

## CONTROL REPORT

### EAST CENTRAL WISCONSIN REGIONAL PLANNING COMMISSION

AERO-METRIC PROJECT NO. 1-950334

#### GENERAL

The East Central Wisconsin Regional Planning Commission (ECWRPC) in cooperation with the eight counties of Calumet, Columbia, Green Lake, Marquette, Monominee, Waushara, and Winnebago contracted with AERO-METRIC on April 20, 1995 to perform Global Positioning System (GPS) control surveys. The project consisted of establishing GPS control on 304 control stations spread throughout the multi-county region.

Additional surveys were completed in Columbia, Green Lake, and Waushara Counties according to the contract. The additional work consisted of the following. Establish orthometric heights in addition to the ellipsoid heights for the control stations of Columbia, Green Lake and Waushara Counties; GPS control on three (3) 10ppm stations around the City of Portage; Transform Columbia County State Plane Coordinate data onto Columbia County's Coordinate System.

#### PERSONNEL

Field observations were collected by Craig Risner, Mike Bean, and Jeff Weber. Data processing was performed by Craig Risner and Rob Merry. The project manager was Brad Muecke.

#### WISCONSIN COUNTY COORDINATE SYSTEM - COLUMBIA COUNTY

The NAD 83/91 geographic positions were transformed to the Columbia County ground coordinate system according to the transformation parameters published in the Wisconsin Coordinate Systems document (1995). The Wisconsin Coordinate Systems document (1995) is distributed through the Wisconsin State Cartographer's Office.

## HORIZONTAL CONTROL SURVEYS - CITY OF PORTAGE

The GPS control surveys were performed using First Order, Class I geometric accuracy standards as specified under Section 1.D.(6) of the RFP. A copy of the scope of work can be found in Book 1 Section 1 of the ECWRPC GPS Network report.

GPS observations were performed on October 2, 1995. GPS measurements were completed utilizing four (4) Leica/Wild GPS System 200 dual-frequency receivers, firmware version 2.30. Static GPS surveying was utilized, due to the accuracy requirements and the length of the baselines.

Field observations followed all requirements of the RFP under Section 1.G. A log was kept of tribrach and barometer adjustments. Meteorological information can be found on the GPS log sheets. The GPS log sheets, station photographs, and station rubbings are included.

## DATA PROCESSING - CITY OF PORTAGE

GPS computations were done in two stages. Initial computations were done with Leica - Static Kinematic software (SKI), versions 1.09 and 2.00. SKI permits the conversion of raw satellite data collected by the receivers to meaningful coordinate differences between points (baseline solutions). Once the baseline solutions were determined they were entered into GEOsurv - GeoLab 2 series of programs (GeoLab version 2.4d and GPS Environment version 6.26), first for quality and closure analysis and eventually for the final weighted simultaneous least squares adjustments.

The SKI computations were performed with the "fixed orbit" technique and used the broadcast ephemeris.

All SKI computations were processed on the World Geodetic System of 1984 (WGS 84).

The Geolab network adjustments and base control used for all phases of this project follow the guidelines described in the RFP. All of the adjustments were performed on the Geodetic Reference System of 1980 (GRS 80). Coordinates were published on the North American Datum of 1983/1991 (NAD 83/91) in the Wisconsin State Plane Coordinate System, South Zone.

Scaling techniques were used for this project. The full matrix was multiplied by 1 and 1.0 PPMS were added to the diagonal of the matrix.

Scale and rotation was also applied in the scaled constrained adjustment. This option allows the constrained GPS networks to fit the control.

All computations and adjustments can be found in Section 7 of this report.

This adjustment and statistical analysis found no discrepancies. All facets of this survey fell within the requirements of the RFP.

### CONTROL SURVEYS - ORTHOMETRIC HEIGHTS

Global Positioning Systems (GPS) observations were performed between October 10 and October 19, 1995. GPS measurements were completed utilizing six (6) Leica/Wild GPS System 200 dual-frequency receivers, firmware version 2.30. The "Rapid Static" method of GPS surveying was used for this project. The "Rapid Static" method of GPS uses two stationary receivers and one roving receiver per operator.

Vertical control was extended from fourteen (14) National Geodetic Survey (NGS) bench marks "C 96", "E 100", "E 109", "F 97", "H 107", "K 84", "K 98", "LOCK 1", "Q 98", "RRCW", "T 84", "T 96", "V 100", and "W 97" and one United States Geological Survey (USGS) bench mark "45 ADP".

Vertical control is based on the National Geodetic Vertical Datum 1929 (NGVD).

### VERTICAL COMPUTATIONS - ORTHOMETRIC HEIGHTS

NGVD 29

NGVD 29 elevations were computed from the GPS observations, using the NGS geoid height model "GEOID 1993".

A GeoLab minimally constrained vertical adjustment was performed in which the elevation for "W 97" was held fixed. The remaining bench mark elevation closures were computed on the following page.

ORTHOMETRIC HEIGHTS  
(UNITS IN METERS)

STATION	PUBLISHED ELEVATION	COMPUTED ELEVATION	CLOSURE
45ADP	257.412	257.513	+0.101
C96OS	290.695	290.758	+0.063
E100	239.646	239.701	+0.055
E109	238.928	238.973	+0.045
F97	290.714	291.213	+0.499 *
H107	264.081	264.195	+0.114
K84	250.548	250.586	+0.038
K98	231.514	231.527	+0.013
LOCK1	236.402	236.350	-0.052
Q98	246.526	246.528	+0.002
RRCW	280.836	280.861	+0.025
T84OS	289.284	289.349	+0.065
T96	323.746	323.849	+0.103
V100	308.914	308.960	+0.046

The elevation of one bench mark F 97 could not be reconciled and was re-adjusted in the final fully constrained vertical adjustment.

The final fully constrained GPS adjustment held the published elevations for "45 ADP", "C 96", "E 100", "E 109", "F 97", "H 107", "K 84", "K 98", "LOCK 1", "Q 98", "RRCW", "T 84", "T 96", "V 100", and "W 97".