INTRODUCTION

"Input Formats and Specifications of the National Geodetic Survey (NGS) Data Base," commonly called the Blue Book or bluebook, is a user's guide for preparing and submitting geodetic data for incorporation into NGS' data base. Survey data that are entered into NGS' data base become part of the National Spatial Reference System (NSRS). The bluebook comprises three volumes and a collection of annexes.

Volume I   – Global Navigation Satellite System Control (detailed below)
Volume II   - Vertical Control
Volume III - Gravity Control

The formats and specifications are consistent with the aims of the Executive Office of the President, Office of Management and Budget's (OMB) Circular A-16, as revised in 2002. A major goal of this circular titled *Coordination of Geographic Information and Related Spatial Data Activities* is to develop a national spatial data infrastructure with the involvement of Federal, state, and local governments, and the private sector. This multilevel national information resource, united by standards and criteria established by the Federal Geodetic Control Subcommittee (FGCS) of the Federal Geographic Data Committee (FGDC) will enable the sharing and efficient transfer of geospatial data between producers and users.

The appropriate data standards and accuracies of individual surveys must be verified. Survey data contributed for inclusion into the NGS data base must be processed and adjusted by the provider, using currently available NGS software, before submitting the survey project to NGS.

The NGS provides review, archiving, and distribution functions free of charge for survey data submitted in the proper format. These surveys must contain connections to the NSRS in accordance with FGCS Standards and Specifications for Geodetic Control Networks 1984, and they must contribute to the public good.

Specifications are described below for submitting Global Navigation Satellite System (GNSS) relative positioning data to the NGS for inclusion in the National Spatial Reference System (NSRS). The submission should be completely in a digital format.

Prior to beginning a survey, obtain approval of the survey project plan from NGS through the Survey Project Proposal form. Once the plan has been reviewed by NGS headquarters or your regional advisor you will receive email notification with a tracking ID. The tracking ID should be included in all correspondance with NGS.

There are three main data files submitted with each GNSS project.

1) The GNSS Data Transfer Format (G-file) specifications and formats are described in Annex N.

2) Specifications and format instructions for submission of the BFILE containing observation metadata and final positions for GNSS data are described in **Chapter 4**.

3) The descriptions and recovery notes associated with the GNSS survey are described in Annex P with additional information in the WinDesc program.

The following subjects are briefly described within this document:

Section 1 – GNSS Observations and G-file
Section 2 - GNSS Bfile
Section 3 - Description/Recovery File(s)
Section 4 - Least Squares Adjustment Guidelines
Section 5 – Project Sketch
Section 6 - Project Report
Section 7 - Additional Submissions
Section 8 – Project Submission Checklist
Section 9 – GNSS Project Transmission

1.0 GNSS Observations and G-file

1.1 GPS OBSERVATIONS (R-files)
Submit the raw GPS observations (receiver manufacturer's proprietary format) for each occupation of a station. Organize the files in a "RAW" or similar-named folder under which there are session folders, such as 173A, 173B, 176A. If the 4-character ID of a station was not used in the file name[s] for a station, place the file[s] in a sub-folder named for the 4-character ID. Also, if RINEX files were created from the raw files, place them in session folders under a "RINEX" folder.

1.2 GNSS VECTOR SOLUTIONS (G-file)
Submit one G-file for each project in the formats specified in Annex N. The G-file is created by vendor software, **OPUS-Projects** or SINEX2G and contains:
- From/to station identification using 4-digit station serial numbers (SSNs) and 4-character IDs.
- Vector coordinate differences (DX, DY, DZ), standard deviations, and correlations (or covariances)
- Name and version of processing software
- Date of solution
- Source of the ephemerides (GNSS orbits)
- Solution Coordinate Reference System (datum) for the vectors
- Solution type

A G-file may contain vectors generated from three different processing methods.

1) Single-vector processing uses data from two stations at a time within a session. Mathematical correlations between multiple vectors that were simultaneously observed are not computed. The resulting G-file may currently include both independent and dependent vectors (though it has been found that excessive dependent vectors result in problematic positional accuracies. Therefore new specifications are forthcoming.) It is currently recommended that not more than about 20% of the vectors be dependent in nature. There will be n(n-1)/2 vectors (total) for each session if all possible vectors are included, where n is the number of receivers observing. If only (n-1) independent vectors are submitted, then one should select fixed integer bias solutions (typically associated with shorter vectors) in preference to float solutions.

