

May 27, 2010

Karen Furlong
Project Manager
Assessment and Abandoned Mines

Our File:36528

BY Email (2 originals to follow)

Dear Ms. Furlong:

Re: Control Report Faro Mine Site, Yukon

On May 25 and 26, 2010 we completed the control work on the Faro Mine Site. During this work we placed 9 Permanent Control monuments. 8 of these locations were positioned based on coordinates and instructions provided by YTG and Denison Environmental Services.

Monument Placement

At each of the 8 locations we searched for the most stable position to place the control monument. 1 additional monument was placed near the Faro sign in the employee parking lot. This location was selected for ease of use for future users and stability.

All monuments have been installed with grout. Where the monuments are placed in solid rock we drilled a $\frac{3}{4}$ " hole and filled the hole with grout before installing the rebar. The top of the hole was also finished with grout. Where we drilled into shale type rocks we installed a $\frac{3}{4}$ " rebar in the $\frac{3}{4}$ " hole with grout. In the cases where the rock was solid we installed $\frac{5}{8}$ " rebar in the $\frac{3}{4}$ " hole with grout due to being unable to drive $\frac{3}{4}$ " rebar into a $\frac{3}{4}$ " hole. Rebar installed into rock is 0.6 meters long.

Where monuments were installed into very compact rocky ground (2010-P7 and 2010-P8) we drilled a $\frac{3}{4}$ " hole 0.6 meters deep and drove a 1.0 meter long $\frac{3}{4}$ inch rebar into the hole. Before installation we filled the drilled hole with grout. We also excavated around the top of the rebar and poured a large grout plug around the rebar. At 2010-P8 we backfilled over the grout plug with surrounding gravel.

All control monuments with the exception of 2010-P8 have been marked by a orange angle iron at least 1.0 meters tall and approximately 0.3 meters from the control monument. Affixed to the top of the angle iron is a white marker plate that has been stamped with the control point number. In the case of 2010-P8 we affixed the plate to a large boulder adjacent to the control monument.

The center of the top of the monument is the coordinate location. We did not punch a mark into the top of the rebar as we felt this may cause uncertainty as to the coordinate location. We were also concerned that in the future a punch mark may not be obvious.

Method of Survey

Coordinates are based on Precise Point Positioning (PPP) solutions at 2010-P3 and 2010-P7. PPP is an online service offered by environment Canada which processes raw GPS data and provides coordinates and their uncertainties as an output.

All control monuments were observed with static GPS. We measured the following vectors;

- 1) **From 2010-P1** to 2010-P2, 2010-P3, 2010-P4, 2010-P5
- 2) **From 2010-P2** to 2010-P1, 2010-P3
- 3) **From 2010-P3** to 2010-P1, 2010-P2, 2010-P4, 2010-P5
- 4) **From 2010-P4** to 2010-P1, 2010-P3, 2010-P5, 2010-P6, 2010-P7
- 5) **From 2010-P5** to 2010-P1, 2010-P3, 2010-P4, 2010-P6, 2010-P7
- 6) **From 2010-P6** to 2010-P4, 2010-P5, 2010-P7, 2010-P8
- 7) **From 2010-P7** to 2010-P4, 2010-P5, 2010-P6, 2010-P8, 2010-P9
- 8) **From 2010-P8** to 2010-P6, 2010-P7, 2010-P9
- 9) **From 2010-P9** to 2010-P6, 2010-P7, 2010-P8

All observations were integrated into a least squares weighted adjustment. The PPP derived positions of 2010-P3 and 2010-P7 were held fixed in this adjustment. Our survey featured many redundant vectors in order to ensure its accuracy and control for blunders.

The attached network adjustment report lists the coordinate values (and their uncertainties at 95%) that resulted from our adjustment. We note that the largest baseline residual was 0.007 meters. This residual represents the difference between the observed raw vector and the computed vector between the adjusted coordinates. We also note that the maximum absolute error ellipse (at 95%) has a semi-major axis of 0.008 meters.

Please note that the adjustment report only outputs ellipsoidal heights. The attached Excel document provides the orthometric heights required.

