MEMORANDUM

State of Alaska
Department of Transportation & Public Facilities

TO: H. Lee Saylor, PLS
Locations Surveyor
Northern Region

DATE: December 23, 1994

FILE NO:

TELEPHONE NO: 474-2413

FROM: John F. Bennett, PLS
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SUBJECT: Basis of Survey Control

There have been situations in the past where our survey data has been passed on to Design or to consultants without a statement specifically defining the basis of the survey control. This leads to the potential for misinterpretation by the end users and makes it more difficult to relate subsequent surveys.

Basis of Survey Control Memo

Along with the transmittal of a survey data package, a memo describing the Basis of Control is to be attached. The Locations files should contain a copy of this memo for every project they develop. The Basis of Control memo will include the following items as applicable:

1. Project Name, Project Number, AKSAS Number
2. Purpose of Survey statement
3. Method of Survey statement
4. Accuracy Statement
5. Problem Statement
6. Date(s) of Survey
7. Basis of Bearings
8. Basis of Coordinates
9. Basis of Stationing
10. Basis of Vertical Control

Each item should consider the following:

1. The project name and number data will be stated in the memo "Subject" field along with the text "Basis of Survey Control".

2. The Purpose of Survey statement should consist of a short explanation of the intent of the survey. This information will generally be drawn from the Project Manager's survey request and should note whether the objective of the request was attained.

3. The Method of Survey statement should briefly describe the equipment and methods used to perform the survey. (i.e. GPS, total station, Rhodes Arc? Data collector or booked? Differential or trig levels? Describe layout of control/reference lines. Did methods vary throughout the project due to topo or availability of equipment?)

4. The accuracy statement should describe the data reduction process for the various

components. (GPS, vertical, conventional horizontal). It should relate the closures, method of adjustment and estimated accuracy of the survey.

5. The problem statement should describe the lack of or questionable control, equipment failures, procedural errors, weather and logistical problems, data reduction and adjustment problems and an explanation as to how these issues were resolved.

6. Date(s) of Survey - self explanatory.

7. Basis of Bearings: Grid, true, assumed? Based upon record bearing between what two monuments? Cite the bearing and the record document, plat, or plans.

8. Basis of Coordinates: The Basis of Coordinates may be either a local grid, Alaska State Plane NAD27, Alaska State Plane NAD83 or GPS navigated positions. We must be specific as to what our coordinate file actually represents.

    a. Does our coordinate file represent GPS navigated positions or are they true ASP coordinates based upon conventional survey or differential GPS techniques?

    b. Were the coordinate values for the controlling points as published or were they mathematically converted from one datum to another? Cite the source of the published data. (NGS, Corps of Engineers? Date? Datum? Adjustment?)

    c. Often we distribute HV control (panel point) and GPS control point data with true ASP NAD83 coordinates which were computed using grid bearings and distances reduced with sea level and grid scale factors. The coordinate files which are typically transmitted to right of way and design, however, represent a local grid in which only one point is a true ASP grid coordinate. This local coordinate grid might best be defined as a "pseudo" grid due to its deceptive similarity to ASP coordinates. The remainder of the "pseudo" grid coordinate file is generated using ground level distances oriented to an ASP grid basis of bearing. The purpose of this system is to allow closure verification using true ASP coordinates while avoiding the issue of "scale factors" with the data forwarded to design & construction. Therefore, we must specifically state whether our transmittal contains true ASP coordinates or ground based "local grid" coordinates.

9. Basis of Stationing: Project stationing has a way of being reversed, truncated or completely renumbered over the years. The Basis of Stationing should be described both by a physical point of beginning (i.e. rebar/cap @ runway centerline, split of ROW monument pair, centerline end of bridge deck) and a reference to the record document relating the physical point and a given station. (i.e. Highway plan sheet ? of ? for Project Name, Number, date.)

10. Basis of Vertical Control: Describe the physical bench mark used as the Basis and reference the record document or plan, date of reference document/plan, datum, date of adjustment and published elevation of the bench mark.

Vertical Datum Policy

The policy for vertical control was established by memo from the Northern Region Design Chief on January 23, 1992. The memo was initiated upon realization that any given bench mark may have several published elevations due to various readjustments of the NAVD29 datum and the current NAVD88 adjustment. The policy memo dictated that NAVD88 datum would be used "on projects requiring substantial reconstruction" and elevations derived from as-built drawings would be used for rehab/repair projects. It was noted that special attention is needed in urban areas where existing structures or utilities may have been based upon various datums. Designers are to "clearly state the basis of elevation used for a plan set and make reference to any other basis used for previous as-builts".

