# Infomapper

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## Contents





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*Editors' note: Due to space constraints, we could not publish the references consulted for all the articles for this issue. Interested individuals may avail themselves of the lists from the authors or the editors of this publication.*

## Editorial

# Realizing NSDI, Realizing Progress through the Philippine Geoportal

Project proposals get worked on for their drafting and approval. When the go-signal for its implementation was given one red-letter day in November 2010, the Philippine Geoportal Project could have been just another planned program of work, but it is not. There had been a long journey leading to its realization, its concept is old, and it had a forerunner known as *NSDI* or *National Spatial Data Infrastructure*.

The creation, way back in 1993, of a group of GIS practitioners from government agencies, the private sector, and the academe called *Inter-Agency Task Force on Geographic Information (IATFGI)* jumpstarted the establishment of the spatial data infrastructure for the Philippines. The NSDI is essentially a collection and somehow a portal of all of the geographic information produced and maintained by the different organizations all over the country. There were two primary tasks assigned to the IATFGI. One was promoting and coordinating the efficient development, management, and utilization of geographic information in the country. Another was leadership in the establishment of the NSDI. The IATFGI officially ended in 2008 but these two tasks have to continue, for as long as geographic information is available, there would be the need to further acquire, manage, and be able to disseminate them to users.

Active participation in the establishment of the NSDI was expected of NAMRIA since the Agency chaired the IATFGI and, by virtue of its mandate as the central mapping and resource information agency of the Philippine government, has first and foremost been part of numerous efforts to help realize the NSDI. The NAMRIA-led IATFGI efforts include coming up with manuals, data standards, policies, programs and projects related to the management of geographic information; conducting an inventory of geographic information holdings and projects; and creating the needed technical working groups on sectors on agriculture, environment, and natural resources; infrastructure and utilities; lands and surveys; socioeconomic; research, training, and technology. At the end of its official duration, the IATFGI was able to formulate a framework plan for the SDI of the Philippines with assistance from the World Bank. Undaunted by unrealized moves like the creation of a body that will govern NSDI to be called *National Geographic Information Council*, NAMRIA continued to undertake activities that would pave the way for the establishment of the NSDI. The rationalization plan of NAMRIA seeks in part to strengthen the Agency and its board through the inclusion of IATFGI functions and to strengthen its research and development group so that the Agency could continuously seek solutions to concerns and issues. Its continued efforts to lobby and submit proposals to sponsoring agencies and institutions for the development of the NSDI finally paid off in the approval and consequent E-Gov funding by the Commission on Information and Communications Technology (CICT) of the proposal for the Philippine Geoportal Project.

The Philippine Geoportal Project, working on the *One Nation One Map* principle, essentially aims to unify the country in the use of just one map, that is one standard multiscale basemap for different users. It likewise seeks to enable the widespread, democratic use of geospatial data via an Internet-based geographic information system.

NAMRIA is not just the lead implementer for the project but is also a contributor primarily in terms of providing the updated digital base layer, all the basemaps it produces over which other agencies will lay their own sets of geographic and attribute information for sharing to the public. It is also the Agency's role to house the basemaps and other fundamental datasets and to first clear the data prior to their uploading into the Portal. NAMRIA is establishing its own SDI, putting together all of the available data including those it produces.

To date there have been projects showcasing the NSDI mechanism where NAMRIA provided the basemap and the different agencies overlaid their own information. There is the READY project being undertaken for the production of multihazard maps. Another

*...continued on page 38*

# PageNET: Mapping the Philippines, Linking the World

*by Ma. Almalyn A. Balladares[*]*

Since its inception in 2007, the Philippine Active Geodetic Network (PageNET) has gone a long way into realizing its objectives. The Network, which was designed to support the Philippine Reference System of 1992 (PRS92) Project, primarily aims to give online positioning service and real-time positioning capability to its users. It is also envisioned to provide a modern fundamental referencing infrastructure to related applications such as mapping, GIS, and navigation; and to contribute to local and international Global Navigation Satellite System (GNSS) initiatives in support of Earth observation and scientific studies.

At present, the PageNET consists of 13 Active Geodetic Stations (AGSs) installed in strategic locations throughout the Philippines. All stations are already continuously gathering and transmitting geographic position data to the Network's Data and Control Center (DCC) at the NAMRIA Main Office in Taguig City. The data generated by the 13 stations are being used to support different applications both within and outside the Agency.


There are currently 13 AGSs established nationwide. These AGSs and their respective locations are:

1. PBAY - Bayombong, Nueva Vizcaya
2. PURD - Urdaneta City
3. PCAB - Cabanatuan City
4. PFLO - Floridablanca, Pampanga
5. PTAG - Taguig City
6. PTGY - Tagaytay City
7. PCAN - Candelaria, Quezon
8. PLEG - Legazpi City
9. PTAC - Tacloban City
10. PILC - Iloilo City
11. PSUR - Surigao City
12. PGEN - General Santos City
13. PPPC - Puerto Princesa City

## Recent Developments

*PTAG becomes part of International GNSS Service Tracking Network*

Months of lobbying to the IGS finally paid off as one of PageNET's AGSs was inducted to the IGS Network on 22 April 2011. The IGS, established in 1994, is a confederation of over 200 voluntary organizations worldwide with the aim of providing to the public the highest-quality GNSS data and products in support of scientific activities such as Earth observation and research, positioning and timing, and many other multidisciplinary applications. PTAG, the AGS installed at the NAMRIA Main Office, is one of the only two stations in the Philippines to be integrated into the IGS Network. PIMO, the first IGS-tracking station in the country, is located at the Manila Observatory in Quezon City and was established by the Jet Propulsion Laboratory of the United States' National Aeronautics and Space Administration.

This recent addition has been well received not only by the IGS but also by the *Institut Géographique National* of France, the agency that manages all DORIS (Doppler Orbitography and

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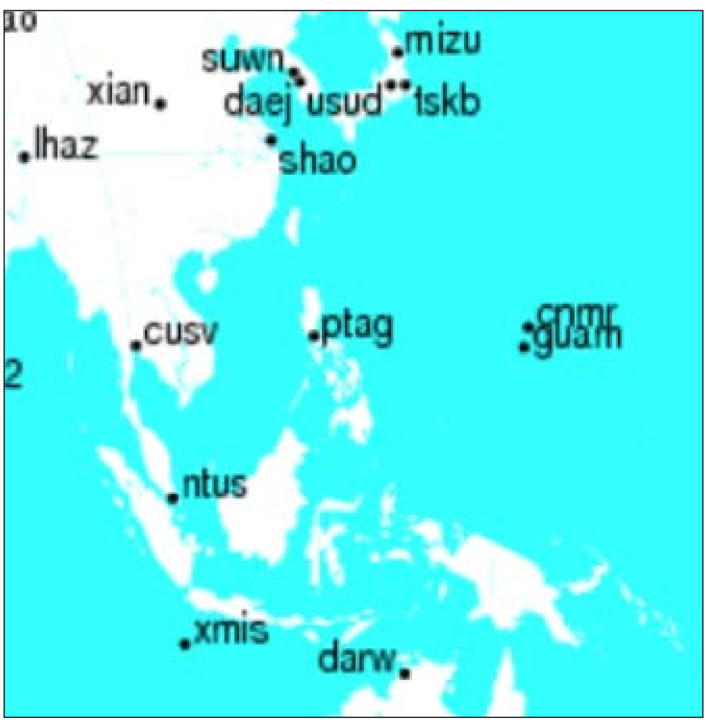


*PTAG and IGS network stations in Asia*

[*]*Project Development Officer II, AGN Section, Geodesy and Geophysics Division, NAMRIA Mapping and Geodesy Department.*

***Pagenet...*** *from page 3*

Radiopositioning Integrated by Satellite) stations around the world. One such station also exists within the NAMRIA compound and provides an interesting collocation with PTAG. Together, these two instruments provide precise satellite orbit and ground position data that are used to create an international reference frame for mapping and surveying applications around the globe.

*PTAG and DORIS stations in NAMRIA*

*PLEG goes online*

On 21 March 2011, PLEG station installed atop the Lignon Hills Nature Park in Legazpi City, Albay was successfully connected to the DCC. The station had been operational since 13 November 2009 but it remained offline due to the unavailability of reliable Internet line to be used in the data transmission. As a result, the PageNET team had to conduct regular visits to the site to manually download the data.

Configuring the Internet connection has been a challenge for the Philippine Long Distance Telephone Company (PLDT) which is the Internet service provider for the PageNET. With Lignon Hill overlooking Legazpi City and proximate to Mayon Volcano, the PLEG AGS is a strategic point for positioning and monitoring applications. However, existing telecommunication facilities that support data transmission are available only up to the bottom of Lignon Hill. The solution for the Internet connection finally came in the

*PLEG station in Legazpi City*

form of a communication reflector, which was installed within the AGS perimeter. This equipment mirrors the signal coming from the PLDT's base station and amplifies it exclusively for the PLEG AGS.

This is welcome news not just for NAMRIA but also for the Philippine Institute of Volcanology and Seismology (PHIVOLCS) which is a partner agency in exploring the application of the PageNET in the field of crustal deformation monitoring.

*APRGP 2010 results out*

Results of the recent Asia and the Pacific Regional Geodesy Project (APRGP) GNSS Campaign 2010 have been released. Seven AGSs of the PageNET participated in the seven-day continuous observation on 12-18 September 2010. The APRGP aims to build and improve the geodetic infrastructure in the Asia and the Pacific region. The Project will also provide estimates of the station coordinates in the International Terrestrial Reference Frame (ITRF) for use in local and global scientific research and applications by its member countries. Approximately 56 countries participate in the annual ITRF campaign with one contributing GNSS data from campaign or continuous GNSS stations.

*Reconnaissance for new sites*

Teams from the Mapping and Geodesy Department were deployed in the cities of Cagayan de Oro, Dapitan, Zamboanga, and Mati on 10-27 May 2011 to conduct site reconnaissance in line with the establishment of AGSs for FY-2011. The said cities are the four new sites for inclusion in the fiducial network of the PageNET. The teams have identified the following government-owned offices as hosts for the installation of a roof-based AGS: the Philippine Veterans Investment Development Corporation Industrial Authority, the Zamboanga del Norte Medical Center, the Zamboanga City National High School-West, and the Davao Oriental Provincial Capitol. Coordination with the hosts is ongoing and the draft Memorandum of Agreement has been transmitted to the respective offices.

*Ongoing system improvements*

An improvement on the system has been under way since February 2011 with the installation of the modem and the GNSS receiver resetter and fan controller at the AGSs of the Network. The resetter is designed to automatically reset the modem and GNSS receiver by dialling the SIM card number installed in the device. On the other hand, the fan controller, using a temperature sensor, automatically turns on/off the ventilating fans of the AGS once the threshold temperature is reached. These devices help in driving down the operational costs of the Network as it cuts down the energy consumption of the stations and reduces the number of site visits needed to ensure their continuous operation.

The PageNET website has been modified and a more comprehensive profile of the network has been uploaded to it. To date, an increase in interested users has been observed since the revisions were made. The PageNET website is accessible at http://pagenet.namria.gov.ph.

**On Realizing its Objectives**


*Modem and GNSS receiver resetter*


*Fan controller*

As they say, Rome was not built in a day, and so is the PageNET. However, this 2011, on its third year since the first AGS has been established, the PageNET is more than halfway into achieving its goals which are the following:

*Give online positioning service and real-time positioning capability to its users.*

The online positioning service of the PageNET is already available and accessible to its registered users through the PageNET website. This service allows the users to submit their own GNSS observation files and have its coordinates computed by the system using the AGSs as reference stations. The system is very versatile since it accepts data from any receiver brand or type through its Receiver Independent Exchange Format (RINEX) upload capability.

In terms of real-time positioning service, the PageNET can provide single-base real-time corrections with the current network configuration. This means that the users can receive real-time corrections from one AGS at a time only. Networked real-time correction, more accurate than single-base correction, requires at least three AGSs with a maximum interstation distance of 70 kilometers. To achieve this, the existing network must be augmented with additional AGSs.

*Provide a modern fundamental referencing infrastructure to related applications such as mapping, GIS, navigation, and geodynamic studies.*

The PageNET stations have been used and are continuously being utilized as references for the mapping and surveying activities of NAMRIA, e.g., the Establishment of Zero-Order Control Network, the Interisland Benchmark Connection, the Establishment of Photo Control Points, the Forestland Boundary Delineation Project, the Land Classification Pilot Projects for the PRS92 Project, and the Checkpoint Collection for the Orthorectified SPOT 5 Imageries of the Cordillera Administrative Region and Region I.

Through a Memorandum of Understanding with PHIVOLCS, the stations also support the study on active crustal structures. Data from all the AGSs are provided to PHIVOLCS, which are used as references for their campaign GNSS observations in determining and quantifying the magnitude and direction of the deformation of the crustal blocks making up the Philippines. In turn, PHIVOLCS provides NAMRIA with the coordinate estimates of the AGSs which are processed using the Bernese GPS processing software and the results of their study on crustal structures.

Data from the AGSs are also being subscribed commercially by outside companies to support their operations. On a GIS Project with the Mabalacat Water District, the Geodata Systems Technologies, Inc. was able to achieve a mean accuracy of 9.2 centimeters in establishing the positions of their ground control points using the PFLO station in Floridablanca, Pampanga as their reference. The accuracies achieved after post-processing with the PFLO station were well within or even exceeded the tolerance level (70 centimeters) required for image orthorectification. Other projects supported by the PageNET are the calibration of the aerial camera for the Digital Aerial Photography Project of Aerometrex in Rizal and Metro Manila (PTAG and PFLO were used); the mapping of water facilities by Geodata for the Manila Water; and the Digital Aerial Photography and Topographic Mapping of the Transmission Assets and Substations Project undertaken by the Certeza Infosys Corporation for the National Grid Corporation of the Philippines (PFLO was used).

The use of the PageNET stations eliminates the major logistical problem of locating a PRS92 ground monument and establishing a mobile base station, hence allowing other receivers to be used as rovers for more productivity. Owing to the good site quality of the AGSs (i.e., minimal obstructions, multipath, interference, etc.), the data gathered are sure to be of good quality. Furthermore, since the PageNET

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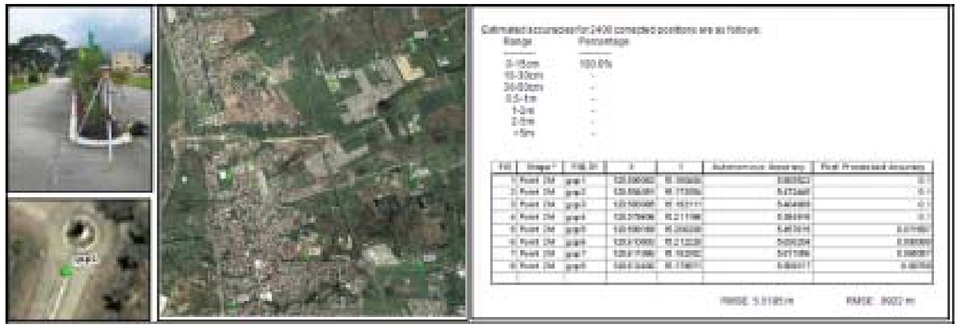
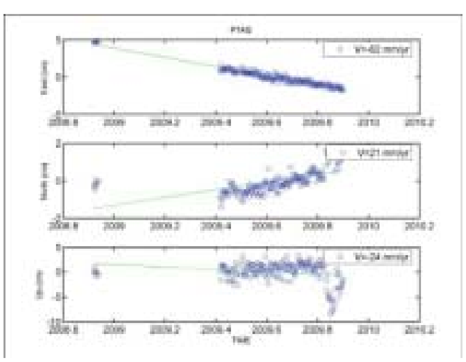
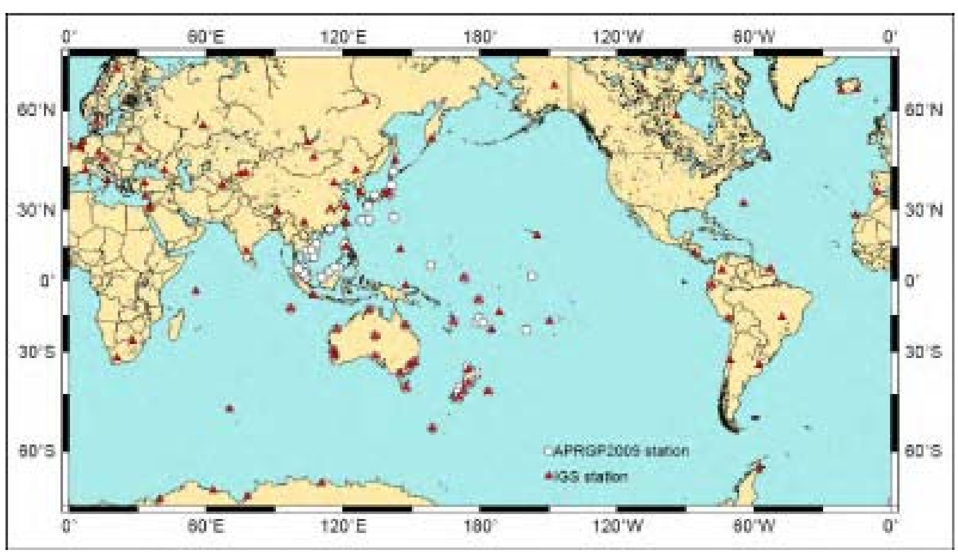


***Mabalacat Water District Project.*** *Sample GCP set up (left), Distribution of GCP points (center), Processing results (right)*




*Sample plots of PTAG coordinate analysis*




*APRGP and IGS stations used in the 2009 campaign analysis*

# The Interisland Benchmark Connection Project: Modeling the Philippine Geoid

*by Cdr. Ronaldo C. Gatchalian**

The classic way to determine accurate elevations is to perform a spirit-leveling survey. Spirit leveling employs a *spirit level*, an instrument consisting of a rigidly connected telescope and a tube level like that used by carpenters. When the bubble in the tube level is in the middle, the telescope's optical axis (collimation axis) will point exactly in the direction of the local horizontal. The spirit level is placed on a tripod in the middle, between the two points whose height difference is to be determined. The points are marked by benchmarks on sidewalks or concrete bridges. A leveling staff or rod is placed on each point with measured graduations, usually in centimeters and fractions thereof. The observer focuses in turn on each rod and reads the value from it. Subtracting the "back" and "forward" values provides the height difference. The summation of a series of back and forward values from the known benchmark to a new benchmark yields the total difference in elevation *D.E.* between the two points (benchmarks). This *D.E.* when arithmetically added to the elevation of the known benchmark will give the elevation of the new benchmark. Surveyors of the present time continue to undertake this arduous procedure of *elevation* determination.

