

IMPLEMENTING RULES AND REGULATIONS (IRR) ON THE CONDUCT OF INSPECTION, VERIFICATION AND APPROVAL OF SURVEY (IVAS) IN THE PHILIPPINE REFERENCE SYSTEM OF 1992 (PRS92)

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Pursuant to Executive Order No. 192, series of 1987, Executive Order No. 45, series of 1993 entitled “Adopting the Philippine Reference System of 1992 as the Standard Reference System for Surveys in the Philippines”, as amended by Executive Order Nos. 280 and 321, DENR Administrative Order No. 2005-13, the “Revised Guidelines for the Implementation of the Philippine Reference System of 1992 (PRS92)”, and DENR Administrative Order No. 2007-29, the “Revised Regulations on Land Surveys”, the following rules and regulations on the conduct of inspection, verification and approval of survey (IVAS) are hereby issued for the guidance and compliance of all concerned.

Section 1. Basic Policy. It is the policy of the State to accelerate land surveys in the entire country through effective and efficient adjudication and disposition of alienable and disposable lands of the public domain and other lands reserved or utilized by other government agencies.

Sec. 2. Objectives. This Order aims to:

- (a) prescribe rules and regulations that will result in an efficient processing of survey returns with non-compliant data submitted to the DENR for verification and approval;
- (b) provide procedures that will supplement the present IVAS methods in the processing of submitted survey returns; and
- (c) provide procedures to review Global Positioning System (GPS) observations for lot surveys including applicable transformation methods from local or arbitrary datum to the PRS 92 datum.

Sec. 3. Scope and Coverage. This Order shall cover all survey returns of all isolated surveys pursuant to DAO No. 2007-29 as follows:

- a. Group Settlement/Townsite Subdivision Surveys
- b. Public Land Surveys
- c. Amendment Surveys
- d. Private Land Surveys
- e. Government Land Surveys
- (i) Friar Land Estate Surveys
- (ii) National Government Lands Surveys
- (iii) Local Government Units (LGU) Lands Surveys

f. Conversion Surveys

g. Other Land Surveys not included in the above list and intended for a specific purpose.

Sec. 4. Definition of Terms. The following terms as used in this order are hereby defined as follows:

- (a) Amendment Surveys – surveys covering untitled/undecreed properties by changing the number of lots

therein without affecting the original technical descriptions of the boundary.

(b) Common Points – points with known positions in terms of both the local survey system and the PRS92 system.

(c) Conversion Surveys – surveys conducted to transform/convert the lots covered by approved graphical cadastral surveys, cadastral mapping (Cadm) and photocadastral mapping (PCadm) into numerical or regular cadastral lots with computation and plotting in the system of the cadastral project.

(d) Friar Land Estate Surveys - surveys of lands purchased by the government from Religious Orders and private corporations from 1904 to 1913 for distribution to actual occupants and bonafide settlers pursuant to Act 1120, “Friar Lands Act”.

(e) Geodetic Engineer (GE) - a natural person with professional expertise in the field of surveying and mapping, either in the government service or in the private practice, and who has been issued a Certificate of Registration and Identification Card by the Professional Regulation Commission (PRC) – Board of Geodetic Engineering, pursuant to Republic Act 8560, otherwise known as the Philippine Geodetic Engineering Act, as amended by RA 9200.

(f) Global Positioning System (GPS) – the satellite-based system of determining positions and elevations of points on the Earth’s surface with the World Geodetic System of 1984 (WGS84) as datum.

(g) Government Land Surveys – surveys of parcels of lots administered by or belonging to the National Government or any of its branches and instrumentalities, and include friar land estate survey, national government land survey and Local Government Unit (LGU) land survey.

(h) Group Settlement/Townsite Subdivision Surveys – subdivision of A&D lands not exceeding 1,500 hectares into 50 parcels or more.

(i) Integration – the process of transforming and consolidating land survey data sets into PRS92 and includes inventory of survey data, physical recovery of location monuments or lot corners, observations of the positions of recovered monuments or corners, and generation of transformation parameters.