For each control monument we have published an associated Combined Scale Factor (CSF). The combined scale factor for a monument is the product of the Grid Scale Factor and the Height Scale Factor. For the Faro Mine Site we recommend the use of **0.9995050** as the Combined Scale Factor. We note that there is little difference between the CSF at the Faro Pit and that at the Vangorda pit although they are 15 km apart.

As a check on our adjustment we have submitted our raw data for 2010-P6 to PPP. We note a 0.015 meter discrepancy from the adjusted position of 2010-P6 which is consistent with the uncertainty of the PPP solution at 2010-P6.

Use of Primary Control in the Future

The 8 control supplied control location were chosen to provide safety to the monuments both in terms of their stability and their susceptibility to disturbance by work on site. As such the majority of these monuments are not convenient to access for day to day work.

In the future it is our assumption that survey contractors will be required to build their own secondary control networks in more accessible locations using the primary control as their reference. Should their secondary control be damaged or become suspect they will be able to reference back to the primary control as needed. We suggest that a minimum of three primary control monuments be used to coordinate a secondary control network.

We note that with the use of PPP another primary control point could be added with as little as four hours of GPS data. If this is done Epoch 2002 should be selected as the epoch to be consistent with the data provided in this report.

Please contact me at 668-6940 if you have any questions.

Yours Truly,

A handwritten signature in blue ink, appearing to read 'P. Burbidge', with a stylized flourish at the end.

CHALLENGER GEOMATICS LTD.

Paul Burbidge, CLS.
North 60 Office
Whitehorse, Yukon

Point ID	Northing	Easting	Elevation	CSF
2010-P1	6903674.985	593404.152	1161.318	0.9995245
2010-P2	6903011.386	594428.246	1147.693	0.9995290
2010-P3	6904045.086	591649.347	1317.985	0.9994960
2010-P4	6914202.677	582192.825	1118.245	0.9995070
2010-P5	6914557.921	580635.174	1060.480	0.9995129
2010-P6	6915038.777	585268.975	1295.486	0.9994856
2010-P7	6915185.357	583895.571	1255.613	0.9994890
2010-P8	6914508.159	582531.715	1138.237	0.9995046
2010-P9	6913817.662	580089.029	1084.706	0.9995081

Coordinates are UTM NAD83 CSRS Epoch 2002 and are derived from PPP solutions at 2010-P3 and 2010-P7

Elevations are Orthometric and are based on the HT2 Geoid Model

CSF is the combined scale factor for the point

Point ID	Location	Accessibilty	Stability
2010-P1	Sheep Pad	7	8
2010-P2	Vangorda	6	9
2010-P3	Grum Waste Pile	7	10
2010-P4	Main Road	8	8
2010-P5	CVP	7	10
2010-P6	Faro East	4	8
2010-P7	Faro West	10	8
2010-P8	Faro Site Sign	10	7
2010-P9	Rose Creek	1	10

Accessibility (1-10)

1=may not be accessible year round due to creek crossing

4= may require waders or low water for easy access

6-8= Short walk required for access from truck

10= Can drive to point

Stability (1-10)

1-4= Not suitable for permanent control

5-6= Reasonabale stability for permanent control

7-8= Very good stability in large embedded boulder, shale etc.

9-10= Extremely good stability in bedrock

Paul Burbidge

From: CSRS-PPP [information@geod.nrcan.gc.ca]
Sent: Thursday, May 27, 2010 9:19 AM
To: pburbidge@chalgeo.com
Subject: CSRS-PPP Results for 2010-P70
Importance: High

Results of your CSRS-PPP processing can be downloaded by clicking on the following link:

http://webapp.csrs.nrcan.gc.ca/ppp_data/20100527_0257_2010-P70/20100527_0257_2010-P70_full_output.zip

~~~~~ 2010-P70

The estimated coordinates / standard deviations for the 2010-P70 RINEX file are as follow:

Latitude (NAD83(CSRS)2002): 62 21 31.1010 (dms) / 0.013 (m) Longitude (NAD83(CSRS)2002): -133 22 44.5343 (dms) / 0.013 (m) Ellipsoidal Height (NAD83(CSRS)2002): 1261.070 (m) / 0.026 (m)

UTM (North) Northing: 6915185.357m Easting: 583895.571m Zone: 8 Scale Factor: 0.99969

MTM (North) Northing: 6916970.232m Easting: 233402.754m Zone: 29 Scale Factor: 0.99996

Orthometric Height CGVD28 (HTv2.0): 1255.613 m

URL to PDF summary file:

[http://webapp.csrs.nrcan.gc.ca/ppp\\_data/20100527\\_0257\\_2010-P70/zip\\_dir\\_1/2010-P70.pdf](http://webapp.csrs.nrcan.gc.ca/ppp_data/20100527_0257_2010-P70/zip_dir_1/2010-P70.pdf)

URL to file of observations residual and satellites azimuth and elevation:

[http://webapp.csrs.nrcan.gc.ca/ppp\\_data/20100527\\_0257\\_2010-P70/zip\\_dir\\_1/2010-P70\\_res.zip](http://webapp.csrs.nrcan.gc.ca/ppp_data/20100527_0257_2010-P70/zip_dir_1/2010-P70_res.zip)

GPS Orbits & Clocks Used: NRCAN Hourly

Velocity Model for NAD83(CSRS) "2002 01 01" epoch transformation: velgsb\_v1.0

WGS84 ellipsoid used for (x,y,z) to (lat,long,h) transformation

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Software Version: 1.04 1087

If you have any questions, please feel free to contact:

Geodetic Survey Division

Canada Centre for Remote Sensing

Natural Resources Canada

Government of Canada

615 Booth Street, Room 440

Ottawa, Ontario K1A 0E9

Phone: 613-995-4410 FAX: 613-995-3215

Email: information@geod.nrcan.gc.ca

Paul Burbidge

From: CSRS-PPP [information@geod.nrcan.gc.ca]
Sent: Thursday, May 27, 2010 10:06 AM
To: pburbidge@chalgeo.com
Subject: CSRS-PPP Results for 2010-P2
Importance: High

Results of your CSRS-PPP processing can be downloaded by clicking on the following link:

http://webapp.csrs.nrcan.gc.ca/ppp_data/20100527_0261_2010-P2/20100527_0261_2010-P2_full_output.zip

~~~~~ 2010-P2

The estimated coordinates / standard deviations for the 2010-P2 RINEX file are as follow:

Latitude (NAD83(CSRS)2002): 62 15 24.7144 (dms) / 0.019 (m) Longitude (NAD83(CSRS)2002): -133 14 06.6312 (dms) / 0.024 (m) Ellipsoidal Height (NAD83(CSRS)2002): 1323.157 (m) / 0.043 (m)

UTM (North) Northing: 6904045.086m Easting: 591649.347m Zone: 8 Scale Factor: 0.99970

MTM (North) Northing: 6905479.549m Easting: 240633.760m Zone: 29 Scale Factor: 0.99995

Orthometric Height CGVD28 (HTv2.0): 1317.985 m

URL to PDF summary file:

[http://webapp.csrs.nrcan.gc.ca/ppp\\_data/20100527\\_0261\\_2010-P2/zip\\_dir\\_1/2010-P2.pdf](http://webapp.csrs.nrcan.gc.ca/ppp_data/20100527_0261_2010-P2/zip_dir_1/2010-P2.pdf)

URL to file of observations residual and satellites azimuth and elevation:

[http://webapp.csrs.nrcan.gc.ca/ppp\\_data/20100527\\_0261\\_2010-P2/zip\\_dir\\_1/2010-P2\\_res.zip](http://webapp.csrs.nrcan.gc.ca/ppp_data/20100527_0261_2010-P2/zip_dir_1/2010-P2_res.zip)

GPS Orbits & Clocks Used: NRCan Hourly

Velocity Model for NAD83(CSRS) "2002 01 01" epoch transformation: velgsb\_v1.0

WGS84 ellipsoid used for (x,y,z) to (lat,long,h) transformation

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Software Version: 1.04 1087

If you have any questions, please feel free to contact:

Geodetic Survey Division

Canada Centre for Remote Sensing

Natural Resources Canada

Government of Canada

615 Booth Street, Room 440

Ottawa, Ontario K1A 0E9

Phone: 613-995-4410 FAX: 613-995-3215

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NB: HEIGHTS IN THIS REPORT ARE
ELLIPSOIDAL. SEE EXCEL REPORT FOR
ORTHOMETRIC
HEIGHTS.