## Mean Sea Level (MSL)

For generations, the only way to express topographic elevation has been to relate it to mean sea level. Mean Sea Level is usually described as a tidal datum that is the arithmetic mean of hourly water surface levels observed over a specific 19-year cycle. This definition averages out tidal highs and lows caused by the changing effects of the gravitational forces from the moon and the sun (Fraczek, ESRI).

MSL is defined as the zero elevation for a local area. The zero surface referenced by elevation is called a *vertical datum*. Unfortunately for mapmakers, sea level is not a simple or regular surface. The sea surface corresponds to the earth's gravity field which is not uniform because of the differing density of the earth's crust. This is why the MSL has slight hills and valleys that are similar to the land surface but are much smoother**.** For example, the zero elevation as defined in Manila is not the same zero elevation as defined in Legazpi, Cebu, Davao or any part of the country. This is why the respective MSLs of locally defined vertical datums differ from one another with reference to an ellipsoid surface. ***(See Figure 1)***

## Geoid Undulation (*N*)

The Global Positioning System (GPS) uses ellipsoidal height *h* above the reference ellipsoid that approximates the earth's surface. The traditional orthometric height *H* is the height above an imaginary surface called the *geoid*, which is determined by the earth's gravity and approximated by MSL. The difference between the two heights, i.e., the difference between the ellipsoid and the geoid, is the geoid undulation *N*. This *N* can also be regarded as the height (above the ellipsoid surface) of the locally defined vertical datum (MSL) of a local area. **Figures 2** and **2A** show the relationships between the two height models. The geoid/MSL undulation is computed by: $N = h - H$.

Undulations result from several phenomena, the most significant of which is the existence of gravitational anomalies caused by the nonhomogeneous nature of the earth. The density of magma in the earth's crust is unevenly distributed. In areas of greater density, it can be significantly higher and consequently cooler. Less dense areas are correspondingly lower and hotter. Dense magma exerts a stronger pull which causes the accumulation of water masses. Not much is known about whether these volumes relocate or how fast they move. If these locations do move, their movement would be at the same pace as other geologic events (i.e., extremely slow) (Fraczek, ESRI). This causes the differing values of *N* in every locality.

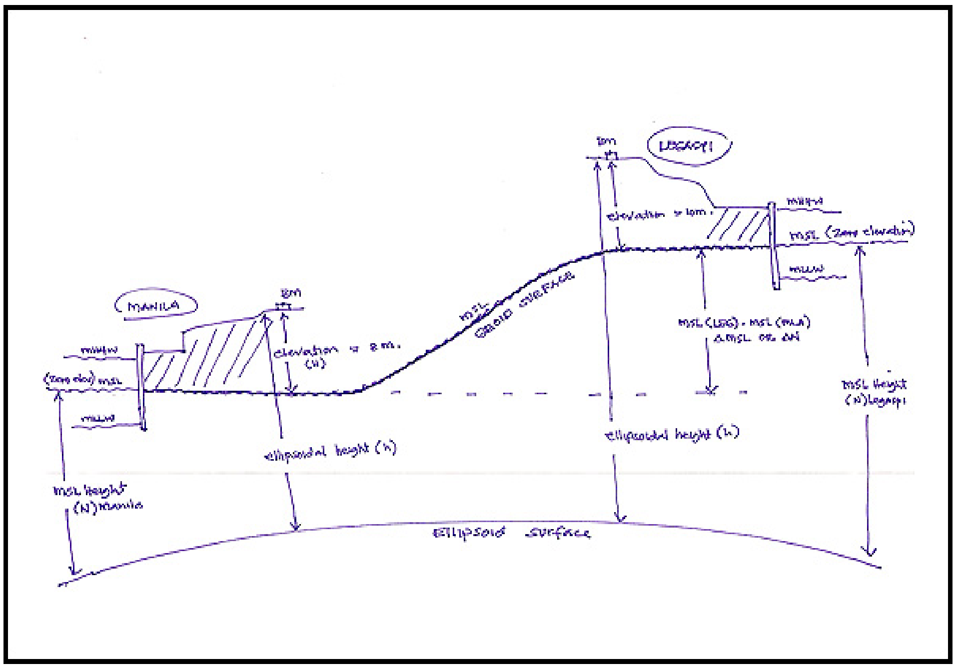



*Figure 1*

*Officer In Charge, Geodesy and Geophysics Division, NAMRIA Mapping and Geodesy Department*

## The Interisland Benchmark (BM) Connection Project

The Interisland BM Connection or GPS/Leveling Survey Project (i.e., GPS measurements at benchmarks) has been one of the projects of NAMRIA since 2009. The project aims to relate the vertical datum (MSL) in Manila to the MSLs of different parts and major islands of the country. The project uses dual frequency GPS receivers occupying selected tidal benchmarks for seven hours in each loop. The Active Geodetic Station PTAG was used as reference with its local WGS84 coordinates. ***(See Figure 3)***

Using the geoid undulation formula $N = h - H$, the processed GPS heights $h$ of the observed tidal benchmarks were subtracted from their corresponding orthometric heights ($H$ from the tide stations) to get the $N$ values of local MSL. To model the local MSL heights or geoid, the $N$ values were plotted using the first column (station name) and sixth column ($N$ local MSL) of Table 1. ***(See Figure 4)***

For comparison and to test if our computed/plotted MSL model will fit the global geoid model, Earth Gravity Model 2008 (EGM08), the GPS-derived orthometric heights from EGMO8 (third column of Table 1) were included to compute the $N$. These $N$s were also plotted using Table 1. ***(See Figure 4A)***

Figures 4 and 4A show the heights of geoid/MSL undulations (local MSL and EGM08, respectively) with respect to the

*...continued on next page*

| Computation of GEOID heights (N): Local MSL and EGM08 | | | | | | | |
|---|---|---|---|---|---|---|---|
| STATION NAME | Ellipsoidal Height (h) | ELEVATION (EGM08) | ELEVATION (H) | N(EGM08) | N (local MSL) | EGM08-H | ΔN (N-Nbm66) |
| BM1-BTS (Batanes) | 35.289 | 5.078 | 2.3824 | 30.211 | 32.9066 | 2.6956 | -12.7245 |
| BM1-CAG (Cagayan) | 40.284 | 4.331 | 2.1026 | 35.953 | 38.1814 | 2.2284 | -7.4497 |
| BM1-ILN (Ilocos Norte) | 41.741 | 5.173 | 2.6552 | 36.568 | 39.0858 | 2.5178 | -6.5453 |
| LU-162 (La Union) | 52.495 | 11.897 | 9.674 | 40.598 | 42.821 | 2.223 | -2.8101 |
| ARA 3419 (Aurora) | 49.544 | 5.393 | 2.842 | 44.151 | 46.702 | 2.551 | 1.0709 |
| BM1-SBMA (Olongapo) | 48.557 | 4.95 | 1.9937 | 43.607 | 46.5633 | 2.9563 | 0.9322 |
| BMX-REAL (Quezon) | 50.349 | 4.347 | 1.7857 | 46.002 | 48.5633 | 2.5613 | 2.9322 |
| BM-66 (Manila) | 46.937 | 3.917 | 1.3059 | 43.02 | 45.6311 | 2.6111 | 0 |
| BM1-BTN (Bataan) | 48.374 | 5.615 | 2.6667 | 42.759 | 45.7073 | 2.9483 | 0.0762 |
| BG-154 (Batangas) | 89.211 | 44.317 | 40.8568 | 44.894 | 48.3542 | 3.4602 | 2.7231 |
| MR-118 (Mindoro) | 50.833 | 5.189 | 1.9283 | 45.644 | 48.9047 | 3.2607 | 3.2736 |
| BM5-MQ (Marinduque) | 55.785 | 6.52 | 3.496 | 49.265 | 52.289 | 3.024 | 6.6579 |
| TGBM-CNS (Catanduanes) | 57.289 | 5.009 | 2.0954 | 52.28 | 55.1936 | 2.9136 | 9.5625 |
| BMX-ABY (Albay) | 58.4 | 5.138 | 2.0818 | 53.262 | 56.3182 | 3.0562 | 10.6871 |
| BM1-SRG (Sorsogon) | 60.686 | 5.694 | 2.4285 | 54.992 | 58.2575 | 3.2655 | 12.6264 |
| BM2-MST (Masbate) | 61.342 | 5.567 | 2.1788 | 55.775 | 59.1632 | 3.3882 | 13.5321 |
| TGBM-AK (Aklan) | 59.863 | 6.16 | 2.517 | 53.703 | 57.346 | 3.643 | 11.7149 |
| BM1-SME (E.Samar) | 68.411 | 5.717 | 2.1543 | 62.694 | 66.2567 | 3.5627 | 20.6256 |
| NW-216 (Negros Occ.) | 68.236 | 6.843 | 3.3778 | 61.393 | 64.8582 | 3.4652 | 19.2271 |
| BM3A-CBU (Cebu) | 69.527 | 6.467 | 2.957 | 63.06 | 66.57 | 3.51 | 20.9389 |
| PL-02 (Palawan) | 62.735 | 12.295 | 9.1807 | 50.44 | 53.5543 | 3.1143 | 7.9232 |
| TGBM-BHL (Bohol) | 69.463 | 5.924 | 2.7738 | 63.539 | 66.6892 | 3.1502 | 21.0581 |
| NE-GS 1 (Negros Or.) | 68.52 | 5.366 | 1.9732 | 63.154 | 66.5468 | 3.3928 | 20.9157 |
| TGBM-CGN (Camiguin) | 70.535 | 5.17 | 2.2561 | 65.365 | 68.2789 | 2.9139 | 22.6478 |
| BMX-SRS (Surigao Sur) | 73.674 | 6.04 | 2.3457 | 67.634 | 71.3283 | 3.6943 | 25.6972 |
| BM5-MSE (Mis. Or) | 75.014 | 5.17 | 2.089 | 69.844 | 72.925 | 3.081 | 27.2939 |
| TGBM-ZGS (Zambo Sur) | 74.315 | 5.504 | 1.8222 | 68.811 | 72.4928 | 3.6818 | 26.8617 |
| BM1-ZGS (Zambo City) | 74.602 | 6.975 | 3.5232 | 67.627 | 71.0788 | 3.4518 | 25.4477 |
| BM1-DVE (Davao) | 73.438 | 7.656 | 2.61 | 65.782 | 70.828 | 5.046 | 25.1969 |
| SC-20 (S. Cotabato) | 76.639 | 6.076 | 2.4819 | 70.563 | 74.1571 | 3.5941 | 28.526 |

*Table 1*

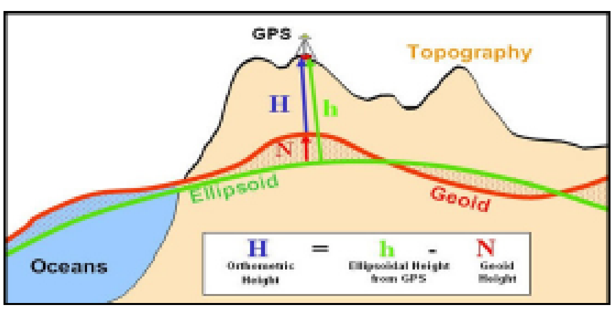



*Figure 2*

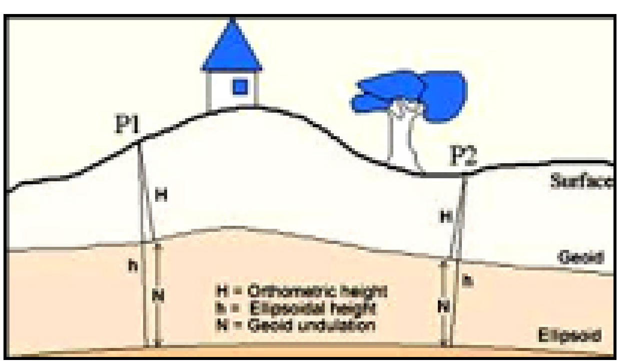



*Figure 2A*

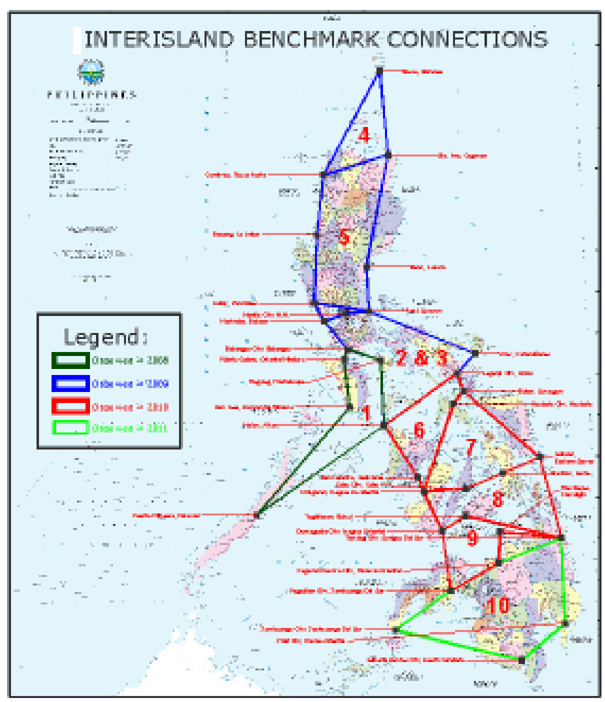



*Figure 3*

## *The Interisland... from page 7*

ellipsoid surface. MSL height comparisons can be made by examining the graphs and the sixth column of Table 1. For example, these graphs indicate that the BM1-BTS MSL (Batanes) is lower compared to the BM1-ZGS MSL (Zamboanga); and the BM-66 MSL (Manila) is lower than all MSLs in Visayas and Mindanao. Take note of the similarity of the height patterns of the two graphs (local MSL and EGM08).

Combining the two graphs in Figures 4 and 4A resulted in Figures 4B and 4C. Looking at the combined graphs, one can conclude that the local MSL/geoid undulations correspond with the global geoid model (EGM08) undulations. Both graphs exhibit the same pattern with nearly the same differences (except Davao Oriental). This means that the modeled local MSL fits the global geoid model (EGM08). This also means that we can use the EGM08 in computing local elevations by applying the corrections (local MSL and EGM08 differences). We can also use EGM08 as the foundation in computing for the Philippine geoid model.

