the Compass Rule.

FINAL ADJUSTMENT

The horizontal field data was prepared for a least squares plane grid adjustment by assigning apriori standard deviations to all of the observed data. Horizontal angles observed as three sets were given standard deviations of 2.5". All distances had standard deviations computed on the basis of 5 mm + 5 ppm. A variety of horizontal least squares adjustments were completed to demonstrate the strength and accuracies of trilateration, triangulation and a combination of both. Stations 1483, 1485 and 1486 have been held fixed in all of the tests with the exception of the unconstrained or free adjustment. Four items are reviewed and summarized from those adjustments to compare and evaluate the different methods:

Degrees of Freedom — the number of redundant or extra observations in addition to the required number of observations to solve the position unknowns for the free stations.

95% Confidence Level on Standard Deviation — if realistic apriori standard deviations of the observations are chosen this value should be close or equal to 1.00

Standard Deviation of Adjusted Coordinates of Free Stations — an indication of the positional accuracy.

95% Relative Confidence Ellipses — interstation accuracies with those under 2 being first order, those under 5 second order, etc.

This information is summarized in Table 1.

TABLE 1

	Trilateration	Triangulation	Unconstrained (Free) Trilateration and Triangulation	Constrained Trilateration and Triangulation
Degrees of Freedom	8	45	64	67
95% Confidence Level on Standard Deviation	.338 Reset to 1.000	.898	.824	1.008
Standard Deviation of Adjusted Coordinates of Free Stations	.009N/.009E	.009N/.008E	.005N/.007E	.005N/.004E
95% Relative Confidence Ellipses	Third Order	Third Order	High Second	High Second

The trilateration adjustment has only 8 Degrees of Freedom or 8 redundant measurements and to provide a strong network this ideally should be a minimum of 15. The 95% confidence level on standard deviation is low (.338) which indicates the apriori weighting on the distances is low for this adjustment. This has been reset to 1 to provide realistic values for standard deviations on the adjusted coordinates and relative confidence ellipses.

In the unconstrained or free adjustment we have fixed the position of Station 1483 and the azimuth to 1485. This evaluates the consistency and relative accuracies of the February/82 survey without constraining or adjusting to previous stations. The constrained adjustment is very similar which indicates good comparison and fit with Stations 1483, 1485 and 1486. The 95% confidence level on standard deviations is 1.008 which indicates a realistic apriori weighting. 67 Degrees of Freedom indicates a very strong network. The constrained adjustment is included in Appendix A.

The elevation differences were adjusted in a least squares elevation adjustment. Elevation differences were assigned link weights based on expected trigonometric levelling accuracies. The adjusted elevation matrix indicated maximum standard deviations of .019 m. Again the adjustment indicated satisfactory results as obtained by the reciprocal simultaneous trigonometric levelling procedure. Results of the vertical adjustment are enclosed in Appendix B.

Both the horizontal and vertical adjustment were completed in our Whitehorse office on an HP-85 mini-computer with software provided by our associated company A.E. Petersen Consulting Ltd.

CONCLUSION

The open pit control survey performed in February, 1982, was successfully adjusted using the least squares plane coordinate adjustment and the least squares elevation adjustment. From the relative positions of the interstation error ellipses the network can be classified as second order in accordance with Geodetic Survey of Canada 1978 specifications. As all of the field measurements and subsequent reduction and adjustments were in metres and the Cyprus Anvil Mine operates on imperial measure the final coordinates and elevations in feet are as follows:

Station Number	Mine Coordinates Northings	Mine Coordinates Eastings	Mine Elevations
1483	9,656.21	17,886.09	4772.45
1485	10,701.19	12,298.09	4356.34
1486	6,062.55	14,763.20	4014.26
20016	9,289.00	16,716.38	4346.98
81063	8,264.83	14,395.80	4062.32
81064	7,422.84	14,591.83	4015.75
81065	6,986.84	14,797.90	4028.19
81066	6,702.09	15,290.76	4015.25
81067	7,178.57	15,906.26	4015.66

Coordinates and elevations have been derived from published values of 1483, 1485 and 1486. Measured distances have been reduced to the datum elevation of 1485 (Tri 18). Coordinates have not been corrected for scale factor. Elevations have been derived from the published elevations of 1483, 1485 and 1486.