Network Adjustment

www.MOVE3.com

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Created: 05/27/2010 10:32:31

Project Information

Project name: 36528 Faro Control
Date created: 05/27/2010 08:51:18
Time zone: -8h 00'
Coordinate system name: NAD 83 ZONE 8
Application software: LEICA Geo Office 6.0
Processing kernel: MOVE3 3.4

General Information

Adjustment

Type: Constrained
Dimension: 3D
Coordinate system: WGS 1984
Height mode: Ellipsoidal

Number of iterations: 1
Maximum coord correction in last iteration: 0.0000 m ✓ (tolerance is met)

Stations

Number of (partly) known stations: 2
Number of unknown stations: 7
Total: 9

Observations

GPS coordinate differences: 54 (18 baselines)
Known coordinates: 6
Total: 60

Unknowns

Coordinates: 27
Total: 27

Degrees of freedom: 33

Testing

Alfa (multi dimensional): 0.4974
Alfa 0 (one dimensional): 5.0 %
Beta: 80.0 %
Sigma a-priori (GPS): 10.0

Critical value W-test:	1.96	
Critical value T-test (2-dimensional):	2.42	
Critical value T-test (3-dimensional):	1.89	
Critical value F-test:	0.98	
F-test:	0.29	✓ (accepted)

Results based on a-posteriori variance factor

Adjustment Results

Coordinates

Station		Coordinate	Corr	Prec (95%)	
2010-P1	Easting	593404.1521 m	-0.0007 m	0.0026 m	
	Northing	6903674.9848 m	0.0045 m	0.0041 m	
	Height	1166.4442 m	-0.0048 m	0.0077 m	
2010-P2	Easting	594428.2457 m	-0.0004 m	0.0036 m	
	Northing	6903011.3859 m	0.0028 m	0.0063 m	
	Height	1152.7768 m	-0.0027 m	0.0122 m	
2010-P3	Easting	591649.3470 m	0.0000 m	-	fixed
	Northing	6904045.0860 m	0.0000 m	-	fixed
	Height	1323.1570 m	0.0000 m	-	fixed
2010-P4	Easting	582192.8249 m	-0.0042 m	0.0015 m	
	Northing	6914202.6772 m	-0.0093 m	0.0023 m	
	Height	1123.7161 m	0.0140 m	0.0039 m	
2010-P5	Easting	580635.1738 m	-0.0027 m	0.0013 m	
	Northing	6914557.9213 m	-0.0044 m	0.0020 m	
	Height	1065.9792 m	0.0086 m	0.0037 m	
2010-P6	Easting	585268.9750 m	-0.0010 m	0.0011 m	
	Northing	6915038.7767 m	-0.0015 m	0.0016 m	
	Height	1300.9178 m	0.0023 m	0.0028 m	
2010-P7	Easting	583895.5710 m	0.0000 m	-	fixed
	Northing	6915185.3570 m	0.0000 m	-	fixed
	Height	1261.0700 m	0.0000 m	-	fixed
2010-P8	Easting	582531.7147 m	-0.0002 m	0.0011 m	
	Northing	6914508.1592 m	-0.0003 m	0.0015 m	
	Height	1143.7059 m	0.0006 m	0.0026 m	
2010-P9	Easting	580089.0292 m	-0.0002 m	0.0019 m	
	Northing	6913817.6616 m	-0.0004 m	0.0026 m	
	Height	1090.2054 m	0.0006 m	0.0039 m	

Observations and Residuals

	Station	Target	Adj obs	Resid	Resid (ENH) Sd	
DX	2010-P9	2010-P7	3511.4754 m	0.0009 m	0.0007 m	0.0013 m
DY			-1877.1439 m	-0.0001 m	0.0009 m	0.0011 m
DZ			742.8548 m	0.0008 m	0.0004 m	0.0019 m
DX	2010-P5	2010-P6	3524.1659 m	0.0006 m	0.0006 m	0.0011 m
DY			-3036.0579 m	-0.0002 m	0.0005 m	0.0010 m
DZ			377.9811 m	0.0004 m	0.0002 m	0.0021 m
DX	2010-P4	2010-P6	2656.8311 m	-0.0040 m	0.0006 m	0.0012 m
DY			-1698.5985 m	-0.0051 m	-0.0061 m	0.0012 m