### Mean-Sea-Level Relationships

Figure 5 shows the MSL relationships or differences in MSL (Ä*MSL* or Ä*N*) with respect to BM-66 MSL (Manila). This graph shows that the MSL heights of Batanes, Cagayan, Ilocos Norte, and La Union are all lower than the MSL height of Manila. Conversely, all other MSL heights from Aurora to South Cotabato are higher than the MSL height of Manila. The numbers in the graphs indicate the separation of the MSL heights with respect to BM-66 (Manila). (***See eighth column of Table 1)***

As GPS surveys have come into wide use, the need has been increasing for the geoid model as a conversion surface, from GPS-derived ellipsoidal heights to leveling-derived elevation. EGM08 is available for GPS users to compute orthometric heights (elevation). The use of this geoid model in GPS processing will give the MSL heights of GPS points. In the fifth and sixth columns of Table 1, however, we see that the *N* values of EGM08 are lower by an amount ranging from 2.2 meters to 3.6 meters from North to South of the Philippines ***(see Figure 6)***. To get the correct local elevation (fourth column of Table 1), one must subtract from the GPS-

**Plotted *N* values of local MSL**

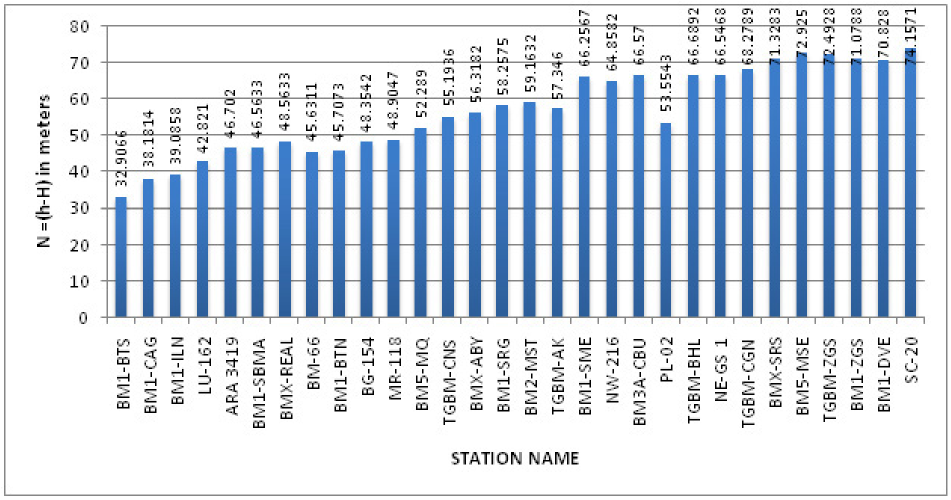



*Figure 4*

**Plotted *N* values of EGM08**

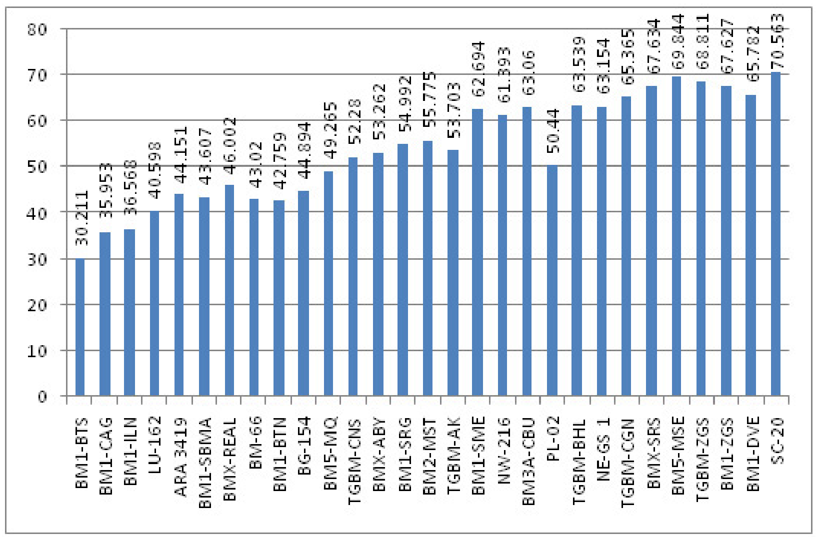



*Figure 4A*

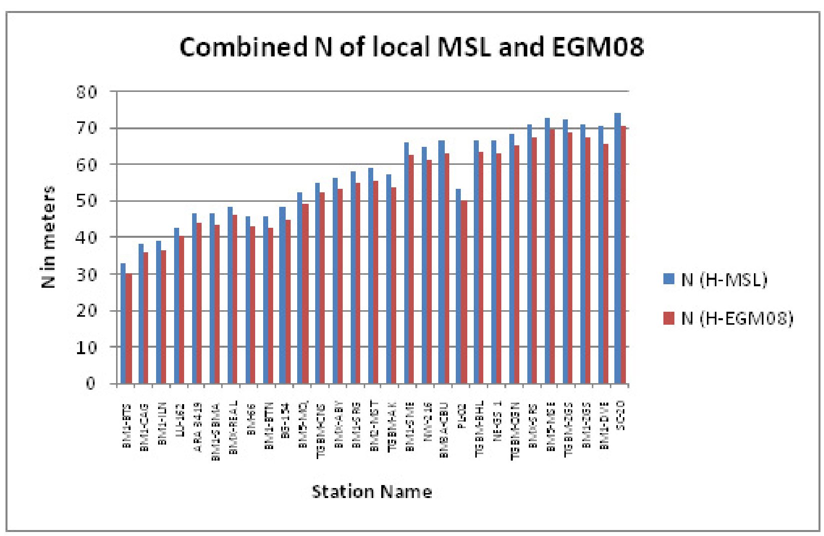



*Figure 4B*

## Graphical plots of combined *N* of local MSL and EGM08

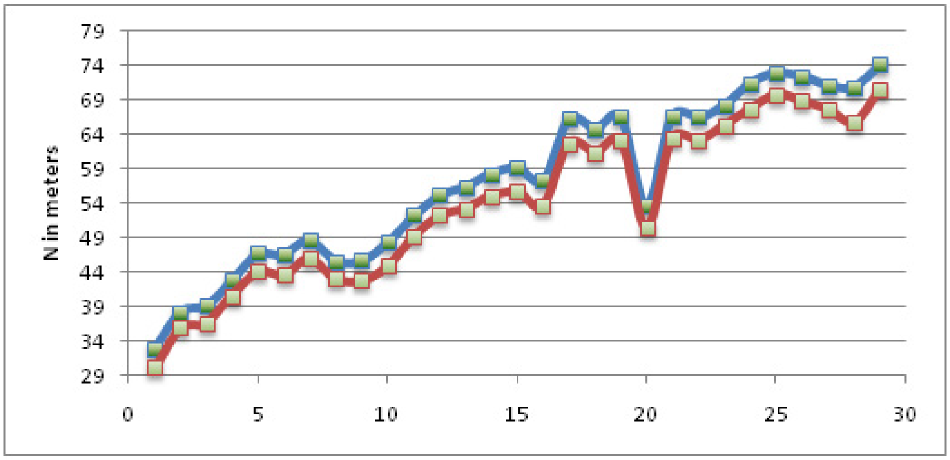



*Figure 4C*

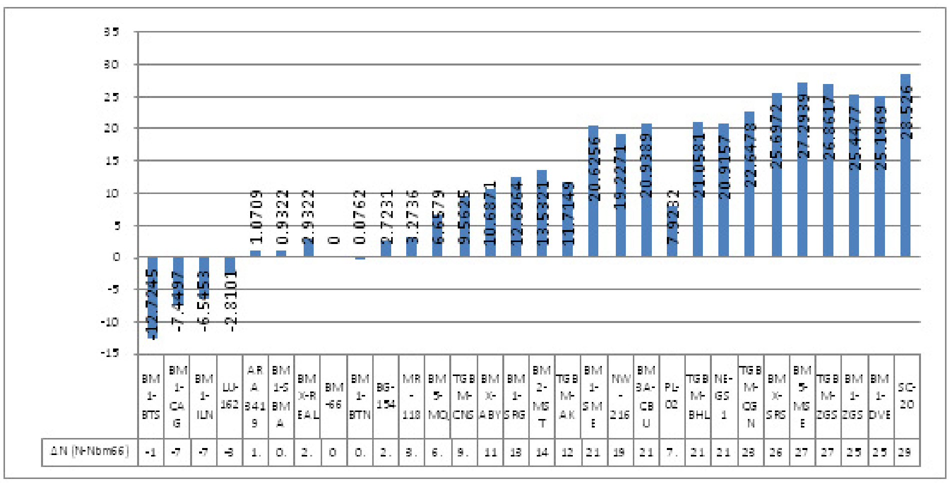



*Figure 5*

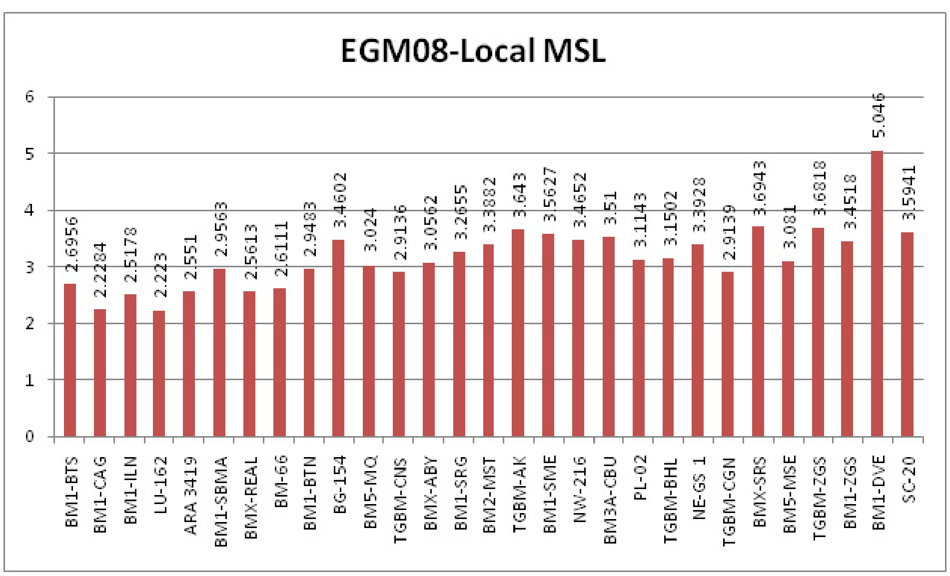



*Figure 6*

derived elevation using EGMO8 model (third column of Table 1) the correction of the corresponding region or province (seventh column of Table 1). For example, to know the elevation of the PRS92 GCP in Batanes, one needs to subtract 2.6956 meters (seventh column) from 5.078 meters (third column) to get 2.3824 meters (fourth column) as the correct local elevation.

If the EGM08 geoid file is not available or if a handheld GPS is used in the survey, the equation $H = h - N$ may be employed. Using Table 1, the $N$ of local MSL of a province (sixth column) must be subtracted from $h$ of the point to get local elevation $H$. For example, for Zamboanga City, 71.0788 meters is subtracted from the WGS84 ellipsoidal height, 74.602 meters to get the local elevation, 3.5232 meters.

The result of the Interisland BM Connection Project will give surveyors an alternative method for determining elevations by providing a crude geoid model for the country. This local geoid model corresponds to the global geoid model EGMO8 with some corrections (Figure 6). It can be used by local surveyors/engineers (using GPS) to estimate elevations of points in regions or locations where there are no available reference benchmarks.

Some test computations were performed in some known points and the accuracy result ranged from 0.14 meter to 0.99 meter depending on the proximity of the test point to the GPS/leveling points. With the assumption that the Position Dilution of Precision (PDOP) is less than 5 or the GPS data is post-processed.

The BM Connection to GCPs Project of NAMRIA will greatly improve this local geoid model by doing GPS/leveling survey on a provincial level. The survey will be executed by connecting GCPs (by leveling) to the benchmarks. This will give elevations to the GCPs and eventually provide denser *N* values that will fill the gaps between tidal benchmarks and refine the model.

Gravity surveys will be combined to the GPS/leveling survey to complete the model computation. The final model computation will be fitted into the global model EGMO8 and incorporated into the GPS processing software.

The Interisland BM Connection Project is just the first step, for further research and consultations are necessary to finalize a refined and reliable Philippine geoid model whose target completion is in 2014.•

# NAMRIA Tide Stations and Their Importance to Tsunami Early Warning

*by Cdr. Rosalino C. Delos Reyes and Ens. Von Allen Ross N. Medina,*
*NAMRIA Hydrography Department*

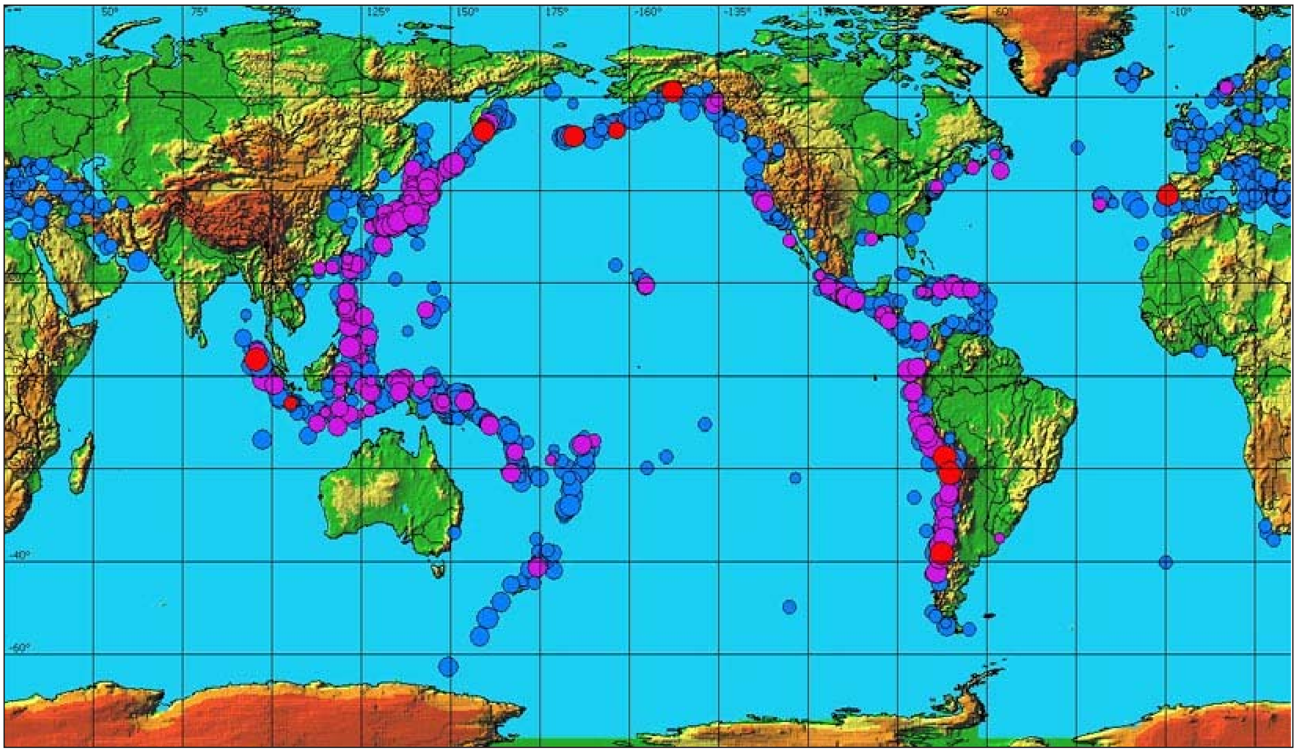


*Figure 1. Global Tsunami Database (GTDB), Tsunami Laboratory, ICMMG SD RAS, Novosibirsk, Russia, 2006*

"*Tsunami*" is a Japanese word which literally means "harbour wave." It is distinguished from tidal waves by the fact that tsunamis have nothing to do with forces exerted by the moon and the sun. Even though both tsunami and tidal waves cause water to move inshore, the movements caused by tsunamis are considerably larger and last much longer. A tsunami is a series of water waves generated by a large, impulsive displacement of water. It has three stages: generation, propagation, and inundation.

**Tsunami Generation**

A tsunami is caused by several factors, like massive landslides into or under the water surface, underwater volcanic eruptions, and asteroid impacts. Most of the tsunamis that have been recorded, however, were generated by earthquakes occurring on or beneath the seafloor.

This extraordinary wave occurrence is a high-impact, low-frequency natural hazard. Since 1650, more than 2,000 tsunamis have been recorded worldwide, 59% of which occurred in the Pacific. Since the turn of the 20th century, however, the incidence of tsunamis has risen in the Pacific where in fact, 77% of the tsunamis recorded around the world occurred.

The Pacific Ring of Fire generates 90% of the earthquakes around the globe. Based on this fact and the foregoing statistics as well, it can only be inferred that most of the tsunamis that will occur in the future will happen in the Pacific area.

**Tsunami Propagation**

The tsunami has three kinds, based on the distance it can cover. The first is a local tsunami ***(blue circle, Figure 1)*** which affects coastal areas within 100 kilometers of the tsunami source. The second is a regional tsunami ***(magenta circle, Figure 1)*** which can travel 100-1000 kilometers from the source. The third is an ocean-wide tsunami ***(red circle, Figure 1)*** that can affect coastal areas thousands of kilometers from the source. A tsunami can travel up to a speed of 900 kilometers per hour. The waves propagate in all directions and the wavelengths extend as far as 200 kilometers, making them unnoticeable in deep waters.