(j) Isolated Surveys – shall refer to all classes of surveys of isolated parcels of land used for agricultural, residential, commercial, resettlement, or other purposes covering areas not exceeding 1,500 hectares.

(k) Local Government Units (LGU) Lands Surveys – surveys of lands acquired by provinces, cities/municipalities, or barangays, pursuant to RA 7160, “Local Government Code of 1991” and other pertinent laws not needed for public purposes.

(l) National Government Lands Surveys – surveys of all patrimonial properties owned by the government not intended for public use

(m) Philippine Reference System of 1992 (PRS92) – the modified Luzon datum used as reference system for all surveys in the Philippines pursuant to Executive Order (EO) No. 45, series of 1993, as amended by EO No. 321, series of 2000, and EO No. 280, series of 2004.

(n) Private Land Surveys – surveys covering lands claimed or owned by an individual, a partnership, a corporation, or other organization, undertaken for purposes of original or subsequent land registration.

(o) Public Land Surveys – all original surveys covering A&D lands not subject to private rights nor devoted to public use pursuant to provisions of public land laws.

(p) Reference Point – a point on the ground with established position (geographic and rectangular grid coordinates) established by traverse, triangulation, trilateration, Global Positioning System (GPS), or any combination thereof, and also known as Control Point, and marked on the ground by a survey monuments

commonly known as Location Monument.

(q) Survey Plan – a two-dimensional map which depicts the lengths and directions of lines, polygons and boundaries as well as the relative horizontal positions of any existing structures on a land parcel.

(r) Survey Returns – the collective documents submitted by a Geodetic Engineer (GE) as a result of his/her survey and include primarily computations, reference data, maps, resulting plan and supporting legal documents as necessary.

(s) Transformation – the process of converting survey data from one coordinate system to another or from one datum to another; e.g., converting local coordinate systems of lot surveys into the PRS92 Philippine Plane Coordinate System (PPCS) – Philippine Transverse Mercator (PTM) Projection, on converting from WGS84 to PRS92 datum.

(t) Transformation Parameters – a set of numerical values defining the mathematical relationship between two sets of coordinates or datum.

(u) WGS-PRS92 Transformation Parameters – the parameters needed to transform GPS observations in the World Geodetic System of 1984 (WGS84) datum into the Philippine Reference System of 1992 (PRS92) datum, consisting of three (3) translations or shifts, three (3) rotations and scale, namely:

- Translation, or shift, parameters

- X = 127.62195 meters

- Y = 67.24478 meters

- Z = 47.04305 meters

- Rotation parameters

- R_x = -3.06762"

- R_y = -4.90291"

- R_z = -1.57790"

- Scale parameter = 1.06002

(Signs are reversed when transforming from PRS92 to WGS84; source: NRMDP Publication)

(v) Verification – the process of checking the completeness of survey data such as field notes or digital data (whichever is applicable) and accuracy of the results with respect to established standards such as errors of closure (linear, azimuth) and relative precision in accordance with the provisions of the Revised Manual for Land Surveys in the Philippines and related Implementing Rules and Regulations.

Sec. 5. Revised IVAS Work Flow. The following revised IVAS work flow (attached as Annex A[*]) shall be followed:

- (a) Submission of survey returns by licensed Geodetic Engineers or other government agencies for verification and approval;

- (b) Preliminary examination of the survey returns to determine completeness and adherence to survey standards;

- (c) Assessment of fees (verification, preparation and other fees), designation of kind of survey, assignment of survey number, and recording and indexing;

- (d) Digital projection of submitted survey returns on the proposed Land Information Map (LIM) by the Projection Unit;

- (e) Verification of computations (boundary, reference, astronomical observations, traverse, recovered corners/common points, lot data, lot corner settings) by the Computation Unit;
- (f) Verification by the Computation Unit of GPS-related observations including supporting documents such as:
 - (i) GPS receiver registration and calibration
 - (ii) GPS data including raw GPS observations in appropriate format, fully accomplished field sheets, descriptions of all PRS92 control stations used, and brand, model and serial number of GPS receivers and antennas.
- (g) Verification of the transformation accuracy including number, distribution and accuracy of recovered “common points” and the transformation technique adopted.
- (h) Verification of prescribed scale, centerline coordinates and plotting, adherence to cartography standards, completeness of features on plan, and completeness of notation and other survey details by the Cartography Unit;
- (i) Final examination of the survey returns by the Chief of Section (Aggregate Surveys or Original and Other Surveys);
- (j) General review of the survey returns and recommendation by the Chief of the Survey Division; and
- (k) Approval of survey returns by the Regional Technical Director (RTD).