2) Multiple-vector or session processing generates correlations between vectors simultaneously observed in a session. The resulting G-file entries correspond to the (n-1) independent vectors.

3) The network reduction method combines multiple sessions into one SINEX file from which the G-file is derived. The G-file in this case contains (s-1) independent vectors, where s is the total number of unique stations in the solution. The vectors that are chosen may reflect how the data were processed by relative positioning, or may be an arbitrary set of independent vectors.

It is important to specify the correct solution coordinate reference system used (the reference frame of the GNSS orbits) by selecting the associated numeric code from a table in Annex N used in the reduction process.

1.3   Four-character station ID (4-char ID), data media identifier, and Serfil

The submittal process requires that each occupied station be identified by both a 4-char ID and a station serial number (SSN); also that an auxiliary text file, the "Serfil" be created to cross-references these two items. The format of the Serfil is:

cc 1-4, 4-char ID
cc 5-7, blank
cc 8-11, SSN

The 4-char ID is intended to be a shortened version of the full station name for use in naming data files and plotting on the project sketch. The data media identifier is a 10-character text string such as "A1732AMOB1" noting the receiver code, day of year, last digit of year, session and 4-char ID. It is discussed more fully in Bluebook Annex N, and in brief must occur identically in both the B- and G-files for a given occupation of a station.

2.0   **GNSS OBSERVATION METADATA AND STATION DATA (Bfile)**
Submit one Bfile for each project in the formats specified in **Chapter 4**. There are a few different programs available from NGS to assist in creating the bfile:

CR8BB -- NGS Software
OPUS-Projects – Requires 2 or more hours of observation times

3.0   **STATION DESCRIPTIONS (D-file)**

Submit one D-file for each project in the formats specified in Bluebook Annex P. The D-file is created by WinDesc. It contains original descriptions for new marks and recovery information for existing stations. It includes all occupied GNSS points and (optionally) NSRS points visited but not occupied during the project.

Datasheets for existing NSRS points in a project area can be downloaded from the NGS website and imported into WinDesc.

In the event that a concurrent leveling project is performed only one D-file need be submitted. In this case, both project reports should specify the connection between the projects and report which contains the descriptions.

Often it is desirable to recover additional stations that are not part of the GNSS project survey. If the recoveries are excessive, it is requested that a separate D-file be submitted with an explanation in the project report.

4.0   LEAST SQUARES ADJUSTMENTS
Four adjustments are to be submitted for NGS review. Refer to the Constrained Adjustment Guidelines for specifics. It should be noted that only software provided by NGS may be used to perform the least squares adjustment and description processing.

5.0   PROJECT SKETCH
Submit a sketch showing all stations occupied during the GPS survey. Show latitude and longitude grid ticks around the border. Use the following symbols as a guide:

- Squares for existing vertical control
- Open triangles for existing horizontal control stations
- Open triangles within squares for existing horizontal/vertical control
- Solid triangles for GPS stations
- Circles for stations occupied during previous GPS projects

  Legend should include:
- Project name & general locality
- Name of group making observations
- Project director
- Beginning and ending dates, month/year
- Scale of sketch

  Show points in a large-scale inset when they are too close together to be depicted clearly at map scale.

6.0   PROJECT REPORT
This document describes project goals, conditions, requirements, personnel, equipment and procedures employed during the survey. The report assists problem resolution during NGS review with detailed explanation of unusual or special project features. Use the following categories as a guide. NGS-supported projects may require a different report.