**Tsunami Inundation and Signs**

This is the stage which can result in some localised overflow into the immediate foreshore. A tsunami is a threat to lives and properties in low-lying coastal areas. As the waves enter shallow water, the speed lessens but the height increases, thus creating devastating waves. The signs of an approaching tsunami are the following: an earthquake may be felt; large quantities of gas may bubble up to the water surface; the water in the waves may be unusually hot; the water may smell of rotten eggs (hydrogen sulfide) or of oil; the water may sting the skin; the sea recedes to a considerable distance; and there is the sound like that of a roaring engine.

**Tsunami Early Warning**

The worst problem that compromises human lives and properties in coastal areas is that a tsunami cannot be stopped once it is set in motion. Nevertheless, scientists are continuously studying tsunamis to better understand their behavior and they have already made progress in monitoring and predicting the threats of tsunamis. It is possible to issue warnings of a tsunami's arrival times because tsunamis travel at a known speed. The following are key points which, when followed properly, may help minimize a tsunami's potential damages: prior knowledge of the risks faced by susceptible communities; technical monitoring and warning service for these risks; dissemination of understandable services for these risks; and knowledge and preparedness to act.

A tsunami may be generated if an earthquake detected is offshore, has a magnitude of at least 6.5, and depth of less than 100 kilometers. Tsunami meters and tide gauges are the instruments that can be used to determine and confirm the existence of a tsunami. A *tsunami meter* consists of a pressure recorder situated at the bottom of the ocean and a buoy floating near it. The recorder is used to detect changes in the water pressure. It is capable of detecting tsunamis as small as a centimeter high above sea level. The recorder sends the data to the buoy which forwards the data to a satellite that in turn transmits the data to warning centers. A *tide gauge* is the main instrument in sea-level monitoring stations. It measures the rise and fall of tides and is an indication of a passing tsunami if an abrupt change in sea level is monitored.

Early-warning centers like the Pacific Tsunami Warning Center (PTWC) in Hawaii and the Regional Integrated Multi-Hazard Early Warning System (RIMES) for Africa and Asia in Thailand operate round the clock to be able to act accordingly and swiftly in times of emergencies. Member states of the international tsunami warning system continuously coordinate their activities to these centers. RIMES is an international, intergovernmental, nonprofit organization registered with the United Nations (UN) Secretariat under Article 102 of the UN Charter which is mandated to provide regional early-warning services and build the capacity of its member states in the early warning of tsunami and other natural hazards.

Last year, NAMRIA entered into a Memorandum of Agreement with RIMES for the establishment, operation, and maintenance of sea-level stations in the country. The Agreement was drawn up under the broader Cooperation Agreement on the RIMES for Africa and Asia, which was signed on 18 May 2010 in Incheon, Republic of Korea by the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) on behalf of the Republic of the Philippines.

With the Agreement, RIMES will collaborate with the NAMRIA Hydrography Department in the establishment of sea-level stations in the country for the purpose of providing tsunami early warning in the South China

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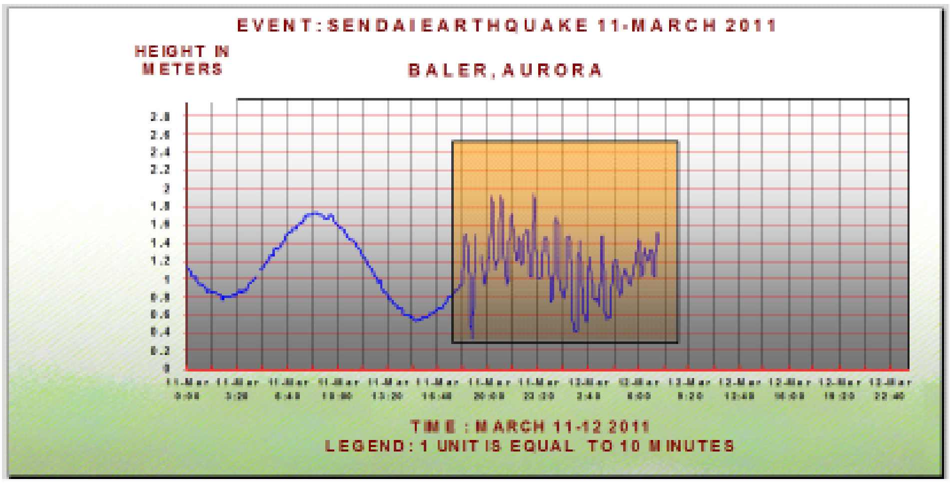
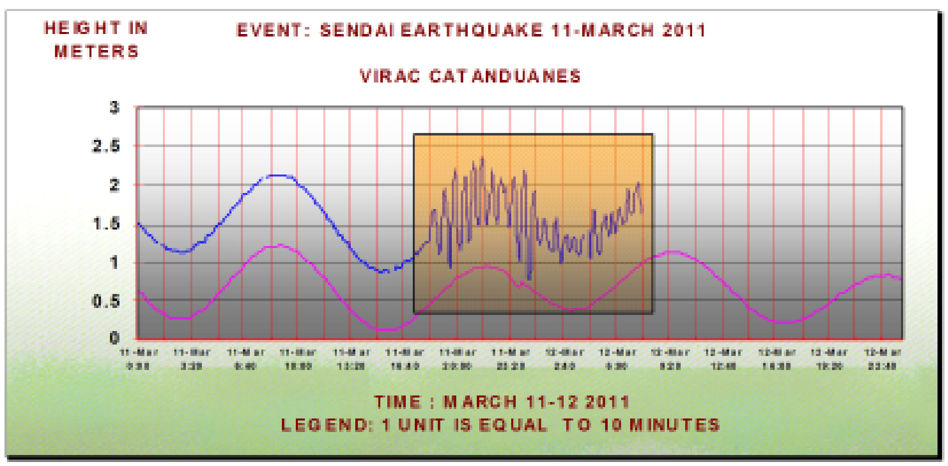
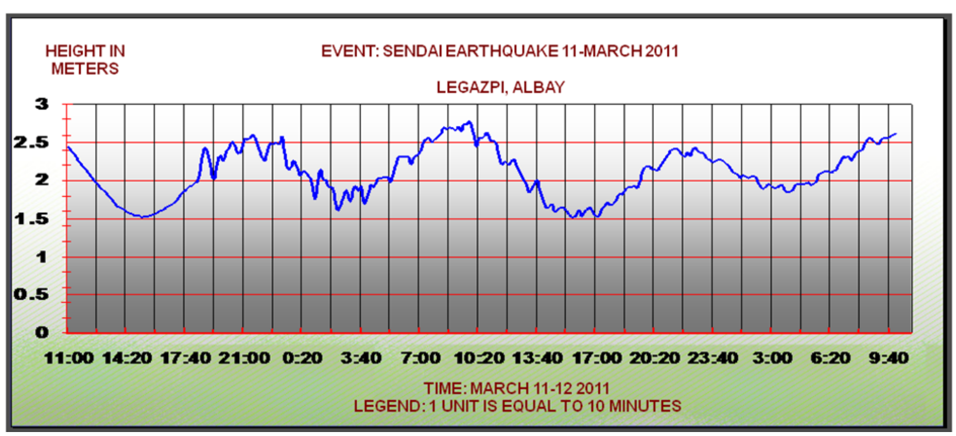
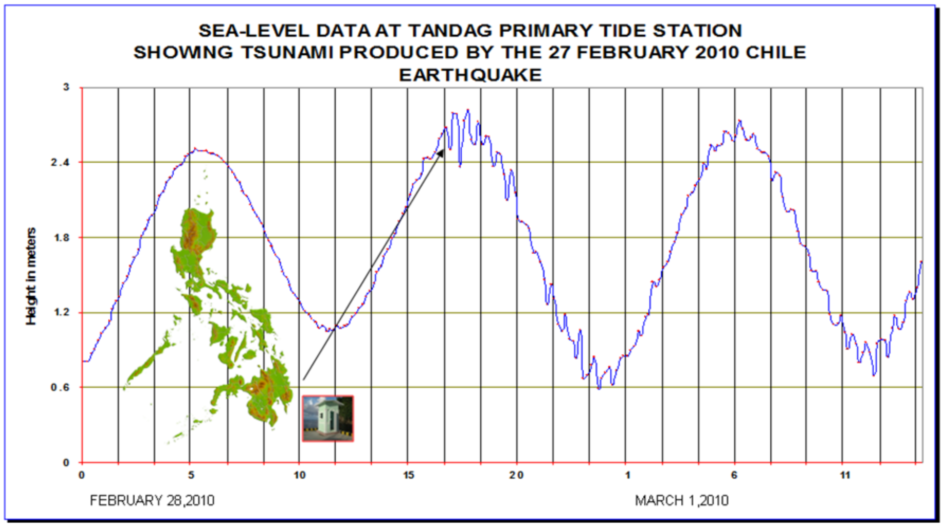
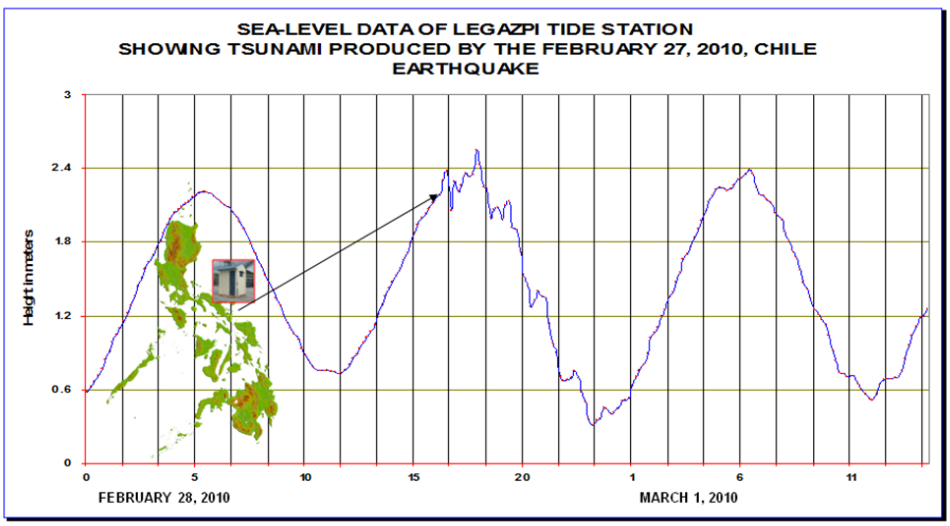


*NAMRIA Tide...* *from page 11*




Sea region; exchange near-real-time sea-level monitoring data with NAMRIA; build the capacity of the Agency's technical personnel in tsunami-warning operations with particular focus on sea-level data acquisitions, processing and analysis, including tsunami forecasting; provide periodic support in the maintenance of the stations; and communicate NAMRIA's contribution to regional tsunami warning in all regional and international forums such as those organized by the UN Educational, Scientific, and Cultural Organization/ Intergovernmental Oceanographic Commission (IOC). Also last year, three technical personnel from the Oceanography Division of the NAMRIA Hydrography Department completed their six-month term as seconded scientists-tsunami watch standers at the RIMES regional facility in Pathumthani, Thailand.

| Tide Stations Equipped with Local Telemetry | | Tide Stations Linked to IOC |
|---|---|---|
| Baler, Aurora | Pagadian, Zamboanga del Norte | Currimao |
| Balintang, Palawan | Real, Quezon | Davao City |
| El Nido, Palawan | San Vicente, Cagayan | Legazpi |
| Guiuan, Eastern Samar | Tandag, Surigao del Sur | Lubang Island |
| Legazpi, Albay | Virac, Catanduanes | Manila |
| Mati, Davao Oriental | Zamboanga City | Subic |

**NAMRIA Tide Stations**

The tide stations in Cebu, Davao, Legazpi, and Manila have been operational for more than 60 years. By 2006, eight more stations had been set up while to date, NAMRIA operates and maintains a total of 47 tide stations, all capable of measuring and monitoring sea levels. Tidal datum planes such as mean sea level and mean lower low water are derived from the continuous data gathered by these tide stations. The data are also used in the *Tide and Current Tables* annual publication of NAMRIA.

Twelve of these stations are equipped with local telemetry that can provide near-real-time data transmission. Six NAMRIA tide stations are also linked to the IOC Sea-Level Facility and are capable of providing real-time data online.

**March 2011 Japan Tsunami and February 2010 Chile Tsunami**

NAMRIA tide stations were able to measure and record the onset of ocean-wide tsunamis caused by the Japan and Chile earthquakes. In the March 2011 Japan earthquake, NAMRIA continuously updated the Philippine Institute of Volcanology and Seismology (PHIVOLCS)* of the arrival times and wave heights until the waves started to wane. The data gathered from these stations were used in determining whether to continue or to cancel the tsunami warnings that were given to affected communities.

**NAMRIA Real-Time Sea-Level Data Transmission and Monitoring System**

Accurate and real-time sea-level data are essential in confirming whether or not an offshore earthquake generated a tsunami. Early-warning centers should have direct access to sea-level data to enable them to immediately disseminate tsunami warnings. Getting real-time data is also very important for the accurate prediction of sea-level rise, monitoring of storm surges, and observing climate change. NAMRIA is continuously upgrading and putting up additional tide stations to strengthen the agency's capabilities in monitoring these natural phenomena for better disaster risk preparedness, reduction, and management.•

* *The PHIVOLCS "is a service institute of the Department of Science and Technology… that is principally mandated to mitigate disasters that may arise from volcanic eruptions, earthquakes, tsunami and other related geotectonic phenomena." (source: www.phivolcs.dost.gov.ph)*

# The PRS92 Project Cadastral Data Integration

*by Nicandro P. Parayno, MSc.*[*]

## The Status of Cadastral Data Integration of PRS92

### Cadastral Data Conversion/Encoding, Reference Monument Recovery, and GPS Observation

Based on the submitted accomplishments of the DENR-Lands Management Sector (LMS) Regional Offices during the PRS92 Project Coordinating Conference held on 18 April 2011, a total of 858,407 lots under the FY 2007 targets were encoded. On the other hand, updates on the regional accomplishments list 2,706,820 as the total number of cadastral data converted for FY 2008, exceeding by 62,578 the original target number of lots to be encoded. Accordingly, this equates to 102.37% of accomplishments on the computerization of records from analog to digital format and their incorporation into the digital database. Lastly, of the targeted 2,596,237 cadastral lots for encoding for FY 2009-2010, the regions were able to accomplish 1,722,036 lots. Correspondingly, these records were merged into their respective digital cadastral databases. As of this overall assessment report, the DENR-LMS regional offices, the Lands Management Bureau (LMB), and the Autonomous Region in Muslim Mindanao (ARMM) have accomplished a total of 5,394,303 encoded cadastral lots and are continuously encoding the remaining targets for FY 2011.

To date, a total of 8,842 old reference monuments out of a total target of 9,782 control points or 90.39% have been recovered nationwide by the Field Network Survey Parties of the respective regional offices. However, only 6,549 or 66.95% have been observed with the use of Global Positioning System (GPS) technology.

### Regionwide Inventory of Cadastral Datasets, Derivation and Validation of Local Transformation Parameters

Most DENR-LMS offices have reported 100% accomplishment in the regionwide inventory of datasets. The same feat, however, cannot be attributed to the activity on the derivation and validation of local transformation parameters. Due to the difficulty in the recovery of old control points, most regions resorted to using stable corner monuments of titled parcels of lots. This is in compliance with DENR Memorandum Circular (DMC) No. 2010-06, dated 04 February 2010, entitled, “Manual of Procedures on the Transformation and Integration of Cadastral Data into the Philippine Reference System of 1992 (PRS92)”. Accomplishments under the FYs 2007 and 2008 targets are respectively at 17.22% and 18.96%. Moreover, some of the reported accomplishments were also not among the targeted areas submitted by the regions.

For FY 2009-2010, only the DENR-LMS Regions X and XIII were allowed to set their targets for the derivation of transformation parameters since the other regional offices were not able to submit all their remaining accomplishments for FY 2008 targets.

*Discussion of PRS92-related issues during the Project Coordinating Conference*

Nevertheless, upon advice from NAMRIA, most DENR-LMS Regional Offices presented their accomplishments on the said activity during the PRS92 Project Coordinating Conference. Furthermore, Regions III, IV-A, VII, VIII, IX, and CARAGA underwent a retraining and lecture program on the derivation of local transformation parameters on 09 May 2011 conducted by NAMRIA. With technical assistance from other NAMRIA officials and personnel, the participants practiced on both the Microsoft Excel template and the developed program of the Agency in transforming cadastral data into PRS92 using Microsoft Visual Studio.

Favorably, a significant increase in accomplishment was noted after the conduct of the Coordinating Conference and retraining. To date, local sets of transformation parameters have been derived for 97 municipalities/cadastral projects nationwide.