J.F. Welter, A.L.S., C.L.S.

APPENDIX A

LEAST SQUARES PLANE ADJUSTMENT

CYPRUS ANVIL OPEN PIT CONTROL SURVEY - 1982

MOSFORD , IMPEY , WELTER
AND ASSOCIATES LTD.
LEAST SQUARES ADJUSTMENT
OF PLANE COORDINATES

DATE: February 19, 1982
JOB NUMBER: 1713

CLIENT: CYPRUS ANVIL

RE: OPEN PIT ADJUSTMENT TRIANGULATION

NOTE: COORDINATES MODIFIED TO T minus t PROJECTIONS & SCALE CORRECTIONS
CENTRAL MERIDIAN FACTOR (SCM) = 1.0000
FALSE EASTING (CMX) = 4,500.000

APPROXIMATE COORDINATES:

NO.	STATION	NORTHING	EASTING
1	1483	2,943.212	5,451.681
2	1485	3,261.723	3,748.458
3	1486	1,847.867	4,499.824
4	20016	2,831.244	5,095.128
5	81063	2,519.106	4,552.413
6	81064	2,262.461	4,447.565
7	81065	2,129.566	4,510.374
8	81066	2,042.771	4,660.602
9	81067	2,188.002	4,864.667

NOTE: METRIC UNITS

UPDATED COORDINATES AND CORRECTIONS: iteration # 1

NO.	STATION	NORTHING	CORR.	EASTING	CORR.
1	1483	2,943.212	.000	5,451.680	-.000
2	1485	3,261.723	.000	3,748.458	.000
3	1486	1,847.866	-.001	4,499.824	.000
4	20016	2,831.288	.045	5,095.153	.025
5	81063	2,519.121	.015	4,552.433	.020
6	81064	2,262.481	.020	4,447.590	.025
7	81065	2,129.589	.023	4,510.400	.026
8	81066	2,042.798	.027	4,660.625	.023
9	81067	2,188.029	.027	4,864.687	.021

95% C.L. ON S.D.= 1.619 2.279 EXPECTED VALUE = 1.000

S.D.= 1.893 MEAN RES.= -.097 D.F.= 67

OBSERVATIONS:

