



# VILLAGE OF TARRYTOWN

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**Lagana Park Survey  
Village of Tarrytown**

## **ADDENDUM NO. 2**

NOTICE is hereby given to prospective Bidders of the following information, clarifications, and modifications to the Bidding Documents for the Lagana Park Survey project. The Bidding Documents remain unchanged except as indicated below. Bidders must acknowledge receipt of this Addendum in the Bid Form and comply with the requirements for submission of Bids as set forth in the Bidding Documents.

### **CORRECTION**

Amendment No. 1 specified that the survey must include contour intervals of 1', North American Vertical Datum 27. Instead, that response should read:

“The survey must include contour intervals of 1'. The survey shall comply with NYSDOT standards for datums. See attached specification.”

## NYSDOT COORDINATE SYSTEMS AND DATUMS

### 6.4 NYSPCS ZONES

NYSPCS is made up of 4 zones: West, Central, East and Long Island.

**FIGURE I. NYSPCS ZONES**



For a definition of these zones refer to Chapter 605 of the 1995 Laws of the State of New York. Coordinates are specific to each zone. Coordinates can be projected from one zone to another accurately. Most Surveying, GPS, and Geographic Information System (GIS) software include projection tools to convert state plane coordinates from one zone to another. NYSDOT Projects that extend from one zone to another should use NYSPCS coordinates based only in one zone.

### 6.5 HORIZONTAL DATUM

An ellipsoid is a mathematically defined, regular surface (with specific dimensions) most closely approximating the shape of the earth. It is a biaxial ellipse rotated about its minor (shorter) axis. It's like a flattened sphere because the earth is in fact flattened slightly at the poles and bulges somewhat at the equator.

A geodetic datum is a mathematical model that consists of an ellipsoid and an initial point of reference. Once a datum is adopted, it provides the surface to which ground control measurements are referred. A horizontal datum forms the basis for the computations of horizontal control surveys in which the curvature of the earth is considered. The two horizontal datums normally concerned with in mapping are the North American Datum of 1927 (NAD27) and the North American Datum of 1983 (NAD83). Problems with NAD27 included measurement errors and intentional distortions. The datum was redefined and recomputed, resulting in NAD83, which is more accurate. Two of the important parameters that define a datum are the reference ellipsoid selected for the computations and the location of an initial point of reference, or origin. NAD83's reference ellipsoid is Geodetic Reference System 1980 (GRS80). GPS

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uses the World Geodetic System 1984 (WGS-84) reference ellipsoid (an earth-centered ellipsoid whose origin is the center of the earth's mass). The differences between WGS-84 and GRS80 are very small and for most GPS applications these ellipsoids can be considered equal (the difference is to the 9th decimal place).

Horizontal coordinates shall be reported in the North American Datum of 1983 (NAD83) as defined in NOAA Manual NOS NGS 5 "State Plane Coordinate System of 1983".

The CORS adjustment of NAD83 coordinates, available from NGS, shall be used. The most recent CORS adjustment shall be used, currently NAD83 (CORS96). The most recent EPOCH date shall be used, currently EPOCH 2002.

To assure the most current data is used, coordinates for these stations shall be obtained from the NGS database at: <http://www.ngs.noaa.gov/cgi-bin/datasheet.pr1>

The physical reference network (the ground control stations) for the NAD83 (CORS) datum shall be any CORS station that is part of the NYS Spatial Reference Network (NYSNet CORS/RTN). When necessary, National CORS surrounding NYS may also be included in the control survey.

When including other CORS stations their data availability and stability should be considered.