### Reconstruction of LDCS/LDS and Preparation of PRS92 Control Maps (PCMs)

Being one of the major implementation issues faced by the regions in the cadastral data conversion in FY 2007, dilapidated and defective Lot Data Computation Sheets/Lot Description Sheets (LDCS/LDS) are no longer causes of significant delay during the present digitization process. Having a noteworthy 100% completion in all regional offices, records and datasets are now completely and meticulously reconstructed according to the accomplishment reports submitted by them. Region II reported an additional 243 reconstructed LDCS/LDS while Region XII accomplishment in the abovementioned activity totaled 1,000 LDCS/LDS despite having no target.

The preparation of PCMs for each of the identified provinces is still ongoing for all regions. This involves the compilation of one provincial PCM and an additional municipal or city PCM for

*...continued on next page*

[*]*Officer In Charge, Aerial and Spatial Surveys Division, NAMRIA Mapping and Geodesy Department*

*The PRS92 Project... from page 13*

each of the municipalities or cities of the target provinces. The PCMs that will be generated or produced after the transformation and integration into PRS92 can be very useful for settling political boundary disputes and other administrative-related discrepancies between adjoining municipalities since the coordinate system of boundary corners will be standardized.

**Updating of Cadastral Projects and Utilization of Land Survey Project Information System (LSPIS)**

A total of 18 municipalities and 64,835 lots were reported accomplished out of the target 35 municipalities and 459,536 lots in the updating of cadastral projects as of 18 April 2011. Consequently, the results of the regionwide inventory conducted in FY 2008 will be placed in the region's database through the utilization of the LSPIS. This activity is in progress, with Region VI, covering the Provinces of Aklan, Antique, and Capiz, utilizing the LSPIS.

**Status of Implementation by the DENR-ARMM**

Pursuant to the implementation of the PRS92 Project, a Memorandum of Agreement (MOA) was signed on 06 April 2010 between NAMRIA and DENR-ARMM at the NAMRIA Boardroom. One of the MOA objectives, as stated in the Terms of Reference, is "to integrate all existing cadastral datasets into PRS92." The activities, targets, and corresponding costs indicated on the signed MOA were based on the results of and agreements reached during a series of meetings and consultations conducted between the two parties, NAMRIA and the DENR-ARMM.

In compliance with the MOA, the PRS92 ARMM Operations Center (OPCEN) was established and is now being utilized in order to undertake the activities related to the Project. Furthermore, the PRS92 Regional Operations Committee was also created and is currently awaiting further instructions from NAMRIA.

To date, the DENR-ARMM has reported an accomplishment of 43% for the regionwide inventory of datasets. Likewise, it has encoded a total number of 15,655 lots as against the targetted 12,198 lots for a 128% completion. Accordingly, data have already been entered in the region's database.

On the other hand, a total of 48 old reference monuments were reported to have been recovered and observed using GPS/GNSS out of the targeted 72 monuments. For the derivation and validation of transformation parameters, the region targeted six cadastral projects and a total of four cadastral projects were reported as accomplished. The corresponding PCM is already being prepared.

**Status of LMB Implementation**

In a similar manner, a MOA was made and entered into, by, and between NAMRIA and LMB on 08 July 2008. As one of the initial outputs, the PRS92 LMB OPCEN was established at the fifth floor of the LMB Building in Binondo, Manila. The OPCEN houses equipment needed for early data integration activities such as policy development, encoding of datasets, encoding of the status of cadastral projects, inventory of maps, and management of the national Geodetic Network Information System (GNIS).

As of 30 November 2010, the LMB reported to have accomplished 17.15% in the inventory/encoding/proofreading of detailed information of reference points; 88.61% in the inventory of land survey records; 67.27% in the scanning of the same records; 96.20% in the encoding of LDCSs; 86.08% in the encoding of cadastral maps and isolated plans; and 23.68% in the transport of records.

**An Assessment of PRS92 Implementation in Relation to Cadastral Data Integration**

The issues and concerns identified during the Coordinating Conference and presented below, generally reflect the course of implementation which the Project has undertaken for the past four years.

a. Deviation of priority cities and/or municipalities from the original targets in order to meet the target number of lots to be encoded, the target number of monuments to be recovered and observed, and target sets of local transformation parameters to be derived - This resulted in a significant discrepancy or difference in the outputs for the activities on cadastral data conversion and transformation, monument recovery and observation, and derivation and validation of transformation parameters.
b. Slow progress in the derivation and validation of the local transformation parameters - This can be attributed but is not limited to lack of recovered and observed old reference monuments to be used as transformation points and deviation of targets.
c. The Land Survey Database Management System (LSDMS) and the GNIS are now being utilized in the regional offices.
d. Information, communications, and technology equipment are limited in some regional offices while GPS receivers are either inoperable, obsolete, or for trade in; commitment to previous projects such as the Comprehensive Agrarian Reform Program, the Public Land Surveys, and other surveys have stretched to the limit the resources of the regional offices; and mobilization of additional manpower is also hampered by Executive Order No. 366, series of 2004, on the Government Rationalization Program.
e. The presence of legal and technical issues on the transformation of old surveys and maps entailing possible changes in the technical descriptions and lot areas.
f. Non-creation by some regions of the Regional Composite Survey Team (RCST) in compliance with DENR Administrative Order 2005-13.

To address the abovementioned issues and concerns, the NAMRIA PRS92 Task Group has recommended the following catch-up plans and action items to be undertaken:

a. Review the status of all cadastral surveys in the country and immediately resolve cadastral survey projects with conflicts, as well as those surveyed and transmitted to LMB or LMS but still with pending approval
b. Direct the LMB to transfer the remaining survey returns of the Manila-approved cadastral, as well as other types of survey projects, to the custody of the regional offices
c. Continuously provide technical assistance to the regional offices for the conversion and transformation of cadastral datasets

d. Provide detailed procedures governing the inspection, validation, and approval of transformed cadastral projects for their integration into PRS92
e. Draft policy guidelines for the conduct and administration of connection surveys for the other ENR datasets and for the preparation of the PCMs
f. Continue undertaking research and development activities to support the preparation of guidelines and/or manual of procedures on, among others, the establishment of geodetic control network and the use of both astronomic and GPS methods of azimuth determination, and eventual drafting and submission of a Bill to Congress on the adoption of PRS92 as the standard reference system of the Philippines in order to render unquestionable and superior legal basis for implementation
g. Search for the missing records from the LMB, other local government units, and private surveyors as soon as possible; realign the priority cities/municipalities so that there are identical target areas for cadastral data encoding and recovery as well as observation of reference monuments
h. Direct the DENR-LMS regional offices to prioritize the derivation of the local transformation parameters
i. Conduct regional financial audit and recommend appropriate actions

**PRS92 Accomplishments and Future Directions**

Indeed, the PRS92 Project has had its fair share of advantages despite occasional and inevitable operational lapses. It has quite a number of achievements under its name. These include a perceptible change in the delivery of service to the DENR clients for the lands and forestry sectors; and a modernized lands sector driven by the virtues of efficiency and effectiveness which now provides the user public with improved quality of assistance.

*Discussion of PRS92-related issues during the Project Coordinating Conference*

Likewise, the Project institutionalized the practice of surveying as well as the surveying procedures. The regional offices, acting as one big surveying and mapping community, can now ride high alongside the fast and relentless shifts in the technological arena. Through the computerization of cadastral records and datasets and

*continued on next page*

| REGIONS | Region-wide Inventory of Datasets | Cadastral Data Conversion/Encoding | Reconstruction of LDCS/LDS | Monument Recovery | Monument Observation | Derivation of Transformation Parameters | Preparation of PRS92 Control Maps |
|---|---|---|---|---|---|---|---|
| **I** | 100% | 573,256 | 10,146 | 780 | 780 | 36 | 100% |
| **II** | 100% | 272,073 | 14,664 | 728 | 606 | 0 | On-going |
| **CAR** | 100% | 150,222 | - | 639 | 296 | 14 | 75% |
| **III** | 100% | 242,345 | 4,500 | 687 | 367 | 0 | On-going |
| **NCR** | 100% | 325,851 | 1,025 | 169 | 6 | 0 | 0% |
| **IV-A** | 90% | 384,304 | 500 | 870 | 431 | 0 | 0% |
| **IV-B** | 100% | 320,473 | - | 349 | 336 | 0 | On-going |
| **V** | 100% | 329,332 | 2,800 | 581 | 581 | 6 | 80% |
| **VI** | 100% | 214,443 | - | 866 | 528 | 10 | On-going |
| **VII** | 100% | 132,758 | 6,050 | 304 | 304 | 3 | |
| **VIII** | 100% | 158,003 | 3,000 | 333 | 303 | 6 | |
| **IX** | 100% | 51,243 | - | 207 | 182 | 0 | |
| **X** | 100% | 95,523 | 411 | 313 | 195 | 0 | |
| **XI** | 70% | 160,000 | - | 214 | 214 | 6 | |
| **XII** | 100% | 85,252 | 1,000 | 241 | 241 | 13 | |
| **XIII** | 100% | 70,149 | 3,000 | 198 | 148 | 12 | |
| Total | **97.50%** | **3,565,227** | **47,096** | **7,479** | **5,518** | **106** | |

*Table 1. Summary Matrix of DENR-LMS Regional Offices' Reported Accomplishments on Cadastral Data Integration for FY 2007 and FY 2008 as of 18 April 2011*

## *The PRS92 Project... from page 15*

| REGIONS | Cadastral Data Conversion/Encoding | Derivation of Transformation Parameters | Updating of Cadastral Projects | Preparation of PRS92 Control Maps | Utilization of LSPIS |
|---|---|---|---|---|---|
| **I** | 503,612 | - | - | - | - |
| **II** | 6,163 | 2 mun./cad projects | 18 mun. | - | - |
| **CAR** | 102,732 | - | - | - | - |
| **III** | 151,388 | - | - | - | - |
| **NCR** | No Target | - | 60,000 lots | - | - |
| **IV-A** | 117,653 | 1 mun./cad project | - | - | - |
| **IV-B** | - | - | - | - | - |
| **V** | 30,990 | 33 mun./cad projects | - | - | - |
| **VI** | 99,628 | - | 727 lots | - | 3 provinces |
| **VII** | 93,000 | 4 mun./cad projects | - | On-going | - |
| **VIII** | 223,319 | 12 mun./cad projects | 4,108 lots | - | - |
| **IX** | - | - | - | - | - |
| **X** | 204,894 | 38 mun./cad projects | - | - | - |
| **XI** | - | - | - | - | - |
| **XII** | 90,596 | 2 mun./cad projects | - | - | - |
| **XIII** | 98,061 | 5 mun./cad projects | - | - | - |
| Total | **1,722,036 lots** | **97 mun./cad projects** | **18 mun. and 64,835 lots** | | |

*Table 2. Summary Matrix of DENR-LMS Regional Offices' Reported Accomplishments on Cadastral Data Integration for FY 2009 as of 18 April 2011*

their incorporation into a digital database, the Project has provided a better land records management which can now be accessed and updated. Creating a dynamic and interactive information system, the Project currently supports the exchange of relevant, consistent, complete, comprehensive, and accurate data among the user public. This spatial framework provides the basis for the integration of the different elements of a successful land information system. Similarly, the process of data conversion unveiled the errors committed by both the already approved cadastral and other ENR projects, such as the presence of gaps, overlaps, and intersections which are now being rectified by the DENR regional offices.

As mentioned above, the Project is not entirely devoid of implementation issues. Some of these are newly discovered, others are pressing, while the rest are recurring. Mitigation measures are a tall order to fill and catch-up plans need to be urgently developed. More particularly, the regional offices must program the accomplishment of the unfinished activities for the past fiscal years such as monument recovery and observation, cadastral data transformation, and evaluation and approval of the derived local transformation parameters.

The PRS92 Project Coordinating Conference ended on a high note in that major agreements were reached among NAMRIA, DENR-LMS Regional Offices, and LMB. These include the commitment of the lands sector to complete the activity on the derivation of local transformation parameters; the commitment of the regional offices to submit the results of the various documentation of transformation cases for distribution/reference to other regional offices; the enhancement of the capability of the regions' technical staff through NAMRIA's conduct of relevant trainings and lectures; and the commitment of LMB to complete the transfer of cadastral data to the regions within the next two years.

Once completed, the PRS92 Project shall provide countless benefits to every Filipino. With land as one of the Philippines' primary resources that spur and dictate the economic activities, the Project would establish the integrity of land management, administration, the tenurial system, and the land titling system. Furthermore, it would also contribute to helping make our land resource information on a par with the rest of the ASEAN nations and even the international scientific community in the field of geodesy, with the migration of the present system into the global geocentric reference system.

In the light of a constantly changing global and local environment, the scenarios painted above put into context the trials that the PRS92 Project underwent in the past years. Amidst all the apprehensions, uncertainties, and anxieties, there should always be room even for a streak of optimism, hopefulness, and faith. Once more, cooperation from all sectors is being sought. It is the responsibility of each player to the inform others of the Project and allocate specific tasks in order to obtain the active involvement and participation of all Filipinos.•

# PRS92 Four-Parameter Derivation Application

*by Angelo T. Arboleda*[*]

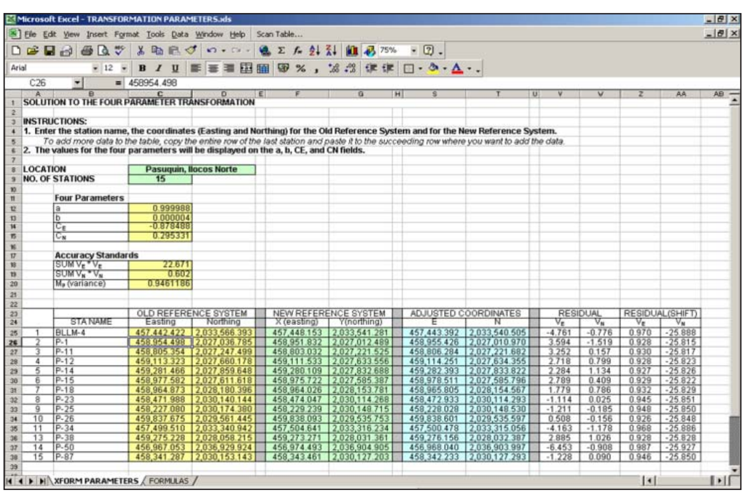
PRS92 is a network of geodetic control points (GCPs) established using GPS technology. Previously established control points are integrated into the network using a transformation formula.

Part of the transformation and integration workflow is the derivation of the local transformation parameters that will be used in the formula. Using a mathematical model[1], a four-parameter solution is computed. These parameters are *A*, *B*, $C_E$&$C_N$ where *A* and *B* are the scale and rotation constants and $C_E$ and $C_N$ are the shift constants.

## Motivation

The computation of the four parameters is proven cumbersome when done by hand. To assist in the computation of the solution of the four transformation parameters, a spreadsheet template was prepared by the NAMRIA Mapping and Geodesy Department (MGD) using Microsoft© Excel©. The spreadsheet was then used for pilot areas of the project.

Although the spreadsheet template is sufficient for its design purpose, evolving requirements gave birth to the idea of writing a stand-alone application that will provide additional functionalities and granular control to the data. Thus, using the spreadsheet as basis, the NAMRIA Information Management Department in collaboration with the NAMRIA MGD designed a stand-alone application that will be used as a tool to derive the four-parameter solution.



Microsoft Excel - TRANSFORMATION PARAMETERS.xls

C26 = 458954.498

SOLUTION TO THE FOUR PARAMETER TRANSFORMATION

INSTRUCTIONS:
1. Enter the station name, the coordinates (Easting and Northing) for the Old Reference System and for the New Reference System.
*To add more data to the table, copy the entire row of the last station and paste it to the succeeding row where you want to add the data.*
2. The values for the four parameters will be displayed on the a, b, CE, and CN fields.