DZ			509.3009 m	-0.0010 m	0.0021 m	0.0023 m
DX	2010-P4	2010-P5	-867.3348 m	0.0003 m	-0.0004 m	0.0009 m
DY			1337.4594 m	0.0008 m	0.0012 m	0.0010 m
DZ			131.3198 m	0.0011 m	0.0006 m	0.0019 m
DX	2010-P1	2010-P5	-2240.0775 m	-0.0042 m	0.0057 m	0.0022 m
DY			15826.9558 m	-0.0128 m	-0.0049 m	0.0025 m
DZ			5124.0462 m	0.0125 m	0.0167 m	0.0055 m
DX	2010-P1	2010-P4	-1372.7427 m	0.0040 m	0.0103 m	0.0020 m
DY			14489.4964 m	-0.0107 m	-0.0124 m	0.0024 m
DZ			4992.7264 m	-0.0170 m	-0.0127 m	0.0053 m
DX	2010-P2	2010-P1	-318.2101 m	-0.0010 m	0.0011 m	0.0025 m
DY			1130.3229 m	-0.0026 m	-0.0021 m	0.0026 m
DZ			334.4264 m	0.0005 m	0.0017 m	0.0062 m
DX	2010-P6	2010-P9	-4384.4292 m	0.0043 m	0.0029 m	0.0014 m
DY			2948.0495 m	0.0003 m	0.0025 m	0.0012 m
DZ			-694.0272 m	-0.0006 m	-0.0020 m	0.0021 m
DX	2010-P9	2010-P8	2153.8266 m	0.0006 m	0.0005 m	0.0013 m
DY			-1303.0410 m	-0.0001 m	-0.0001 m	0.0011 m
DZ			340.3562 m	-0.0008 m	-0.0009 m	0.0019 m
DX	2010-P8	2010-P6	2230.6026 m	0.0006 m	-0.0001 m	0.0010 m
DY			-1645.0085 m	0.0008 m	0.0003 m	0.0008 m
DZ			353.6710 m	-0.0012 m	-0.0015 m	0.0016 m
DX	2010-P3	2010-P5	-1172.1989 m	-0.0095 m	-0.0097 m	0.0017 m
DY			14415.4183 m	0.0041 m	-0.0074 m	0.0018 m
DZ			4790.5468 m	-0.0092 m	-0.0065 m	0.0043 m
DX	2010-P3	2010-P4	-304.8641 m	0.0001 m	-0.0010 m	0.0015 m
DY			13077.9589 m	0.0016 m	0.0024 m	0.0016 m
DZ			4659.2270 m	0.0027 m	0.0019 m	0.0040 m
DX	2010-P3	2010-P2	1386.0887 m	-0.0020 m	0.0012 m	0.0026 m
DY			-2541.8604 m	-0.0039 m	-0.0033 m	0.0028 m
DZ			-667.9257 m	0.0010 m	0.0029 m	0.0062 m
DX	2010-P3	2010-P1	1067.8786 m	0.0001 m	0.0012 m	0.0016 m
DY			-1411.5375 m	-0.0016 m	-0.0013 m	0.0020 m
DZ			-333.4994 m	-0.0007 m	-0.0001 m	0.0039 m
DX	2010-P7	2010-P8	-1357.6488 m	0.0000 m	-0.0001 m	0.0007 m
DY			574.1029 m	0.0003 m	0.0001 m	0.0006 m
DZ			-402.4986 m	-0.0002 m	-0.0003 m	0.0013 m
DX	2010-P7	2010-P6	872.9538 m	0.0004 m	0.0001 m	0.0008 m
DY			-1070.9056 m	0.0002 m	0.0006 m	0.0007 m
DZ			-48.8276 m	0.0004 m	0.0002 m	0.0014 m
DX	2010-P7	2010-P5	-2651.2121 m	0.0008 m	0.0011 m	0.0009 m
DY			1965.1523 m	-0.0008 m	-0.0009 m	0.0009 m
DZ			-426.8087 m	-0.0020 m	-0.0017 m	0.0020 m
DX	2010-P7	2010-P4	-1783.8773 m	-0.0038 m	-0.0028 m	0.0012 m
DY			627.6929 m	0.0001 m	0.0004 m	0.0012 m
DZ			-558.1285 m	0.0059 m	0.0064 m	0.0023 m