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### 6.6 VERTICAL DATUM

A vertical datum is a surface to which elevations are referred. Elevations (Orthometric Heights) shall be reported in the North American Vertical Datum of 1988 (NAVD88). The physical reference network (the ground control stations) for NAVD88 shall include any station listed in the NGS database for which the orthometric height was determined by differential leveling techniques, adjusted to the NAVD88 datum, and has the appropriate accuracy classification for the survey. To assure the most current data is used; orthometric heights for these stations shall be obtained from the NGS database at: <http://www.ngs.noaa.gov/cgi-bin/datasheet.prl>

The NYSNet CORS/RTN is not directly connected to the North American Vertical Datum of 1988 (NAVD88). Depending upon required survey accuracy, the user must determine the appropriate connections to local vertical datums, including NAVD88. Possible connection methods when using the NYSNet CORS/RTN:

- 1) Use of GPS observations and a GEOID model.
- 2) Use of GPS observations, a GEOID model, and mean shift transformation to local benchmarks.
- 3) Use of GPS observations and a transformation to at least 4 local benchmarks surrounding the project area. Benchmarks must be checked for accuracy and integrity. For project areas larger than 10k or where there is significant undulation in the GEOID through the project area, a GEOID model should also be used.

The regional land surveyor shall be consulted when determining methods for connecting to NAVD88.

When working with old contract plans that are in US Customary Units you must take into account the difference in the Vertical Datums before incorporating the information into current Record Plans.

### 6.7 UNITS OF LENGTH

Survey distance measurements will be collected and reported in **feet (ft) or meters**, as specified in Section 1.2. To convert **between feet and metric** dimensions they will be converted based on the U.S. Survey foot definition, by **using** the result of 39.37/12, which is 3.28083333333 (to no less than twelve significant figures).

### 6.8 COORDINATE CONVERSIONS

GPS works in an earth centered coordinate system. The projection to a state plane coordinate system is usually handled by GPS processing software. The GPS processing software will also calculate convergence angles and combined factors. Combined factor = (grid scale factor x ellipsoidal reduction factor).

Though convergence angles will differ from point to point, if the procedures outlined in this manual for establishing project control are followed, the effect of the change in convergence angle will have a minimal effect on the accuracy of the survey.

Though combined factors will differ from point to point based on distance from reference meridian or elevation, as a general rule a mean combined factor should be used for each

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project. This policy will usually cause no appreciable loss in accuracy and will eliminate confusion caused by multiple combined factors. However, where elevations of stations vary significantly, or for projects extending away from the reference meridian, applying more than one combined factor may be necessary to achieve required position and azimuth closure standards. If proper field procedures are followed, and the application of a meaned combined factor does not achieve azimuth and position closure standards, the regional land surveyor should be consulted on use of multiple combined factors.

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### 6.9 DISTANCE CONVERSIONS

When processing survey data from a total station traverse the combined factor must be applied to distances so that required traverse closure accuracy in the NYSPCS is achieved. The combined factor is the resulting product of the grid scale factor multiplied by the ellipsoidal reduction factor. Combined factor = (grid scale factor x ellipsoidal reduction factor).

When staking out survey points in the field using a total station for a survey on the NYSPCS the inverse of the combined factor (1/combined factor) should be applied to distances in order to convert NYSPCS grid distances back to ground distances.

### 6.10 DATUM TRANSFORMATIONS

There are coordinate transformation programs available to transform coordinates from one datum to another such as CORPSCON.

<http://crunch.tec.army.mil/software/corpscon/corpscon.html>

CORPSCON incorporates NGS programs such as NADCON

<http://www.ngs.noaa.gov/TOOLS/Nadcon/Nadcon.html>

and VERTCON

[http://www.ngs.noaa.gov/FORMS\\_PROCESSING/Vertcon/vertcon.html](http://www.ngs.noaa.gov/FORMS_PROCESSING/Vertcon/vertcon.html)

to compute transformations between datums. NADCON and VERTCON transformations between datums are based on a model of over 250,000 common stations. Therefore, conversions are approximate and accuracy can vary depending on location and proximity to common stations.

#### NADCON

The accuracy of the transformations should be viewed with some caution. At the 68 percent (1 sigma) confidence level, this method introduces approximately 0.15 meter uncertainty within the conterminous United States between NAD27 and the initial adjustment of NAD83 published in 1986 and referenced as NAD83(1986).