6.1   **GNSS Project Report (cover page)**

Locality/Project Title

Submitting Organization Information
Organization Name:
Organization Abbreviation (see Annex C)
Contact Name:
Contact Email:

Contracting Organization Information (if applicable)
Organization Name:
Organization Abbreviation (see Annex C)

Observing Timeline
Start of GNSS Observations:
End of GNSS Observations:

Datum Realization and Epoch

Associated Leveling (if applicable): L#

Station Count
Number of Occupied Stations:
Number of NGS Published CORS:
Total Number of Stations:

Project Boundaries
Minimum Latitude (Nddmm): N
Maximum Latitude (Nddmm): N
Minimum Longitude (Wdddmm):W
Maximum Longitude (Wdddmm):W

6.2 The report should include the following:

Survey Project Proposal
Include the original survey proposal submitted with the notice of approval sent by email which should include the tracking number assigned. All correspondence concerning the project should be included. If the survey was contracted, include a copy of the instructions and/or contract under which the project was performed. Include any revisions or changes to the instructions or specifications.

Location
Describe the geographic location and extent of the project.

Conditions Affecting Progress
Note any factors which facilitated or impeded the project.

Field Work
Reconnaissance and mark-setting

Chronology, the progress of the project.

Instrumentation
List the make and model of the receivers and antennas used in the project. Indicate any unusual or faulty equipment.

Weather

List all observing sessions which occurred during periods of changing or severe weather conditions such as passing fronts, storms, etc. Details should be narrated on the field log sheets.

Deviation from Instructions
Describe any deviation from the procedures and specifications stated in the project instructions.

Data Processing Performed
Describe the data processing that was performed. Include tasks such as checking data quality (eg, running teqc or submitting files to OPUS for initial coordinates), analyzing differences in repeat vectors, and writing station descriptions. Specify the ephemeris type used (broadcast, rapid, ultra-rapid, precise, etc.) and the source (IGS, NGS, DMA, etc.).

Software Used
Specify all software by name and version which was used to acquire, manage, reduce, adjust, and submit field data. If the project data were reduced or acquired with different versions of a program, specify which version was used with which block of data.

Rejected Data
Specify vectors which were rejected and possibly reobserved. Include the reason(s) for the rejection, such as failed equipment or bad weather listed under Field Work above.

Adjustment
Discuss in detail the adjustments performed. List constrained station(s) with PIDs, along with the heights and their source. Discuss possible weaknesses or distortions found or suspected in the NSRS.

Comments and Recommendations
Include comments and recommendations not found elsewhere in the project report.

7.0 Additional Submissions

Field Logs
Provide scanned copies of observation logs, field notes, record books and any weather observations.

Equipment Failure Logs
Include a failure log for any equipment used to gather data which failed anytime during the project. State the type of component, serial number, date of failure and nature of failure.

Project Observing Schedule
Prepare a list containing the following: observing days/sessions, 4-char IDs and station names, session start and stop dates and times (UTC).

Station Photographs
Refer to NGS photo submission guidelines for formatting information. Photos serve as an additional check to help detect misidentified stations by checking the station logo, stamping, and date.

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RETAIN A COPY OF ALL DIGITAL DATA FILES.

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8.0 PROJECT SUBMISSION CHECKLIST

- Ajustments: Horizontal free and constrained, Vertical free and constrained
- Bfile - final
- Gfile(s): The western US requires the gfile be transformed with HTDP (Horizontal Time Dependent Transformation). Ensure the original gfile includes the same rejections as the transformed file.
- B & Gfile checking programs: chkobs, obschk, obsdes, , compvecs
- Descriptions: The .dsc description file
- Description checking programs: Neighbor, Discrep, Chkddesc
- RINEX files and raw data
- Observation logs (it is important to ensure these are complete and correct, particularly the antenna model numbers and HIs)
- Photos
- Project Sketch
- Report
- Screen shots of CORS short term plots if used for sigma constraints
- Opus solutions if run

9.0 DATA TRANSMISSION

Submit all files to NGS in digital format.

Send to:

NOAA, NOS, NGS
GNSS Survey Project Submission
1315 East West Hwy, SSMC3
8th Floor - N/NGS41
Silver Spring, MD 20910

10.0 Federal Geodetic Control Subcommittee publications

NOTE: National Geodetic Survey and Federal Geodetic Control Subcommittee publications are available online.

NOAA, National Geodetic Information Branch, N/NGS12
voice: 301-713-3242
fax: 301-713-4172