

CITY OF LUBBOCK TEXAS

GEODETIC NETWORK

AERIAL CONTROL

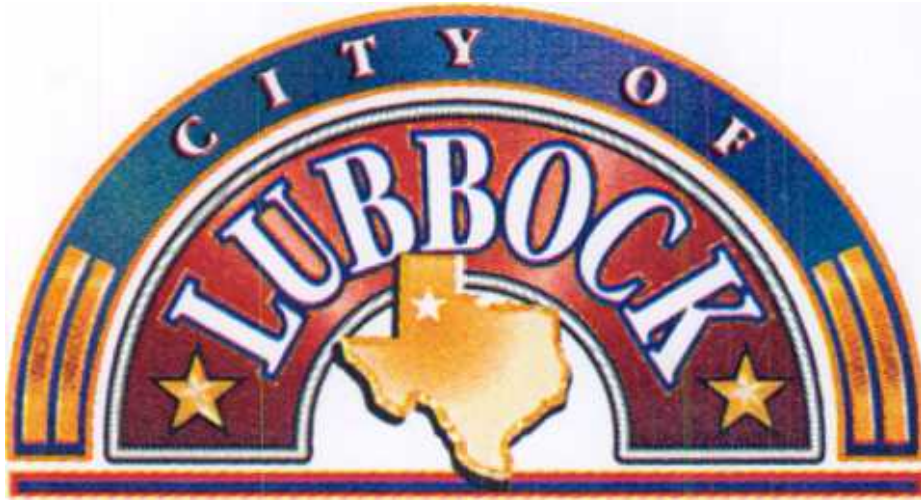
FEMA CONTROL



Carter & Burgess

Consultants in Planning, Engineering, Architecture,
Construction Management and Related Services

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Consultants in Planning, Engineering, Architecture,
Construction Management, and Related Services

City of Lubbock, Texas Geodetic Network, Aerial Control, and Fema point location Report

The Aerial control points and Geodetic Network was defined by the perimeter of the aerial photography work done during the first quarter of 2000, an area covering 206 square miles (+/-). The project area was divided by using 5-mile radius circles to establish monument locations. The 5-mle length was used to represent how far Carter & Burgess could project its radio link for the Real Time Kinematic (RTK) GPS portion of the project. Monument locations were then adjusted to find the most suitable locations for the monuments, such as parks and subdivision greenbelts. Additional monuments were set to match the agreed upon number of monuments between the City of Lubbock and Carter & Burgess.

The monuments set for Geodetic Network are 3-1/4 inch round, domed aluminum caps set on top of a 30-inch piece of 5/8-inch steel rebar. The monuments are set 0.1 to 0.2 feet below the surface of the ground. The caps are stamped "City of Lubbock Geodetic Monument" around the edge of the cap with the monument number stamped below the center punch mark. The aluminum cap and rebar are set inside a cylinder of concrete 30-inchs deep.

Carter & Burgess recovered four Nation Geodetic Survey (NGS) triangulation stations and four NGS vertical stations (benchmarks). The station designations and datum classifications are as follows:

Station Type	Station Name	Horizontal Order	Vertical Order
Tri-Station	McCauley	1 st	None Listed
Tri-Station	J-71	2 nd	1 st – Class 2
Tri-Station	Lubbock Magnetic	2 nd	None Listed
Tri-Station	Shepard	1 st	3 rd
TxDOT Lubbock RRP Station		Cors	None Listed
Vert-Station	V905	*	1 st – Class 2
Vert-Station	Y905	*	2 nd – Class 0
Vert-Station	B71	*	1 st – Class 2
Vert-Station	M905	*	1 st – Class2

Carter & Burgess has knowledge of more recent NGS vertical stations set across the county of Lubbock but choose not to use them in the network because they have no 1929 National Geodetic Vertical Datum (NGVD) values. *Pease note that this network used NGS Tri-Station J-71 and not NGS Tri-Station J-71-ECC.* These two monuments are only about 15-feet apart and a surveyor could easily us setup over the wrong monument. Carter & Burgess selected monument J-71 because of its published vertical data. Monument J-71-ECC has no published vertical data.

Static GPS surveys were conducted through the above listed monuments and the 10 monuments constructed for this Geodetic Network. Each monument was independently occupied a minimum of two times, with session times of thirty minutes for each occupation. In addition the TxDOT RRP Station data was applied as a third independent vector measurement.

The Static GPS data was processed, prior to any network adjustment loop closures of the raw data were run to verify how well the data worked with it's self prior to constraining it to any published data. Loop closures vary from 1-part in 250,000-parts, to a 1-part in 1,000,000-parts. All of the network adjustment was performed with geographical coordinate values (Latitudes, Longitudes and Ellipsoid Heights). Two database were created, one for the North American Datum (NAD) 1927, North Geodetic Vertical Datum (NGVD) 1929, and one for the NAD1983, North American Vertical Datum (NAVD) 1988. Both database were then fully constrained to two published horizontal positions and three vertical positions. The adjusted monument positions were then applied to the RTK GPS surveys that were run to locate the nearly 500 aerial control points set across the project.