GPS Baseline Vector Residuals

	Station	Target	Adj vector [m]	Resid [m]	Resid [ppm]
DV	2010-P9	2010-P7	4050.4274	0.0012	0.3
DV	2010-P5	2010-P6	4666.9329	0.0008	0.2
DV	2010-P4	2010-P6	3194.2723	0.0065	2.0
DV	2010-P4	2010-P5	1599.4725	0.0014	0.9

DV	2010-P1	2010-P5	16785.8966	0.0184	1.1
DV	2010-P1	2010-P4	15386.9180	0.0205	1.3
DV	2010-P2	2010-P1	1220.9539	0.0029	2.4
DV	2010-P6	2010-P9	5328.7793	0.0043	0.8
DV	2010-P9	2010-P8	2540.2219	0.0010	0.4
DV	2010-P8	2010-P6	2794.0516	0.0016	0.6
DV	2010-P3	2010-P5	15235.7367	0.0138	0.9
DV	2010-P3	2010-P4	13886.4807	0.0031	0.2
DV	2010-P3	2010-P2	2971.2658	0.0045	1.5
DV	2010-P3	2010-P1	1801.1176	0.0017	1.0
DV	2010-P7	2010-P8	1528.0083	0.0003	0.2
DV	2010-P7	2010-P6	1382.4874	0.0006	0.4
DV	2010-P7	2010-P5	3327.5990	0.0023	0.7
DV	2010-P7	2010-P4	1971.7312	0.0070	3.5

Absolute Error Ellipses (2D - 95% 1D - 95%)

Station	A [m]	B [m]	A/B	Phi	Sd Hgt [m]
2010-P1	0.0051	0.0033	1.6	-5°	0.0077
2010-P2	0.0080	0.0044	1.8	9°	0.0122
2010-P3	0.0000	0.0000	1.0	-10°	0.0000
2010-P4	0.0029	0.0018	1.6	-11°	0.0039
2010-P5	0.0025	0.0016	1.6	-8°	0.0037
2010-P6	0.0020	0.0013	1.5	7°	0.0028
2010-P7	0.0000	0.0000	1.0	-10°	0.0000
2010-P8	0.0019	0.0013	1.5	14°	0.0026
2010-P9	0.0033	0.0022	1.5	17°	0.0039

Relative Error Ellipses (2D - 95%)

Station	Station	A [m]	B [m]	A/B	Psi	Sd Hgt [m]
2010-P9	2010-P7	0.0033	0.0022	1.5	-54°	0.0039
2010-P5	2010-P6	0.0028	0.0018	1.6	-89°	0.0040
2010-P4	2010-P6	0.0031	0.0020	1.6	-83°	0.0042
2010-P4	2010-P5	0.0026	0.0015	1.7	68°	0.0035
2010-P1	2010-P5	0.0056	0.0035	1.6	43°	0.0084
2010-P1	2010-P4	0.0057	0.0036	1.6	39°	0.0084
2010-P2	2010-P1	0.0077	0.0044	1.8	64°	0.0121
2010-P6	2010-P9	0.0036	0.0024	1.5	-62°	0.0043
2010-P9	2010-P8	0.0033	0.0022	1.5	-58°	0.0039
2010-P8	2010-P6	0.0024	0.0016	1.5	-68°	0.0032
2010-P3	2010-P5	0.0025	0.0016	1.6	37°	0.0037
2010-P3	2010-P4	0.0029	0.0018	1.6	30°	0.0039
2010-P3	2010-P2	0.0080	0.0044	1.8	77°	0.0122
2010-P3	2010-P1	0.0051	0.0033	1.6	72°	0.0077
2010-P7	2010-P8	0.0019	0.0013	1.5	-51°	0.0026
2010-P7	2010-P6	0.0020	0.0013	1.5	90°	0.0028
2010-P7	2010-P5	0.0025	0.0016	1.6	-89°	0.0037
2010-P7	2010-P4	0.0029	0.0018	1.6	-73°	0.0039