LOCATION: Pasuquin, Ilocos Norte
NO. OF STATIONS: 15

| Four Parameters | |
|---|---|
| a | 0.999988 |
| b | 0.000004 |
| $C_E$ | -0.878488 |
| $C_N$ | 0.295331 |

| Accuracy Standards | |
|---|---|
| SUM $V_E * V_E$ | 22.671 |
| SUM $V_N * V_N$ | 0.602 |
| $M_o$ (variance) | 0.9461186 |

| | STA NAME | OLD REFERENCE SYSTEM Easting | OLD REFERENCE SYSTEM Northing | NEW REFERENCE SYSTEM X (easting) | NEW REFERENCE SYSTEM Y(northing) | ADJUSTED COORDINATES E | ADJUSTED COORDINATES N | RESIDUAL $V_E$ | RESIDUAL $V_N$ | RESIDUAL(SHIFT) $V_E$ | RESIDUAL(SHIFT) $V_N$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BLLM-4 | 457,442.422 | 2,033,566.393 | 457,448.153 | 2,033,541.281 | 457,443.392 | 2,033,540.505 | -4.761 | -0.776 | 0.970 | -25.888 |
| 2 | P-1 | 458,954.498 | 2,027,036.785 | 458,951.832 | 2,027,012.489 | 458,955.426 | 2,027,010.970 | 3.594 | -1.519 | 0.928 | -25.815 |
| 3 | P-11 | 458,805.354 | 2,027,247.499 | 458,803.032 | 2,027,221.525 | 458,806.284 | 2,027,221.682 | 3.252 | 0.157 | 0.930 | -25.817 |
| 4 | P-12 | 459,113.323 | 2,027,660.178 | 459,111.533 | 2,027,633.556 | 459,114.251 | 2,027,634.355 | 2.718 | 0.799 | 0.928 | -25.823 |
| 5 | P-14 | 459,281.466 | 2,027,859.648 | 459,280.109 | 2,027,832.688 | 459,282.393 | 2,027,833.822 | 2.284 | 1.134 | 0.927 | -25.826 |
| 6 | P-15 | 458,977.582 | 2,027,611.618 | 458,975.722 | 2,027,585.387 | 458,978.511 | 2,027,585.796 | 2.789 | 0.409 | 0.929 | -25.822 |
| 7 | P-18 | 458,964.873 | 2,028,180.396 | 458,964.026 | 2,028,153.781 | 458,965.805 | 2,028,154.567 | 1.779 | 0.786 | 0.932 | -25.829 |
| 8 | P-23 | 458,471.988 | 2,030,140.144 | 458,474.047 | 2,030,114.268 | 458,472.933 | 2,030,114.293 | -1.114 | 0.025 | 0.945 | -25.851 |
| 9 | P-25 | 458,227.080 | 2,030,174.380 | 458,229.239 | 2,030,148.715 | 458,228.028 | 2,030,148.530 | -1.211 | -0.185 | 0.948 | -25.850 |
| 10 | P-26 | 459,837.675 | 2,029,561.445 | 459,838.093 | 2,029,535.753 | 459,838.601 | 2,029,535.597 | 0.508 | -0.156 | 0.926 | -25.848 |
| 11 | P-34 | 457,499.510 | 2,033,340.942 | 457,504.641 | 2,033,316.234 | 457,500.478 | 2,033,315.056 | -4.163 | -1.178 | 0.968 | -25.886 |
| 13 | P-38 | 459,275.228 | 2,028,058.215 | 459,273.271 | 2,028,031.361 | 459,276.156 | 2,028,032.387 | 2.885 | 1.026 | 0.928 | -25.828 |
| 14 | P-50 | 456,967.053 | 2,036,929.924 | 456,974.493 | 2,036,904.905 | 456,968.040 | 2,036,903.997 | -6.453 | -0.908 | 0.987 | -25.927 |
| 15 | P-87 | 458,341.287 | 2,030,153.143 | 458,343.461 | 2,030,127.203 | 458,342.233 | 2,030,127.293 | -1.228 | 0.090 | 0.946 | -25.850 |

XFORM PARAMETERS / FORMULAS

*Transformation parameters spreadsheet template*

## System Description

The application was written in C# on top of .NET framework. Several open-source libraries available in the market were employed in writing the application. Due to its ubiquity, XML was chosen as the standard data format for the storage and interchange of data.

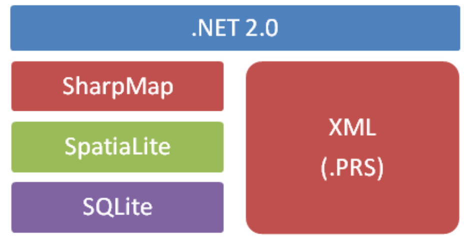
## Open Source

One of the salient features of the application is its ability to visualize the points used in the computation. The visualization engine is provided by the open-source library SharpMap[2]. The library itself was written in C# and requires a minimum of .NET version 2.0.

Visualizing points alone are not of much use if no base map is used. The points are thus overlaid to the vector map of the municipalities of the Philippines. The vector maps are originally shape (.SHP) files imported into a SpatialLite[3] database. SpatialiLite is a wrapper to SQLite[4] which is originally written in C++. SpatialLite enables SQLite to be used on .NET projects.

## Portability

Part of the design consideration is the portability of the application. By using XML as standard interchange format, the data can stand alone and is immune to any specific database issue. Thus, the result of the




computation, the points used, and a number of metadata are stored in an XML file with the extension .PRS.

```
<?xml version="1.0"?>
<prs92>
  <derivation>
    <projectNo>CAD 100</projectNo>
    <zone>3</zone>
    <location>{location}</location>
    <municipality />
    <province />
    <region />
    <a>0.999998 </a>
    <b>-0.000021 </b>
    <Ce>44.684178 </Ce>
    <Cn>-26.921891 </Cn>
        .
        .
        .
```

The application was designed to detect the presence of the PRS92 database in the network. If one is found, the application has the ability to extract GCPs from the database and present it to the user. The user can simply select which GCPs to use in the computation instead of inputting each point. This, however, is an optional feature. The application will run even if no PRS92 database is found in the network.

## User Interface

The graphical user interface of the application was designed to be friendly even to the novice user. It has three major parts: the toolbar, the data input pane, and the visualization pane.

Another feature of the application is the ability to print the displayed map. This feature is useful when producing maps as attachments to activity reports.

*...continued on page 39*

[*]*Information Systems Analyst II, Systems Development and Programming Division, NAMRIA Information Management Department*

# Station BALANACAN: The Story of a Geodetic Datum Origin

*by Xenia R. Andres*

*….On the highest hill at the northwest point of Marinduque Island. Salvaria Island in the entrance to Looc Bay bears N. 9° E., distant 3 kilometers, and the highest point of the western one of the two San Andres Islands bears 80° E., distant 3 kilometers. It is on the northwest end of the hill, 10 meters northwest of the highest point, and is in a commanding situation, seeing a hundred miles of the coast of Luzon, much of the north and west coasts of Marinduque, the coast of Mindoro and other islands. Station mark is the center of a hole 1.5 centimeters in diameter and 6 centimeters deep, drilled at the center of a triangle 16 centimeters on a side, cut in a hard rock. Reference mark is on a hard, white boulder of about one cubic meter in volume, standing 80 centimeters above the ground and 90 centimeters higher than the station. The mark is a hole 1.5 centimeters in diameter and 8 centimeters deep, at the center of a cross cut on top of this stone. From the station, the reference mark is in azimuth 326° 34' and is distant 18.85 meters.*

– Description of Station BALANACAN in the report The Triangulation of the Philippine Islands, Volume I

**Historical Background**

The institutionalization of Station BALANACAN as geodetic datum origin is traced to the surveying and mapping activities in the Philippines of the then United States Coast and Geodetic Survey (USCGS). With the new territorial claim of the US following the Spanish-American War, the responsibilities of the USCGS grew which included the conduct of various scientific and cartographic initiatives in the Philippine Islands beginning 1901.

Coast and geodetic surveys involved the charting of insular waters and harbors and the development of a geodetic network that "had to be begun from scratch." The initial surveys would have been the expansion of a general scheme of triangulation which utilizes a network of interlocking triangles to determine positions at survey stations. Military and commercial factors were however considered.

The military telegraph and cable line system aided the establishment of astronomical stations such as those in Legaspi, Vigan, Ormoc, Tacloban, Iloilo, Bancalan Island, Cagayan Sulu Island, Davao, Iligan, Misamis Oriental, and Zamboanga. Each having its own datum, the 39 foundation stations were used to start surveys in various localities. These stations made possible the publication of charts but the projections from the positions did not match. The Vigan Datum of 1901 eventually connected them and was used for a period of time.

Efforts to establish a new and single geodetic datum were exerted due to the inadequacy of the Vigan Datum to extend the triangulation to the central and southern parts of the country. The components of a geodetic datum are (1) the specifications of an ellipsoid with a spherical coordinate system and an origin and (2) a set of surveyed points and lines. E. R. Frisby, chief of the Computing Division of the USCGS Manila Field Station from 1902 to 1921, was tasked to formulate the substitute scheme with Clarke's Spheroid of 1866 as the model for the interpolations. The work in 1911 converged on a geodetic network based in the island of Luzon which was later expanded throughout the archipelago. The new datum established became the primary geodetic reference of all surveys in the Philippines.

The Station BALANACAN (Latitude 13° 33' 41".000 North, Longitude 121° 52' 03".000 East) in the Province of Marinduque defined the datum origin of the Luzon Datum of 1911 with Clarke Spheroid of 1866 as reference ellipsoid. While a datum is a

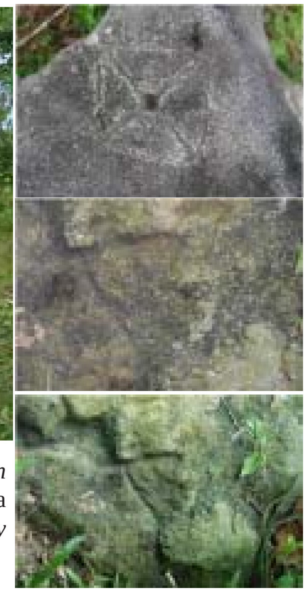
*Observation in 1903 on station San Nicolas Beacon using Wild T-3 [Photo courtesy of the NAMRIA Library and Documentation Services]*

reference value to which other measurements are referred, a geodetic datum is the adopted standard position (latitude and longitude) of a given station, together with the adopted standard azimuth of a line from that station. The Station BALANACAN had for its azimuth mark the Station BALTASAR (azimuth: 9° 12' 37".00) located in the western Tres Reyes Group of Islands also in Marinduque Province. O.W. Ferguson established both stations with H.D. King as Chief Of Party. The historical document on the triangulation of the Philippine islands gives the establishment of Station BALANACAN as 1906.

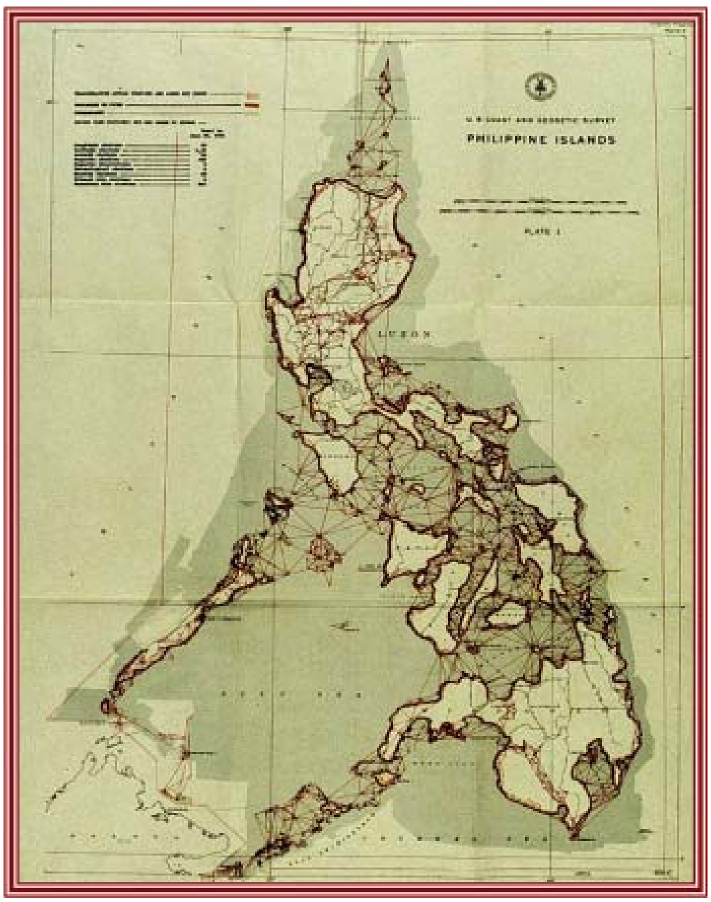
All surveys in the Philippines from 1901 to 1927 were corrected and based on the position of this station. Thus, a geodetic station is said to be in the Luzon Datum if it is connected by continuous triangulation from the Station BALANACAN. The formed triangulation network spanned vast distances with stations that were located on high mountain peaks and far across straits and channels. The platforms for the triangulation surveys were wooden tower structures until the portable Bilby steel tower named after its designer was started to be used in 1927 to minimize the costs of materials and labor. The towers were necessary to provide clear lines-of-sight in the conduct of surveys. Second- or lower-order grade geodetic operations were conducted to control charts; to provide geographic positions, elevations, distances and azimuths;

and to determine the earth's figure. The data gathered were essential in defining property boundaries, extensive mapping such as topographic survey, delimiting political boundary subdivisions, and surveying for an area improvement or a city plan.

The USCGS developed the Philippine Geodetic Network (PGN) until 1946. The PGN consisted of narrow chains of triangulation stations concentrated along the coastal areas for topographic and hydrographic surveys. By 1950, the Philippine Bureau of Coast and Geodetic Survey (BCGS) assumed the establishment of geodetic control points following the Philippine Rehabilitation Act of 1946. The BCGS was one of the four agencies that were merged to form NAMRIA in 1987. From 1988 to 1991, the PGN was upgraded into the Philippine Reference System of 1992 (PRS92) under the Geodetic Component of the Natural Resources Management and Development Project, an Australian-assisted project of the DENR. The standard reference system of all survey and mapping activities in the country, PRS92 consists of a national network of geodetic control points (GCPs) marked by survey monuments or *mojons* established using the Global Positioning System. To date, the Station BALANACAN is the datum origin.



*Station BALANACAN mark is intact on a hill locally known as* Mataas na Bundok *with reference marks nearby (right picture)*




*The old geodetic network*

### Preserving the "Mother of All *Mojons*"

A NAMRIA team went to the Province of Marinduque in 2007 to conduct reconnaissance survey of the Station BALANACAN. After a century, the station established and marked on a hard rock is intact on a hill locally known as *Mataas na Bundok* in the Municipality of Mogpog. It still stands, including its nearby reference marks, surviving time and the elements.

The year 2007 was also the time when the PRS92 Project was implemented to complete the densification of and maintain the national geodetic network. The project also aimed to integrate all old surveys and maps into the new network for sustainable management and development of the country's natural resources and to establish more accurate spatial positioning for infrastructure and other activities. As the lead agency, NAMRIA undertook activities and strategies to ensure the successful implementation of the project.

One of these strategies was the Information, Education, and Communication (IEC) component to generate PRS92 awareness and support from stakeholders and the general public and to create a pool of national experts in geodesy and allied fields. The IEC component included the "Adopt-a-*Mojon*" program which is a nationwide initiative for the sustainable utilization of PRS92 through the adoption of its GCPs in different localities by stakeholders. The program aims to enlist the participation and support of the local government units, people's organizations, and the general public in the establishment and preservation of *mojons* and to advocate the significance of GCPs to resource management and land administration.

### Preservation Initiatives

In view of the significance of Station BALANACAN in Philippine surveying and mapping, efforts to preserve it were initiated through an interagency collaboration. The preservation efforts also aim to develop the station as a domestic tourism site in order to ensure stewardship for its maintenance and protection and to create a high-impact drive to generate awareness among the various stakeholders and their support to the "Adopt-a-*Mojon*" program of the PRS92 project. The initiatives are the *(1) National Recognition of the Station BALANACAN, Luzon Datum Origin through a Historical Marker; (2) Issuance of a Presidential Proclamation reserving a parcel of land of the public domain as site for the Luzon Datum Origin National Historical Landmark,*

*...continued on page 22*


The Philippine Geoportal Project is a three-year multiagency project of NAMRIA which aims to establish a spatial data infrastructure that provides and integrates geographically-referenced data generated by various government agencies/offices, the academe, and other organizations using one standard multiscale basemap and governed by data management, exchange, and use policies.

The project likewise aims to provide a customer-friendly portal with 24/7 web/online access to spatial data and an Information and Communications Technology (ICT) platform for collaboration, data and resource sharing, integration, transparency and resource optimization.

The Philippine Geoportal is the realization of the National Spatial Data Infrastructure (NSDI). The Philippine Geoportal promotes the "One map" principle which is one set of consistent, multiscale basemaps that can be used for thematic mapping by many users working on Philippine geospatial data.

Philippine Geoportal
one nation one map

## Station BALANACAN ...*from page 19*

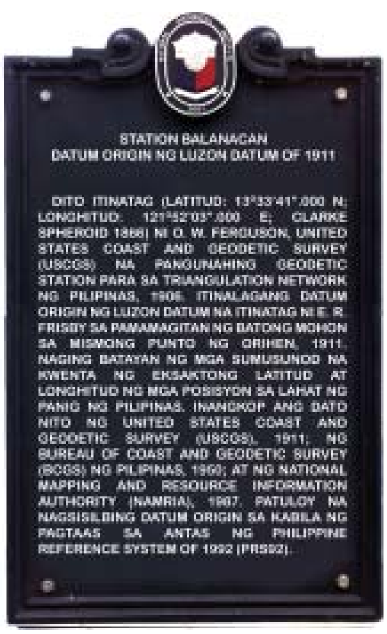
*ecotourism development, and for other purposes;* and *(3) Development of the Station BALANACAN, Luzon Datum Origin Site*.