Transformations between NAD83 (1986) and HARNs introduce approximately 0.05 meter uncertainty.

#### VERTCON

The VERTCON 2.0 model was computed on May 5, 1994 using 381,833 datum difference values. A key part of the computation procedure was the development of the predictable, physical components of the differences between the NAVD 88 and the National Geodetic Vertical Datum of 1929 (NGVD 29) datums. This included models of refraction effects on geodetic leveling, and gravity and elevation influences on the new NAVD 88 datum. Tests of the predictive capability of the physical model show a 2.0 cm RMS agreement at the 381,833 data points. For this reason, the VERTCON 2.0 model can be considered accurate at the 2 cm (1 sigma) level.

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These programs only model shifts between datums, they are not based solely on a mathematical formula. While these transformations may be adequate for most mapping, low-accuracy surveying, or navigation applications, they are usually not accurate enough for survey control. Therefore, if the scope of a project requires tying in to a previous project on a different datum, either:

1. control stations from the previous project must be reobserved in the current survey. A minimum of 5 , well distributed control stations should be incorporated into the current survey, or
2. original observations from connected stations can be readjusted in the new datum.

### 6.11 DOCUMENTATION

The survey field notes and/or control report shall identify:

- 1) The coordinate system (NYSPCS), zone (EAST, CENTRAL, WEST, or LONG ISLAND), and datum (NAD83).
- 2) The date of the datum adjustment (NAD83/96).
- 3) The name and coordinates of horizontal control stations used to establish such coordinates. The NGS PID (Point Identifier).
- 4) The agency establishing those coordinates (NGS).
- 5) The combined factor, ellipsoidal reduction factor, and grid scale factor.
- 6) Units of Length.
- 7) The geoid model used.

The Licensed Land Surveyor responsible for such work shall certify on or within such documents that the survey connections to the control stations meet or exceed the minimum accuracy standards.

### 6.12 REFERENCES

1. Chapter 605 of the Laws of 1995 of the State of New York. Refer to this for the definition of NYSPCS zones.
2. State Plane Coordinate System of 1983, NOAA Manual NOS NGS 5; [http://www.ngs.noaa.gov/PUBS\\_LIB/ManualNOSNGS5.pdf](http://www.ngs.noaa.gov/PUBS_LIB/ManualNOSNGS5.pdf) Refer to this document for definitions and computations required for working in the NYSPCS.
3. National Imagery and Mapping Agency, Technical Report TR8350.2 "World Geodetic System 1984, Its Definition and Relationship with Local GeodeticSystems." <http://earth-info.nga.mil/GandG/publications/tr8350.2/wgs84fin.pdf>
4. Federal Register Notice, Vol 54. No. 113, June 14, 1989 "Affirmation of Datum for Surveying and Mapping Activities." [http://www.ngs.noaa.gov/PUBS\\_LIB/FedRegister/FRdoc90-18809.pdf](http://www.ngs.noaa.gov/PUBS_LIB/FedRegister/FRdoc90-18809.pdf)
5. Federal Register Notice, Vol 58. No. 120, June 24, 1993 "Affirmation of Vertical Datum for Surveying and Mapping Activities." [http://www.ngs.noaa.gov/PUBS\\_LIB/FedRegister/FRdoc93-14922.pdf](http://www.ngs.noaa.gov/PUBS_LIB/FedRegister/FRdoc93-14922.pdf)
6. Federal Register Notice, Vol 55. No. 155, August 10, 1990 "Notice to Adopt Standard Method for Mathematical Horizontal Datum Transformation." [http://www.ngs.noaa.gov/PUBS\\_LIB/FedRegister/FRdoc90-18809.pdf](http://www.ngs.noaa.gov/PUBS_LIB/FedRegister/FRdoc90-18809.pdf)

Refer to the remaining chapters of this manual for standards and procedures consistent with working in the NYSPCS.