NO.	CODE	FROM	TO	OBSERVATION	S.D.	RESIDUAL (adj.-obs.)	STANDARD RESIDUAL
1	DIR.	1483	81067	000 00 00.0	2.5000	-2.463	.985
2	DIR.	1483	1486	003 07 56.8	2.5000	.512	.205
3	DIR.	1483	81066	003 26 33.5	2.5000	.338	.135
4	DIR.	1483	81065	011 18 09.3	2.5000	-.413	.165
5	DIR.	1483	81064	018 00 19.5	2.5000	3.253	1.301
6	DIR.	1483	1485	062 44 04.3	2.5000	-1.227	.491
7	DIR.	1485	1483	000 00 00.0	2.5000	.402	.161
8	DIR.	1485	20016	007 08 01.0	2.5000	-2.394	.958
9	DIR.	1485	81066	042 35 56.8	2.5000	-.395	.158
10	DIR.	1485	81067	033 17 43.2	2.5000	-.618	.247
11	DIR.	1485	81065	045 28 00.0	2.5000	.407	.163
12	DIR.	1485	81064	044 25 43.8	2.5000	.022	.009
13	DIR.	1485	1486	051 25 10.7	2.5000	2.577	1.031
14	DIR.	1486	1485	000 00 00.0	2.5000	-4.566	1.826
15	DIR.	1486	20016	059 10 33.8	2.5000	-2.151	.860
16	DIR.	1486	81066	067 30 19.3	2.5000	1.222	.489
17	DIR.	1486	1483	068 58 30.7	2.5000	6.104	2.442 ###
18	DIR.	1486	81067	074 59 34.7	2.5000	-.609	.243
19	DIR.	20016	81066	000 00 00.0	2.5000	3.667	1.467
20	DIR.	20016	1486	002 19 51.2	2.5000	2.477	.991
21	DIR.	20016	81065	010 56 52.8	2.5000	.314	.126
22	DIR.	20016	81064	019 50 50.8	2.5000	-1.953	.781
23	DIR.	20016	1485	078 52 07.3	2.5000	-4.505	1.802
24	DIR.	81063	81067	000 00 00.0	2.5000	-1.360	.544
25	DIR.	81063	81066	030 31 30.7	2.5000	.661	.265
26	DIR.	81063	81065	049 28 50.5	2.5000	1.650	.660
27	DIR.	81063	81064	065 32 36.0	2.5000	.698	.279
28	DIR.	81063	81067	000 00 00.0	2.5000	-1.360	.544
29	DIR.	81063	81066	030 31 31.7	2.5000	-.339	.135
30	DIR.	81063	81065	049 28 53.8	2.5000	-1.650	.660
31	DIR.	81063	81064	065 32 35.0	2.5000	1.698	.679
32	DIR.	81064	81063	000 00 00.0	2.5000	-1.506	.603
33	DIR.	81064	20016	026 29 00.8	2.5000	-1.967	.787
34	DIR.	81064	1483	033 38 29.0	2.5000	5.258	2.103 ###
35	DIR.	81064	81067	077 53 55.8	2.5000	1.706	.682
36	DIR.	81064	81066	113 39 29.7	2.5000	1.611	.644
37	DIR.	81064	81065	132 28 53.0	2.5000	-.395	.158
38	DIR.	81064	1485	302 48 02.7	2.5000	-4.707	1.883
39	DIR.	81065	81063	000 00 00.0	2.5000	3.885	1.554
40	DIR.	81065	20016	033 38 52.5	2.5000	.538	.215
41	DIR.	81065	1483	043 00 11.7	2.5000	-1.369	.548
42	DIR.	81065	81067	074 28 31.8	2.5000	.885	.354
43	DIR.	81065	1485	319 54 07.8	2.5000	-3.283	1.313
44	DIR.	81065	81064	328 32 43.2	2.5000	-.656	.262
45	DIR.	81066	1485	000 00 00.0	2.5000	-8.310	3.324 ###
46	DIR.	81066	81063	024 00 35.0	2.5000	-.730	.292
47	DIR.	81066	1483	078 06 21.5	2.5000	4.957	1.983
48	DIR.	81066	81067	091 21 59.2	2.5000	2.946	1.178
49	DIR.	81066	1486	256 19 31.5	2.5000	2.149	.859

50	DIR.	81066	81064	352	41	13.5	2.5000	-1.076	.431
51	DIR.	81066	20016	065	39	54.7	2.5000	.065	.026
52	DIR.	81067	81063	000	00	00.0	2.5000	-1.702	.681
53	DIR.	81067	81066	277	53	01.5	2.5000	-2.606	1.043
54	DIR.	81067	81065	303	57	25.2	2.5000	-4.592	1.837
55	DIR.	81067	81064	323	26	40.3	2.5000	-4.933	1.973
56	DIR.	81067	81063	000	00	00.0	2.5000	-1.702	.681
57	DIR.	81067	1483	081	10	43.8	2.5000	3.103	1.241
58	DIR.	81067	1486	270	19	43.8	2.5000	.166	.066
59	DIR.	81067	81066	277	52	56.7	2.5000	2.194	.877
60	DIR.	81067	81065	303	57	17.5	2.5000	3.108	1.243
61	DIR.	81067	81064	323	26	32.0	2.5000	3.367	1.347
62	DIR.	81067	1485	357	12	31.3	2.5000	3.316	1.326
63	DIR.	81067	81063	000	00	00.0	2.5000	-1.702	.681
64	DIR.	81067	1483	081	10	42.3	2.5000	4.603	1.841
65	DIR.	81067	1486	270	19	43.5	2.5000	.466	.186
~~66~~	~~DIR~~	~~81067~~	~~1485~~	~~357~~	~~12~~	~~37.7~~	~~2.5000~~	~~3.084~~	~~1.234~~
67	NORTH.	1483	1483			2,943.212	.0010	.000	.376
68	EAST.	1483	1483			5,451.681	.0010	-.001	.530
69	NORTH.	1485	1485			3,261.723	.0010	.000	.454
70	EAST.	1485	1485			3,748.458	.0010	.000	.422
71	NORTH.	1486	1486			1,847.867	.0010	-.001	.830
72	EAST.	1486	1486			4,499.824	.0010	.000	.108
73	DIST.	1485	1486			1,601.115	.0130	-.008	.635
74	DIST.	1485	20016			1,413.804	.0120	.007	.559
75	DIST.	1485	81064			1,219.537	.0110	-.000	.040
76	DIST.	1485	81067			1,548.803	.0130	-.001	.068
77	DIST.	1486	20016			1,149.589	.0110	-.008	.745
78	DIST.	81063	81064			277.222	.0060	.007	1.164
79	DIST.	81063	81065			391.789	.0070	.004	.627
80	DIST.	81063	81066			488.447	.0070	.009	1.241
81	DIST.	81063	81067			455.108	.0070	.002	.280
82	DIST.	81064	20016			861.915	.0090	-.010	1.165
83	DIST.	81065	81064			146.987	.0060	.001	.210
84	DIST.	81065	20016			913.412	.0100	-.002	.163
85	DIST.	81066	1486			252.703	.0060	-.007	1.134
86	DIST.	81066	20016			900.296	.0100	-.001	.063
87	DIST.	81066	81064			306.016	.0060	-.002	.310
88	DIST.	81067	81064			423.699	.0070	-.009	1.230
89	DIST.	81067	81065			359.076	.0070	-.001	.159
90	DIST.	81067	81066			250.469	.0060	-.003	.447
91	DIST.	81067	1486			498.845	.0070	-.011	1.528
92	DIST.	1483	1486			1,451.148	.0120	-.006	.479
93	DIST.	1483	81064			1,213.089	.0110	.003	.277
94	DIST.	1483	81067			956.474	.0100	.011	1.097