With the increasing concern to protect Station BALANACAN and to preserve its usefulness in surveying and mapping, initial coordination at the national government level was made after the reconnaissance survey. In 2008, a detailed site inspection at the triangulation stations BALANACAN and BALTASAR and coordination with the provincial and municipal government officials were conducted. The NAMRIA Task Group BALANACAN was created during the year to, among other functions, undertake research and data gathering; coordinate and maintain strong linkages with other stakeholders; and conduct resource assessment, demarcation surveys, and information campaigns.

The Interagency Task Group BALANACAN was organized in 2009 to expedite the technical and complete staff work (CSW) for the issuance of the Presidential Proclamation. The interagency group is composed of representatives from NAMRIA, which laid down the groundwork, and the DENR Region IV-B Office, including the Marinduque Provincial and Community ENR Offices. It works closely with the Provincial Government of Marinduque and the National Historical Commission of the Philippines (NHCP) in carrying out the preservation initiatives.

### Historical Marker

Also in 2009, the then National Historical Institute (now NHCP) was requested to grant national recognition to the Station BALANACAN as having a significant role in the history of Philippine surveying and mapping. Ocular survey, research, and documentation were conducted subsequently. In 2010, the NHCP issued a certification recognizing the national significance of the Station BALANACAN "in the history of land surveying in the Philippines" through a national historical marker. This year 2011, the NHCP Board affirmed the station's historical value during its meeting for the month of May.




*The Station BALANACAN historical marker*

### Presidential Proclamation

In order to ensure the full preservation of Station BALANACAN, the issuance of a Presidential Proclamation was initiated in 2008. The initiative undertaken with the DENR Region IV-B Office involved the preparation of the requirements for the Presidential Proclamation and its processing. The requirements include the (a) request for reservation by the reservee; (b) comments and recommendations from the Department of Health and the Department of Public Works and Highways; (c) survey of the land to be reserved duly approved by the concerned DENR Regional Technical Director for Lands; (d) approved plan; (e) verified and certified correct technical descriptions; (f) certified photos or visual documentations showing the panoramic view of the subject area of the proposed proclamation and the adjacent vicinities; (g) land classification of the proposed area for proclamation and land uses of the proposed area and the surrounding areas within a two-kilometer radius; (h) narrative report of investigation endorsed to the DENR Secretary by the Regional Executive Director (RED) through the Undersecretary for Field Operations; and (i) CSW containing the justification, legal bases, agencies involved and coordination made, and potential problems in the approval or disapproval of the request.

Milestone events in 2009 for this initiative were the presentation of the Station BALANACAN preservation efforts during the joint session of the *Sangguniang Panlalawigan ng* Marinduque-*Sangguniang Bayan ng* Mogpog; the passage of Resolution Number 630, a joint resolution requesting the issuance of a Presidential Proclamation reserving a certain parcel of land of the public domain situated at *Barangays* Hinanggayon and Argao, Municipality of Mogpog, Province of Marinduque as site for the Luzon Datum Origin National Landmark, for ecotourism, and for other purposes; the creation of an interagency committee to determine the most appropriate area for proclamation (amended in 2010); and the first indorsement of the joint resolution from the Office of the President to the DENR Secretary for comment and recommendation and in turn to the concerned DENR RED for evaluation and submission of the CSW.

The completion of the technical and staff work was on the upswing in 2010, including the filing of a petition at the Department of Agrarian Reform Region IV-B Office for the cancellation of the Certificates of Land Ownership Awards (CLOAs) involving parcels of land located in *Barangays* Hinanggayon and Argao in Mogpog, Marinduque. The request for the cancellation of CLOAs was granted on 22 November 2011 and the same became final and executory on 03 February 2011. The Presidential Proclamation was drafted in May 2011 following the tenets of the CSW and the mandates of the Office of the President and the DENR. The draft proclamation reserves a parcel of public domain land covering an area of 281,817 square meters. The parcel of land reserved shall be non-alienable and not be subject to occupation, entry, sale, lease, or other modes of disposition. It shall be comanaged by DENR Region IV-B Office, NAMRIA, and the Provincial Government of Marinduque. The LMB reviewed the draft issuance and the supporting papers. As of this writing, the documents are being evaluated by the Office of the DENR Secretary, through the Undersecretaries for Field Operations and Staff Bureaus and Project Management, for eventual transmittal to the Office of the President.

### Site Development

The initiative covered the physical development of the 1,000 square meters out of the total area of the parcel of land proposed to be reserved. It took inspiration from the Geodetic Center of North America, the Australian Geodetic Datum 1966, and the

Japanese Geodetic Datum Origin. The development aimed to spruce up the site of the Station BALANACAN without causing in any manner the movement of the solid rock on which it is marked and the obstruction of the horizon around it. NAMRIA and the Provincial Government of Marinduque signed a Memorandum of Agreement in March 2011 to implement this component. The work included the provision of access road to the site; the installation of the historical marker; the landscaping of the area within a three- to four-meter radius from the Station BALANACAN; the fencing of the perimeter; and the construction of a visitors' resting area, a view deck, and the stairways to the Station.


*Plan of the Station BALANACAN, Luzon Datum Origin site*

**Alone No More**

The Station BALANACAN stands as a mute witness to the history of Philippine surveying and mapping. It is a testament of the determination and dedication of our forebear surveyors and mapmakers to complete the surveys that are the bedrock of our nation's spatial reference framework. The geodetic station truly needs protection to preserve its usefulness in surveying and mapping.

After so long a time, the Station BALANACAN has finally secured the recognition it greatly deserves. With the preservation project, it is no longer a desolate orphan in the forest whose size belies the big role it plays in surveying and mapping. The national historical marker with an inscription in the national language will

*Interagency task group meeting with NHCP and GEP representatives held on 02 June 2011*

be unveiled on 09 August 2011. The ceremony is a timely honor as the whole surveying and mapping community celebrates the centenary year of the establishment of the Luzon Datum of 1911 and as NAMRIA counts down for its silver anniversary in 2012. A *Certificate of Transfer* will be inked between the NHCP and the Provincial Government of Marinduque to ensure the protection, upkeep, and maintenance of the marker. The signing will be witnessed by NAMRIA and the Municipal Government of Mogpog. Hopes are pinned on the signing of the proclamation by President Benigno S. Aquino III in order for the ancient legacy and national edifice to last another lifetime.

The work to preserve Station BALANACAN actually never ceases. May there be more concerned and dedicated souls for this.

*Courtesy call on NAMRIA Administrator Peter N. Tiangco of representatives from the US Embassy in Manila, 27 June 2011*

**Postscript**

In a separate briefing in June 2011, the Geodetic Engineers of the Philippines, Inc. and the Embassy of the United States of America in Manila have expressed their support for the Station BALANACAN Preservation Project. The participation of other stakeholders such as the academe and the general public is encouraged to fully realize the objectives of the undertaking.•

# An Overview of the Quality Control Process of NAMRIA for the Digitized 1:50,000 Topo Maps

*by the Quality Control Section, Cartography Division*
*NAMRIA Mapping and Geodesy Department*

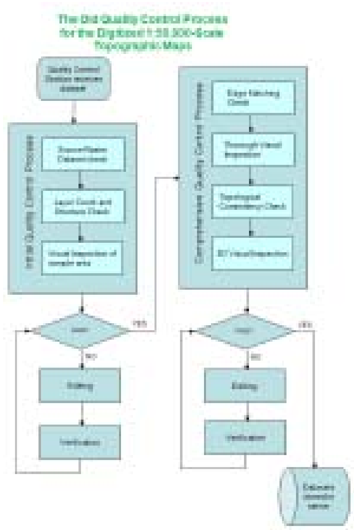
One of the biggest challenges in the Philippines in the analysis of natural hazards is the availability and accessibility of base data at the appropriate resolution and in relevant formats. Because of the inherent risk of using inaccurate information for analyzing natural hazards, quality control for spatial data has become a necessity. *Data quality control* is defined as the assessment of completeness, currency, logical consistency, and accuracy of a dataset for a particular application or use. It is a combination of manual and automated methods to measure or assess data completely and comprehensively. To be useful tools for communities, spatial data derived from existing topographic maps should be within specified quality standards. Thus, the development of the quality control process of NAMRIA has been a key to providing useful and accurate GIS data to clients.

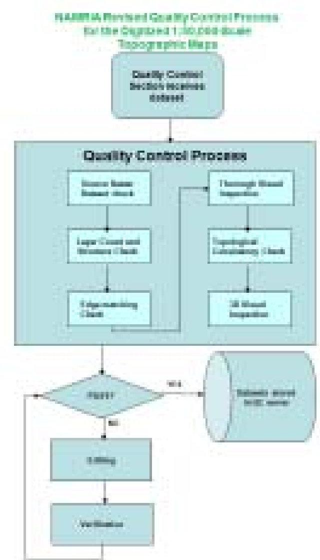
The old quality control process of NAMRIA covered the conversion to vector data of georeferenced raster data or scanned topographic maps. The process was composed of the *Initial Quality Control Check* and the *Comprehensive Quality Control Check*. The former was a series of quick and simple procedures which aimed to check if a particular dataset passed the minimum requirements. The latter was a combination of manual and semi-automated methods for assessing the data completely against standards for spatial data.

The current quality control process of NAMRIA, covering digitized topographic maps at 1:50,000 scale, is based on the guidelines enumerated in the Agency's seamless national topographic database manual, the international standards for spatial data, and recommendations from Geoscience Australia. Geoscience Australia (GA), the national agency of the Australian Government for geoscience research and geospatial information, undertook a scoping mission in the Philippines on 18-29 May 2009 which sought to provide expert technical advice in spatial data management.

In January 2010, upon recommendation from the GA scoping mission, NAMRIA instituted changes to its quality control process. These changes include relaxing the following requirements: (1) Positional Accuracy – from 100 to 95 percent; (2) Completeness and Attribution – from zero to two or less percent; and (3) Logical Consistency – from zero to one or less percent. As a result, the Agency was able to significantly increase evaluation speed without sacrificing the usability of the datasets to hazard mapping and other applications. Figures A and B respectively show the flowcharts of NAMRIA's old and revised quality control processes.

The *Quality Control Section* established in NAMRIA in 2008 is responsible for the conduct of quality evaluation prior to the inclusion of the digitized map sheet into the topographic database. The section is tasked to evaluate the completeness, positional accuracy, attribute accuracy, and logical consistency of a dataset and to properly document such measures in a data quality evaluation form. To illustrate further, below is the table on *Data Quality Conformance Level* that shows the Agency's quality checks for the digitized topographic maps.•






| Data Quality Element | Data Quality Sub-Element | Scope | Conformance Level |
|---|---|---|---|
| Completeness | Omission | All Features | *(2% or less) Zero omission of features in the dataset |
| Positional Accuracy | Absolute or External Accuracy | All Features | *(At least 95%) 100% of the items in the dataset are position ally accurate |
| Logical Consistency | Topological Consistency | All Features | *(1% or less) Zero items may have topological inconsistencies |
| | Format Consistency | All Features | All features from the source are captured according to specifications |
| | Domain Consistency | All Features | All attributes fall within the correct range of values |
| Thematic Accuracy | Quantitative attribute accuracy | Contours, Spot heights, etc. | All attributes and additional information including but not limited to elevation have correct values. |
| | Non-quantitative attribute correctness | All Features | All features are correctly labeled |
| | Classification correctness | All Features | All captured features are interpreted correctly. |

*Geoscience Australia recommended values*

# The Philippine Geoportal "One Nation One Map" Project

*by Febrina E. Damaso**

NAMRIA is spearheading the activities for Philippine Geoportal "One Nation One Map" Project. The central portal to be set up is for all geospatial information shared and made available by all stakeholders. The three-year project is actually an E-gov-funded project, which was approved in November last year by the CICT. The portal will serve as an interface that enables search, portrayal, evaluation, sharing, analysis, and reuse of spatial information and its attributes. It will be interconnected with other resources through the Internet and help create a distributed structure of information and data with spatial position.

By utilizing integration interfaces for discovery and view services from stakeholder's portals, it also aims to foster the harmonization of all stakeholders data or portal implementations within the framework of the National Spatial Data Infrastructure (NSDI). The NSDI is the precursor of the Philippine Geoportal Project and both are basically the same. The NSDI is actually a network of geographic databases and provides a platform for better access to essential and consistent geographic information. These geographic information or databases are actually produced by the different government agencies, the academe, and other organizations and combined together into one central database. Creation of the NSDI involves the combination of GIS and ICT technologies to include the Internet. This makes possible the intended nature or essence for the NSDI to combine disparate databases being maintained by the organizations themselves.

The NSDI infrastructure is intended to provide also the fundamental data needed to achieve the country's economic, social, human resources development and environmental objectives. NSDI basically has development objectives which are anchored on its components, namely: institutional framework, which will basically create an environment for the agencies to be able to contribute whatever data are available in their agencies for uploading to the Geoportal; Fundamental datasets which define the NAMRIA basemap and other fundamental datasets produced and maintained by other agencies, and should be fully compliant with technical standards; Technical standards and protocols, which define the technical characteristics of the fundamental datasets especially for sharing and exchange purposes; and Data clearinghouse network, the means by which fundamental datasets are made accessible to the community in accordance with the policies determined within the NSDI framework. These four components eventually will be part and parcel of the Philippine Geoportal Project.

The "One Nation One Map" concept is adopted in the Philippine Geoportal Project which simply means that there will only be one set of multiscale base or framework maps to be used by a variety of users. The idea is that from one source (e.g., a 1:10,000 orthorectified imagery) multiple data can be generated at different scales (e.g. 1:5,000; 1:20,000; and 1:50,000) for multiple uses. Thus, there will be one standard framework map.

For the first year, the Project will build one set of multiscale framework maps for Metro Manila and its environs. It will utilize modern technologies in building digital maps which could be automatically rescaled for different purposes and based on just one set of high-resolution imagery source. Different stakeholders can overlay their own sets of geographic and attribute information using one set of standard basemaps. Likewise, it will guarantee the sustainable content maintenance and the rules of engagement in serving the data on the Web, as well as the viability and requirements of providing GIS as a service in the government.

Being a multiagency project, agencies can either be producers or users of maps, or both, in terms of building content and utilizing the framework map. The agencies will adjust their thematic layers to fit the basemap and create their own layers to suit their specific requirements or to serve their mandated functions. For example, the Department of Public Works and Highways can add the national roads; local government units (LGUs) can add local

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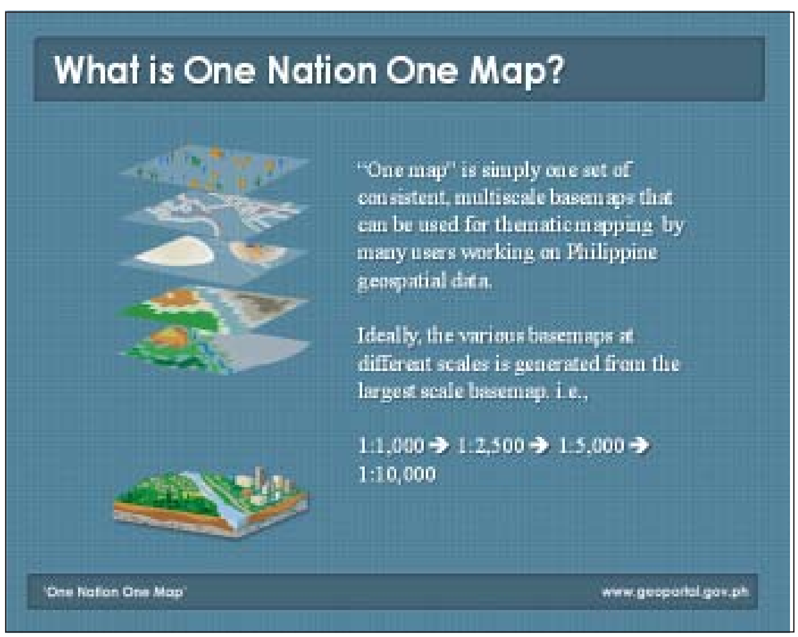


*The One Nation One Map concept*

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***The Philippine...** from page 25*

roads and tax maps; and DENR can add thematic layers on forestry, mines, and environment. Also, the Mines and Geosciences Bureau; PAGASA; PHIVOLCS; and NAMRIA can jointly build geohazard map layers while the Department of Education can add school locations and the Department of Health can add health data.