Sec. 6. Supplementary IVAS Procedures for non-compliant survey returns. The following supplementary IVAS procedures shall be adopted for non-compliant survey returns based on conventional survey equipment:

- (a) Checking and evaluation of GPS survey returns in accordance with relevant provisions of Department Administrative Orders 98-12 (Manual for Land Surveys), Administrative Order No. 2005-13 and Administrative Order No. 2007-29;
- (b) Verification of the accuracy of the transformation including number, distribution and accuracy of recovered “common points” and the transformation technique adopted; and
- (c) Digital projection of submitted survey returns on the proposed Land Information Map (LIM)

Sec. 7. Survey returns for isolated surveys. Survey returns for isolated surveys shall be submitted together with the following documents accomplished in the LMB prescribed form as provided under DAO 2007-29.

- a. Letter of transmittal enumerating therein the documents being submitted as part of the survey returns and signed and sealed by the Geodetic Engineer;
- b. Original drafting film plan, complete in details, indicated by appropriate conventional symbols signed and sealed by the Geodetic Engineer;
- c. Copy of the latest tax declaration (when applicable);
- d. Original field notes and field notes cover, duly notarized;
- e. GPS survey returns in digital format;
- f. PRS92 control map duly signed by the Chief of Party containing the following:
 - i. PRS92 control points used in the project;
 - ii. Tabulation of coordinates of control points;
 - iii. Map scale;
 - iv. Project boundary including locality;
 - v. Adjoining lots with corresponding survey numbers;

- vi. Prominent natural and man-made prominent features;
- vii. Area;
- viii. Project Number; and
- ix. Dates of survey and submission
- g. Survey notification letter(s);
- h. Lot data computations;
- i. Traverse computations;
- j. Astronomical observation computations;
- k. GE Certificate, duly notarized;
- l. Certificates of Instrument Registration (GPS/Total Station)
- m. Digital copy of all applicable survey returns
- n. Certificate of title duly certified by the Register of Deeds (ROD) concerned.

Sec. 8. Verification of Survey Returns. Survey returns and other related documents enumerated under Sec. 7 shall be verified by the supervising DENR GE. The supervising DENR GE shall stamp or write his/her name and affix his/her signature in all pages of the field notes, computation sheets, lot descriptions and other related submitted documents during the process of verification. After verification and if the required documents are found to be in order, the Chief of Regional Surveys Division shall sign the survey plan(s) and other necessary endorsement letter to the RTD for Lands for approval. However, if any of the documents is incomplete and inaccurate, the GE who conducted the survey shall be informed immediately in writing by the RTD for Lands.

Sec. 9. Criteria for the Recovery of Control Stations or Lot Corners for Transformation. The following provisions shall guide the recovery of control stations and lot corners for transformation to PRS92:

- a. Transformation accuracy is generally determined by the following factors, namely;
 - Number of common points;
 - Distribution of common points around the project area;
 - Accuracy of positions of common points; and
 - Transformation technique adopted
- b) The provisions of DENR Administrative Order No. 98-12 (Manual for Land Surveys) pertaining to the “common point” should be complied with. In general, the higher the accuracy required, the more common points are needed. If the local survey network is consistently and homogeneously accurate, a single common point will be sufficient to determine the shift of the local network to PRS92. However, this is a highly unlikely scenario and the more irregular the local survey network, the more common points will be required.
- c) To provide redundant measurements for a least squares solution of the transformation parameters, it is always best to recover and observe more than the minimum number of common points per survey project. Generally, a minimum of six (6) recovered control points per survey project will be sufficient to generate the transformation parameters on the assumption that these points are well distributed around the project area and have homogeneous accuracy. Redundant points will provide a clearer picture of the consistency of the survey network and the derived transformation parameters.
- d) A number of the redundant common points can serve as “check points”, i.e., points reserved from the initial

transformation modeling and later used as independent check of the quality of the transformation process by comparing actual and transformed positions. If the difference between the actual and transformed positions (residuals) is not acceptable, any of the following three courses of action may be done:

- Repeat the process of deriving the transformation parameters using a different set of “common points”
- Recover and observe more “common points”
- Use a different transformation technique

Sec. 10. Positions of Common Points. To locate the positions of control points and lot corners in open, vegetated and other areas, the use of the following survey equipment is recommended:

a) If the recovered survey stations or lot corners are located in open areas (i.e., line-of-sight to GPS satellites is at least 150 above the horizon around the point), GPS receivers may be used to locate their positions. These geocentric GPS observations based on the World Geodetic System of 1984 (WGS84) are later converted to geodetic PRS92 coordinates using a 7-parameter transformation formula. The line-of-sight criterion is a requirement for GPS observations to minimize or eliminate multipath error that results to an erroneous distance between the satellite and the receiver due to intervening structures (such as buildings, houses, fences), trees or towers or antennas.

b) If a control point or lot corner is covered by vegetation or is adjacent to structures, towers, or fences higher than the tripod-mounted GPS receiver, it is recommended that its position should be located using an electronic total station either by traverse from an existing control network or by a side-shot from the nearest GPS station established in an open area.

Sec. 11. Transformation Formulas. The Helmert’s four-parameter equation and the Affine transformation shall be used to transform to PRS coordinates.

a) One mathematical model that can be used for transformation is Helmert’s four-parameter equation involving rotation, scaling and translation to preserve the shape of the lot or feature being transformed. This is a linear conformal transformation with translation, or shift, based on the following mathematical model:

$$\begin{aligned} A * X + B * Y + CE &= E \\ -B * X + A * Y + CN &= N \end{aligned}$$

where A, B = scale and rotation constants
 CE, CN = translation, or shift, constants
 X, Y = PPCS-TM/Luzon 1911 coordinates
 E, N = PPCS-TM/PRS92 coordinates

(Note: PPCS-TM refers to the Philippine Plane Coordinate System in the Transverse Mercator Projection)

The number of unknown parameters is four (A, B, CE and CN) while the number of equations is two per control point. Therefore, mathematically, two control points will solve the parameters. However, more than two points are needed for error adjustment using the least squares method.

b) Another mathematical model is affine transformation with six unknown parameters and, mathematically, can be solved using three control points. However, for increased accuracy, more than three points should be recovered. Affine transformation uses the following model:

$$\begin{aligned} A * X + B * Y + CE &= E \\ -D * X + F * Y + CN &= N \end{aligned}$$

where A, B, D, F = scale and rotation constants

CE , CN = translation, or shift, constants
X, Y = PPCS-TM/Luzon 1911 coordinates
E, N = PPCS-TM/PRS92 coordinates

Sec. 12. Supplementary Regulations. Whenever necessary, the Supervising Undersecretary, upon the recommendation of the Director of the Land Management Bureau (LMB), shall issue additional or supplementary regulations for the effective implementation of these guidelines.

Sec. 13. Penalties. Any violation of any provision of this IRR by a Geodetic Engineer or survey contractor shall be sufficient ground for non-acceptance of the survey returns submitted for verification and/or approval and shall be dealt with accordingly pursuant to Section 73 to 80 of DAO 2007-29.

Sec. 14. Repealing Clause. Any provisions of previous DENR orders, memorandum circulars and other issuances inconsistent herewith are hereby accordingly superseded, amended or repealed.

Sec. 15. Effectivity. This Order shall take effect fifteen (15) days after its publication in a newspaper of general circulation and upon acknowledgment of receipt of a copy thereof by the Office of the National Administrative Register (ONAR).

Adopted: 18 June 2010

(SGD.) HORACIO C. RAMOS
Secretary

[*] Text Available at Office of the National Administrative Register, U.P. Law Complex, Diliman, Quezon City

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