UPDATED COORDINATES AND CORRECTIONS: iteration # 2

NO.	STATION	NORTHING	CORR.	EASTING	CORR.
1	1483	2,943.212	.000	5,451.680	-.000
2	1485	3,261.723	.000	3,748.458	.000

3	1486	1,847.866	-.000	4,499.824	.000
4	20016	2,831.288	.000	5,095.153	-.000
5	B1063	2,519.121	-.000	4,552.433	.000
6	B1064	2,262.481	-.000	4,447.590	.000
7	B1065	2,129.589	-.000	4,510.400	.000
8	B1066	2,042.798	-.000	4,660.625	.000
9	B1067	2,188.029	-.000	4,864.687	.000

95% C.L. ON S.D.= 1.008 1.419 EXPECTED VALUE = 1.000

S.D.= 1.179 MEAN RES.= -.029 D.F.= 67

ADJUSTED COORDINATES AND STANDARD DEVIATIONS:

NO.	STATION	NORTHING	S.D.	EASTING	S.D.
1	1483	2,943.212	.0012	5,451.680	.0012
2	1485	3,261.723	.0012	3,748.458	.0012
3	1486	1,847.866	.0012	4,499.824	.0012
4	20016	2,831.288	.0069	5,095.153	.0062
5	B1063	2,519.121	.0047	4,552.433	.0043
6	B1064	2,262.481	.0040	4,447.590	.0039
7	B1065	2,129.589	.0041	4,510.400	.0042
8	B1066	2,042.798	.0037	4,660.625	.0034
9	B1067	2,188.029	.0039	4,864.687	.0036

ERROR ELLIPSE MULIPLIER = 2.504

95% CONFIDENCE ELLIPSES:

NO.	STATION	SEMI-MAJOR AXIS	SEMI-MINOR AXIS	AZIMUTH OF MAJOR AXIS
1	1483	.003	.003	-30.8
2	1485	.003	.003	54.2
3	1486	.003	.003	90.0
4	20016	.018	.015	-24.3
5	B1063	.012	.010	29.5
6	B1064	.010	.009	42.3
7	B1065	.011	.010	53.4
8	B1066	.011	.006	40.7
9	B1067	.011	.007	39.5

95% RELATIVE CONFIDENCE ELLIPSES:

ELLIPSES OVER ORDER 2 ARE FLAGGED WITH ###
ACC.FACTOR UNDER: 2=FIRST; 5=2ND; 12=3RD; 30=4TH ORDER

LINE STN - STN	SEMI-MAJOR AXIS	SEMI-MINOR AXIS	AZIMUTH OF MAJOR AXIS (deg)	LINE AZIMUTH (deg)	AZIMUTH ACCURACY (sec)	LENGTH ACCURACY	ACCURACY FACTOR
1483 - 1485	.004	.004	8.2	280.6	.5	.004	.214
1483 - 1486	.004	.004	-66.0	221.0	.6	.004	.250
1483 - 20016	.018	.015	-23.8	252.6	9.8	.015	3.084
1483 - 81063	.012	.011	29.3	244.8	2.3	.012	1.025
1483 - 81064	.011	.010	42.2	235.9	1.7	.011	.755
1483 - 81065	.011	.010	55.0	229.2	1.7	.011	.781
1483 - 81066	.011	.007	41.4	221.3	1.1	.011	.799
1483 - 81067	.011	.007	40.4	217.9	1.6	.011	.988
1485 - 1486	.004	.004	74.0	152.0	.5	.004	.229
1485 - 20016	.018	.015	-22.6	107.7	2.4	.016	1.103
1485 - 81063	.012	.011	28.1	132.7	2.3	.011	.946
1485 - 81064	.011	.010	42.2	145.0	1.8	.010	.752
1485 - 81065	.011	.010	53.9	146.1	1.7	.010	.723
1485 - 81066	.011	.007	40.7	143.2	1.5	.007	.653
1485 - 81067	.012	.008	39.2	133.9	1.5	.008	.659
1486 - 20016	.018	.015	-26.4	31.2	3.0	.016	1.308
1486 - 81063	.012	.010	31.3	4.5	3.3	.012	1.371
1486 - 81064	.010	.009	42.6	352.8	4.9	.010	1.680
1486 - 81065	.011	.010	51.8	2.1	7.6	.010	2.275
1486 - 81066	.011	.006	40.2	39.5	4.7	.011	2.390
1486 - 81067	.011	.007	38.9	47.0	2.9	.011	1.592
20016 - 81063	.018	.015	-18.6	240.1	5.8	.015	2.134
20016 - 81064	.018	.014	-33.6	228.7	4.2	.014	1.651
20016 - 81065	.018	.014	-41.0	219.8	4.0	.014	1.605
20016 - 81066	.017	.015	-44.4	208.9	3.8	.015	1.507
20016 - 81067	.016	.015	-43.5	199.7	4.9	.015	1.853
81063 - 81064	.008	.007	18.8	202.2	5.2	.008	1.778
81063 - 81065	.009	.009	-9.4	186.2	4.6	.009	1.597
81063 - 81066	.010	.009	23.2	167.2	4.0	.010	1.418
81063 - 81067	.009	.009	-53.8	136.7	4.0	.009	1.401
81064 - 81065	.008	.004	-25.1	154.7	5.7	.008	2.375
81064 - 81066	.008	.007	-30.4	135.9	4.7	.008	1.580
81064 - 81067	.008	.008	-58.7	100.1	3.7	.008	1.336
81065 - 81066	.008	.007	-40.2	120.0	8.8	.008	2.254
81065 - 81067	.009	.007	-71.7	80.6	4.4	.008	1.553
81066 - 81067	.008	.005	50.8	54.6	4.2	.008	1.808

TIME USED: 0 41 14

APPENDIX B

VERTICAL ADJUSTMENT

CYPRUS ANVIL OPEN PIT CONTROL SURVEY - 1982

HOSFORD, IMPEY, WELTER
AND ASSOCIATES LTD.
LEAST SQUARES ADJUSTMENT
OF ELEVATIONS

DATE: March 2, 1982

JOB NUMBER: 1713

NUMBER OF LINKS = 22
NUMBER OF STATIONS = 9
NUMBER OF FIXED STATIONS = 3

APPROXIMATE STATION ELEVATIONS:

NO.	NAME	ELEVATION
1	20016	1,324.950
2	81063	1,238.200
3	81064	1,224.000
4	81065	1,227.790
5	81066	1,223.860
6	81067	1,223.990
7	1483	1,454.642
8	1485	1,327.812
9	1486	1,223.547

LINK ELEVATION DATA:

NO.	FROM	TO	ELEV DIFF	INV WEIGHT
1	1485	1486	-104.194	.07700
2	1485	20016	-2.854	.00200
3	1485	81064	-103.802	.00100
4	1485	81067	-103.897	.00200
5	1486	20016	101.407	.01300
6	81063	81064	-14.198	.00100
7	81063	81065	-10.400	.00200
8	81063	81066	-14.349	.00200
9	81063	81067	-14.216	.00200
10	81064	20016	100.956	.00800
11	81065	81064	-3.790	.00020
12	81065	20016	97.180	.00800
13	81066	1486	-.305	.00006
14	81066	20016	101.101	.00800
15	81066	81064	.151	.00090
16	81067	81064	.020	.01800
17	81067	81065	3.827	.00100
18	81067	81066	-.129	.00006
19	81067	1486	-.441	.00200
20	1483	1486	-231.320	.06500
21	1483	81064	-230.667	.00200
22	1483	81067	-230.707	.00100

ADJUSTED STATION ELEVATIONS:

NO.	NAME	ELEVATION	S.D.
1	20016	1324.9582	.0186
2	81063	1238.1951	.0129
3	81064	1224.0004	.0092
4	81065	1227.7920	.0104
5	81066	1223.8482	.0041
6	81067	1223.9733	.0054
7	1483	1454.6420	0.0000
8	1485	1327.8120	0.0000
9	1486	1223.5470	0.0000

LINK RESIDUALS AND S.D.:

LINE NO.	FROM	TO	ADJ-EL DIFF	OBS-EL DIFF	RESIDUAL OBS-ADJ	INVERSE WEIGHT	LINK S.D.
1	1485	1486	-104.265	-104.194	.071	.07700	0.0000
2	1485	20016	-2.854	-2.854	-.000	.00200	.0186
3	1485	81064	-103.812	-103.802	.010	.00100	.0092
4	1485	81067	-103.839	-103.897	-.058	.00200	.0054
5	1486	20016	101.411	101.407	-.004	.01300	.0186
6	81063	81064	-14.195	-14.198	-.003	.00100	.0121
7	81063	81065	-10.403	-10.400	.003	.00200	.0129
8	81063	81066	-14.347	-14.349	-.002	.00200	.0126
9	81063	81067	-14.222	-14.216	.006	.00200	.0127
10	81064	20016	100.958	100.956	-.002	.00800	.0197
11	81065	81064	-3.792	-3.790	.002	.00020	.0073
12	81065	20016	97.166	97.180	.014	.00800	.0201
13	81066	1486	-.301	-.305	-.004	.00006	.0041
14	81066	20016	101.110	101.101	-.009	.00800	.0188
15	81066	81064	.152	.151	-.001	.00090	.0090
16	81067	81064	.027	.020	-.007	.01800	.0094
17	81067	81065	3.819	3.827	.008	.00100	.0103
18	81067	81066	-.125	-.129	-.004	.00006	.0041
19	81067	1486	-.426	-.441	-.015	.00200	.0054
20	1483	1486	-231.095	-231.320	-.225	.06500	0.0000
21	1483	81064	-230.642	-230.667	-.025	.00200	.0092
22	1483	81067	-230.669	-230.707	-.038	.00100	.0054

MEAN RESIDUAL = -.00410 STD ERROR = .56922

CONCLUSION

The open pit control survey performed in February, 1982, was successfully adjusted using the least squares plane coordinate adjustment and the least squares elevation adjustment. From the relative positions of the interstation error ellipses the network can be classified as second order in accordance with Geodetic Survey of Canada 1978 specifications. As all of the field measurements and subsequent reduction and adjustments were in metres and the Cyprus Anvil Mine operates on imperial measure the final coordinates and elevations in feet are as follows:

Station Number	Mine Coordinates Northings	Mine Coordinates Eastings	Mine Elevations
1483	9,656.21	17,886.09	4772.45
1485	10,701.19	12,298.09	4356.34
1486	6,062.55	14,763.20	4014.26
20016	9,289.00	16,716.38	4346.98
81063	8,264.83	14,935.80	4062.32
81064	7,422.84	14,591.83	4015.75
81065	6,986.84	14,797.90	4028.19
81066	6,702.09	15,290.76	4015.25
81067	7,178.57	15,960.26	4015.66

Coordinates and elevations have been derived from published values of 1483, 1485 and 1486. Measured distances have been reduced to the datum elevation of 1485 (Tri 18). Coordinates have not been corrected for scale factor. Elevations have been derived from the published elevations of 1483, 1485 and 1486.

J.F. Welter, A.L.S., C.L.S.