Two independent databases were created for the RTK GPS surveys, one for the NAD 27, NGVD 29 data, and one for NAD 83, NAVD 88 data. Upon completion of the RTK surveys the RTK data was calibrated (adjusted) to seven monuments (Static GPS points) across the project area. The RTK calibration is an adjustment method using "Least Squares", the residual error found in the RTK surveys ranged from 0.03 feet to 0.06 feet. Multiple checks were taken throughout the RTK surveying process. Any point found to be outside of the error range was deleted from the databases and relocated in the field.

Independent databases were created to insure accuracy and consistency between the two datum's. Although the reports show the latitudes and longitudes to be the same (WGS84) the coordinate values were derived from published coordinates, not translated coordinates through programs CORPSCON or VERTCON offered by the NGS.

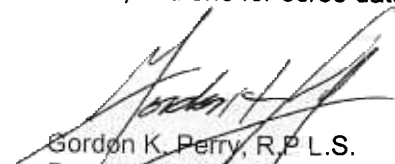
The FEMA marks were added into network by locating the eight control points the nearly 90 benchmarks were located from. The FEMA work was done in October 1998 using both RTK and Static GPS. Two more databases were created to recalibrate the FEMA RTK GPS data. One for NAD 27, NGVD, and NAD 83 NAVD 88. These two database are independent of the 27/29, 83/88 database for the geodetic and aerial control work. At any point in the future the four project databases can be combined into just two, one for 27/29 datum and one for 83/88 datum. The eight calibration points are as follows:

City of Lubbock Point No.	FEMA Point No.
812	1
1115	4
1075	38
814	28
1001	44
811	89
1356	58
813	77

Residual error from the calibration of the FEMA data ranges from 0.03' to 0.12' horizontally and from 0.02' to 0.13' vertically. The average residual difference is 0.05' horizontally and vertically. The differences found in the coordinate values and elevations can be explained by a few reasons as follows:

1. Differences in network areas
2. How network adjustment was performed and what monuments were used to constrain the adjustment.
3. What Geoid Model was used.
4. Static observations time limits
5. Elevation conversion from NAVD88 to NGVD29 using the NGS program VERTCON.

Carter & Burgess sees no problems with any of the FEMA data, and would have no problem using any of the FEMA points with any of Geodetic or aerial points. At any future date the City of Lubbock could merge the four separate databases established into just two. One for 27/29 datum, and one for 83/88 datum.


Gordon K. Perry, R.P.L.S.
Registered Professional Land Surveyor
Texas Registration No. 5185

3/20/00

Date



LETTER OF TRANSMITTAL


Attention: Ms. Sally Abbe	Date: 4/17/00	Project No: 020205010
To: City of Lubbock, Planning	Re: Lubbock Geodetic & Aerial Control	
1625 13th Street, Rm. 107		
Lubbock, Texas 79401		

We are sending you these items via: Federal Express

COPIES	DATE	DESCRIPTION
2	4/17/00	CD's with all project data.
2	4/17/00	Disks with NAD 83 & 27 grid coordinate asc files

For approval	<input checked="" type="checkbox"/> For your use	For review & comment
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REMARKS: Sally please have people using the asc files that the coordinates values are "GRID" values and to be able design, measure or survey from they need to be multiplied by the scale factors (1.000241042 for NAD 83 and 1.000240722 for NAD 27) to get surface values. Again if you or any of the staff have questions please call me. Thanks for all your help through out the project, I look forward to coming back to Lubbock to talk with the surveyors.



SENDER: Gordon Perry	Telephone: 214 920 8128
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CITY OF LUBBOCK, TEXAS

**N.A.D. 83 / 27 SCALE FACTORS
FOR THE CITY
GEODETIC NETWORK, AERIAL CONTROL, AND FEMA CONTROL**

POINT NO.	NAD83 SCALE FACTOR	NAD27 SCALE FACTOR
801	0.999745091	0.999749925
802	0.999747543	0.999747595
803	0.999753650	0.999753702
804	0.999754940	0.999754991
805	0.999762164	0.999762216
806	0.999760172	0.999760224
807	0.999770424	0.999770476
808	0.999767831	0.999767882
809	0.999758909	0.999758962
810	0.999750702	0.999750775
811	0.999768412	0.999768465
812	0.999749418	0.999749471
813	0.999763109	0.999763161
814	0.999744687	0.999744740
815	0.999773212	0.999773265
816	0.999756086	0.999756138
817	0.999768911	0.999768979
818	0.999767020	0.999767073
AVE. SCALE FACTOR	0.999759016	0.999759336

PROJECT AREA SCALE FACTORS

<i>GRID TO SURFACE</i>		<i>1.000241042</i>		<i>1.000240722</i>
<i>SURFACE TO GRID</i>		<i>0.999759016</i>		<i>0.999759336</i>