Horizontal Datum Policy

In general, DOT&PF policy with regard to the NAD27/83 datum issue has been guided by the Department's participation in the TIC/GIS subcommittee. The TIC (Telecommunications Information Council) is a statutorily defined group to manage information systems policy. The GIS (Geographic Information Systems) subcommittee's task is to consider and recommend policy with regard to datum conversions and the role of new technology (GPS). By his 9/19/94 memo, Deputy Chief Engineer Mal Linthwaite appointed Greg Frazier, the Central Region's Location Surveyor, as the Department's representative to this sub-committee. A TIC/GIS working group met on 4/13/93 and provided recommendations with regard to the datum issue. The TIC/GIS committee recognized that although NAD83 provides a more accurate definition of the shape of the earth, the BLM PLSS township protractions and USGS mapping is still based in NAD27 and will be for the indefinite future. The GIS managers are therefore reluctant to spend much time and effort in converting their existing systems from NAD27. The TIC/GIS recommendations have essentially been adopted by DOT&PF. The recommendations are paraphrased as follows:

1. Whenever coordinate files are transmitted between users, the datum needs to be clearly referenced.

2. The NGS software, "NADCON" should be used to convert between datums.

3. Users must be allowed to determine their own datum needs. (NAD27 vs. NAD83)

4. When data is captured in NAD83, it should be permanently stored in its original coordinates to protect the integrity of the source.

The requirements of DOT&PF are such that we have an interest in both datums. Our desire to improve the accuracy of our control has led to an increasing use of GPS and the development of the Georeferencing monumentation project. Our objective is to control our projects with NAD83 coordinates. Our right of way acquisition mapping often requires that we locate the intersection of our project centerline with a protracted section line which is based upon NAD27 coordinates, therefore requiring a conversion from NAD27 coordinates to NAD83.

My initial concern with conversions between datums had to do with the questionable accuracy

of the conversion software as the NAD83 was a complete readjustment of observations as opposed to a pure mathematical conversion between coordinate systems. My concern dissipated with the realization that ambiguity of the NADCON conversion is probably much less than the ambiguity of how those section corner positions would eventually be monumented. Therefore, the NADCON conversion was the only and best game in town. Also, the Federal Geodetic Control Subcommittee (FGCS) has adopted the NAD83 as the official horizontal datum for U.S. surveying and mapping activities performed or financed by the federal Government. The FGCS also stated that "NADCON will be the standard conversion method for all mathematical transformations between NAD83 and NAD27." (Engineer Technical Letter No. 1110-1-147, Engineering and Design Conversion to North American Datum of 1983, dated March 5, 1990)

The software we will use for conversions is the Corps of Engineers program "CORPSCON" v3.01. This software uses NADCON as a conversion engine within a user friendly shell. Right of Way Engineering will use this software to convert BLM protraction coordinates to NAD83 and subsequently merge these converted coordinates with the survey data file.

Citation of Alaska State Plane Coordinates

A.S. 38.20.040 Use of coordinate system. states that the Alaska Coordinate System of 1927 (NAD27) is to be expressed in feet and decimals of a foot. The Alaska Coordinate System of 1983 (NAD83) is to be expressed in meters and decimals of a meter.

Following this method of citation should not be a problem as the majority of the FHWA funded highway surveys being performed now and in the future are required to be metric.

FAA, however, has not made the shift to metric and requires that plans and surveys still be prepared in English units. The trend toward using GPS as a navigational aid has led to requests that we provide NAD83 positions at the centerline of each threshold and at the middle of the runway. FAA has initiated a program in conjunction with NGS to monument and perform GPS observations on a large number of Alaska airports in anticipation of the further development of non-precision instrument GPS airport approach procedures. Their 12/22/93 letter states that "non-precision approaches can not be developed without known runway threshold locations based on GPS(WGS-84) surveys. In order to avoid placing the metric coordinates on an aviation plan, we will only provide NAD83 latitudes and longitudes.

Summary

1. A "Basis of Control" memo will be transmitted with each survey data package.

2. The vertical datum for reconstruction projects will be NAVD88. Rehab/repair projects may be based upon as-built elevations.

3. The horizontal control datum for highway & airport projects will be NAD83. Metric coordinates will not be labeled on aviation plans.

4. Datum conversions will be made using the program CORPSCON v3.01.