The project also intends to serve to the participating stakeholders through the portal all the basemaps that NAMRIA produces and eventually all the fundamental and thematic datasets of the other data-producing agencies. This will promote participation of data producers and other stakeholders in terms of providing location and attribute information. The buildup of data content and development of other GIS-based applications will also be done in the succeeding phases of the Project.

**Project Objectives**

Generally, the Project aims to: (1) establish a spatial data infrastructure that provides and integrates geographically-referenced data generated by various government agencies or offices, the academe, and other organizations using one standard basemap; (2) provide a customer-friendly portal 24/7 web/online access to spatial data; (3) provide an ICT platform for collaboration, data and resource sharing, integration, transparency and resource optimization; and (4) formulate policies and standards for data sharing, access, updates, security and pricing.

Specifically, it would (1) develop in a limited area a large-scale framework map that consists of the following layers of spatial information: ground control points, digital terrain model, orthorectified imagery, and topographic line map consisting of roads, building footprints, surface hydrology, administrative and political boundaries; and (2) upload the resulting maps and associated attribute information onto the web**.**

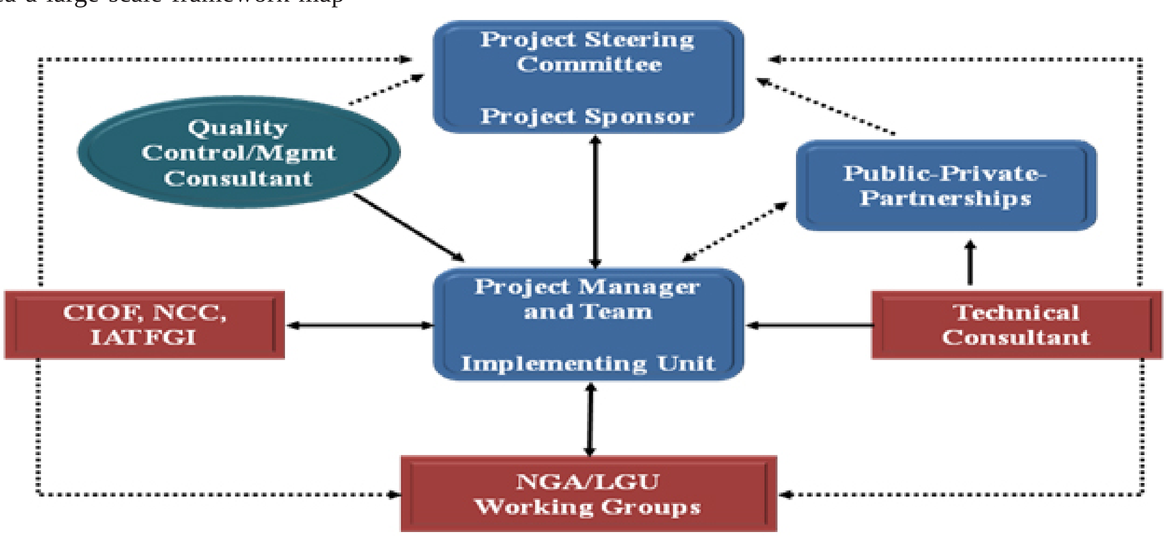
**Project Components**

The four previously discussed components can be broken down into eight activity components, namely: **(1) Data** – this component will be responsible for the preparation of fundamental datasets that will be uploaded to the portal, development of the database design, acquisition of 20-centimeter orthorectified aerial photos of Metro Manila and its environs, and the creation of a multiscale basemap to include feature extraction; **(2) Applications Development** – This component will take care of the development of a Web-based data access/service/viewer to include data fusion, mashups, data maintenance and updating; (3) **ICT Infrastructure** – This component will be responsible for the acquisition of hardware and software requirements of the project and the installation of the network; **(4) Training and Capability Building** – Staff of key agencies and other participating agencies will undergo instructor-led training on the technology on data creation, processing, mash-up, etc. (staff who will use the framework map will also undergo on-the-job training); **(5) Policy Framework and Planning/Institutionalization** – Activities under this component will include the formulation of the Spatial Data Infrastructure (SDI) Implementation Plan and the formulation of the Philippine Geoportal policies, standards, and protocols; **(6) Phase 2 and 3 Planning** – Since this is a three-year project, this component will already draft a detailed implementation plan for the next phases; **(7) Technical Support and Warranty** – This component will take care of the provision of technical support for the applications developed and use of data provided; and **(8) Project Management and System Integration** – This component will ensure that all components of the project are in place and the whole system is operational. A Project Management Team will also be put in place for day-to-day project operation and for monitoring and evaluation.

**Governance**

The multiagency project will have a Project Steering Committee comprising key participating agencies. This Committee will be composed of DENR as the Chairman and at the same time the Project Sponsor. NAMRIA will serve as the Project Owner and Implementer. Key stakeholders are the national government agencies, LGUs, academe and public users. The Project Steering Committee shall set policy and directions and conduct final review of the Project based on performance metrics and indicators.

The Stakeholders or the Working Group shall prepare the inventory, metadata, and the actual data of their organization which are worth deploying on the Web; develop the thematic layers and attributes associated to their agency using the standard multiscale basemap; and set up a training program for participating agencies and other




*The project governance structure*

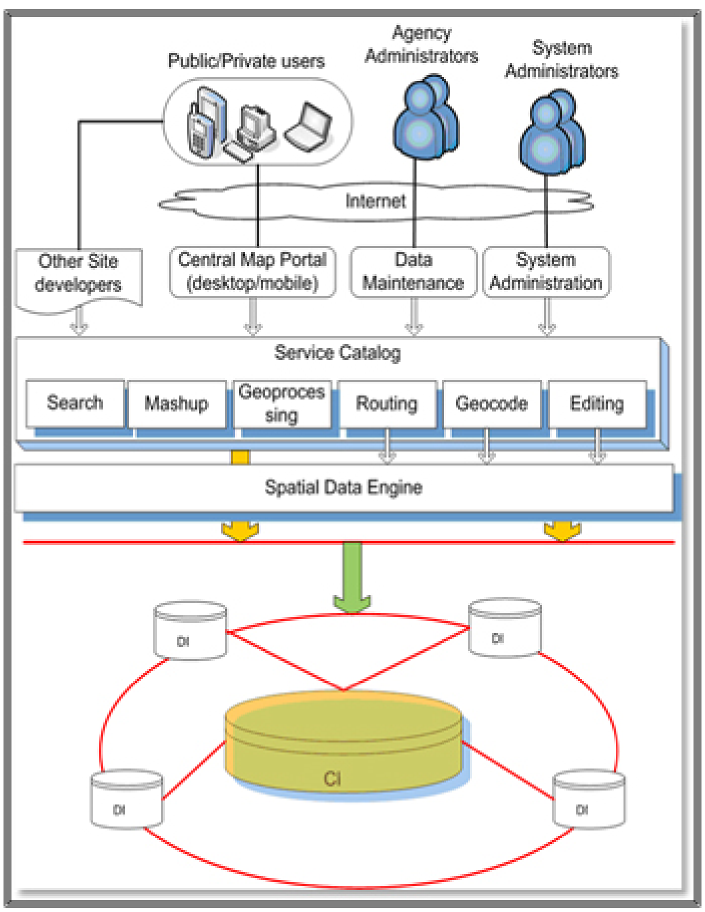
potential users to facilitate data integration and fusion. The Network Group shall prepare the operations environment, the readiness for 24/7 performance, the warranty and application services, and the deployment of application into the operational activities. Technical consultants will also be tapped in the development and maintenance of the portal, configuration of network infrastructure, conduct of technical training, and project management.

**Conceptual Framework**

NAMRIA will establish its own Spatial Data Infrastructure (SDI) that will be responsible for the uploading of geographic data onto the web. Agencies will maintain geospatial data in their own decentralized infrastructure (DI) network. The system will allow other agencies to access data from other DIs. Each DI will be equipped with the same kind of hardware and software required to maintain or publish data through the portal.

Databases will be served on the Web and be discoverable, accessible, downloadable. Web-based applications such as mash-up, search, routing and GIS operations such as geoprocessing and geocoding will be built to address queries, visualization, aggregation, geographic overlay, feature selection and analysis, and data conversion, among others.

Other applications will be built, however, for selected sectors using the GIS as a service. Policy and procedures will be established with log-ins being required for some data and public access will be allowed for other datasets.




*Conceptual framework*

**Outcomes**

For the first year of implementation, the project is expected to improve capability of government map/data producers to provide data in GIS format. For the second year of implementation, the project will have the following outcomes: (1) Improved service delivery of maps and data by government map/data producers; and (2) Citizen-centric service of enabling others to create value-added goods and services.

The ultimate outcomes of the project are expected to be provided after the third year of project implementation to include the following: (1) One multiscale framework map; (2) built-up, updated, and maintained databases guided by standards and established data policies; (3) highly accessible and available map service; and (4) established policies and procedures on data access, standards, sharing, security, and pricing. Finally, the vision of the Project is to have a spatially-enabled and interconnected government, that provides consistent, authoritative and updated geographic information that can be accessed and shared 24/7 onto the web through the Philippine Geoportal.

*Top picture: First Philippine Geoportal Project meeting with stakeholders held on 28 February 2011 at the NAMRIA Lecture Hall*
*Bottom picture: NAMRIA Administrator Peter N. Tiangco welcomes the participants of the second stakeholders' meeting held on 21 June 2011*

**Stakeholders' Commitment**

To date, there have been two stakeholders' meetings for the Philippine Geoportal Project. These were held on 28 February and 21 June of this year. Both were well-attended affairs which served to introduce the project, give updates on accomplishments, and overall draw commitment from agencies to contribute their respective fundamental data to the Philippine Geoportal database.•

Technical Paper

# GIS in Flood-Risk Management: The Case of Cainta, Rizal*

*by R. C. Gatchalian**, M. T. Pandan, E. Tamayo, and M. J. Villanueva*

## I. Introduction

### 1.1 Rationale

Flooding is considered as one and probably even the most devastating of all of the most common disaster phenomena or natural hazards (Guarin, et al.; 2004 and Hailin and Baoyin, 2009). Flooding is a recurring natural phenomenon usually brought about by heavy rains. Other causes of flooding include overflowing of rivers, inflow of tides, storm surges, and other indirect sources such as seismic activities (PAGASA).

Over the years, problems associated with flooding incidents have greatly increased. The effects have spread to wider populations and jurisdictions. These effects can be related to the physical and social changes in the environment particularly in the changes in landscape, land cover and land use, urbanization, increase in population density, illegal occupancy of unsafe land, and many others (Guarin, et al., 2004; Adeaga, 2008).

Several flooding incidents have been experienced in the Philippines. These are caused mainly by heavy rains brought about by tropical storms or typhoons passing each year. Mitigating flood incidents has been one of the major concerns in several cities and municipalities in the country. There is an urgent need to manage flooding incidents to minimize, if not totally eliminate, the losses and damages they bring.

The problems associated with flooding are usually addressed by local government units (LGUs) that are keen to institute measures. In order to come up with improved plans and programs, however, the LGUs should be able to consider physical and social factors, integrate information from diverse sources, and make decisions which are location-specific. These can be facilitated through the use of GIS (geographic information systems). GIS provides spatial visualization and analysis tools which are very useful in planning, strategizing, decision making, and plan execution.

### 1.2 Objectives of the Study

The study aimed to develop a GIS-based flood-risk management plan for an LGU. Said plan is intended to aid the LGU officials in the planning and implementation of activities relating to flood risk management and disaster response.

Among the specific objectives of this study were to (1) Gather information related to flood risk such as topography, geography, infrastructure, and demography of the study area and other relevant documentations; (2) Conduct spatial analysis to determine high-risk or vulnerable areas and evacuation or emergency areas; (3) Determine flood-risk management strategies for the identified high-risk areas and evaluate mitigation measures prepared by the local government; and (4) Produce a comprehensive flood-risk management plan.

## II. Related Literature

In many researches, identifying the risks associated with flood incidences is based on several natural and social factors. The scope of study and the level of assessment are influenced by the availability and type of data and information, thus the differences in models and methodologies used. The fields to which the results of studies should be applied are likewise a consideration.

The scope of such assessment is usually made on a provincial or regional level. The results can be applied to disaster prevention planning and economic analysis (Guarin, et al., 2004), land use planning (Bapalu and Sinha, 2005), and development impact assessment (Rahman and Alkema, 2006).

In the study conducted by Fano (2009), the overall Philippine Flood-Risk Index (P-FRIc) by province is determined by using five key indices with both natural and social factors as indicators. The indices, namely, Hazard (H), Exposure (E), Vulnerability (V), and Coping Capacity using Soft countermeasures (CS) and Hard countermeasures (CH) were used to compute for the P-FRIc using the formula

$$\text{P-FRIc} = \frac{H \times V \times C}{C_S + C_H}$$

This flood-risk assessment utilizes present-time data and presents the structure of flood risk in a comparative and quantitative approach. The calculated P-FRIc values were verified to be in agreement with past actual flood-damage data and the methodology can be considered as a source of new knowledge for disaster managers.

## III. Description of Study Area

The Municipality of Cainta (Figure 1) is among the 14 municipalities/cities of Rizal Province. This first-class urban municipality lies in the boundary of the country's metropolis and serves as the secondary gateway to the rest of the Province.

Based on the 2007 National Census, the municipality has a total land area of 4,299 hectares and a population of 289,833. The municipality comprises seven *barangays*.

The geographic location and physical condition of the municipality make it generally prone to flooding and flashfloods. It is located in the Marikina Valley where elevation is significantly lower than the neighboring towns. Adding to this are the river and

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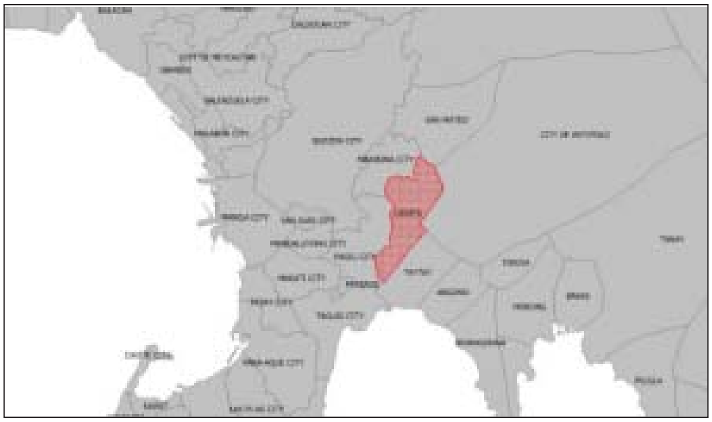

*Figure 1. Geographic location of Cainta*

water systems surrounding the municipality including the Cainta River, Marikina River, and the Floodway. It is further aggravated by the informal settlers occupying the banks of the waterways and the siltation of rivers and streams.

In 2009, Cainta was one of the municipalities/cities badly affected by the Tropical Storm Ketsana (local name *Ondoy*). According to the incident report prepared by the Municipal Disaster and Coordinating Council (MDCC), the rains brought about by the storm submerged 98% of Cainta in floodwaters with heights ranging from three to ten feet. It affected 45,000 families representing more or less 285,000 individuals. It consequently damaged roads, buildings, facilities, properties, and other infrastructure, and ultimately affected the livelihood of the residents of Cainta.

## IV. Materials and Methods

### 4.1 Materials

Both spatial and non-spatial data and information were used in this study, as follows:

I. Spatial Datasets - (1) Scanned Topographic Map of Cainta, 2005 (Sheet 3230 III 13 and 3230 III 18 at 1:10,000 scale from NAMRIA; Vector Dataset derived from scanned maps (comprising points, line and polygon features and is in *.dxf* format); *Barangay* Boundary Shapefiles based on *Barangay* Index Map from the Cainta Assessor's Office; Cainta Tourist Map from the Cainta Municipal Planning and Development Coordinating Office (MPDC)

II. Non-spatial Datasets - (1) Demographic Profile from the National Statistical Coordination Board-National Statistics Office, 2007 and from the MPDC—Municipality of Cainta Socioeconomic Profile, Annual Report for CY 2009, and Contingency Plan on Natural Disasters, 2009

The ArcGIS software was used to integrate, process, and analyze the data and information gathered. Other spatial technology resources used were the AutoCAD 2004, Global Mapper 9, Google Earth™ application, and other online street maps for conversion of data and validation of geographic information. The handheld GPS was also used to obtain the geographic location of some points of interest within the study area.

### 4.2 Methods

The study had two major considerations. First was the identification of high-risk or vulnerable areas and second was the actual development of a flood-risk management plan. To address these, four major activities corresponding to the data and process flow (Figure 2) were defined.

#### 4.2.1 Data Inventory/Collection

This activity refers to the search and collection of both spatial and non-spatial datasets from various respective data sources for use in the processing and analysis. The initial activity goal was to gather as much information as possible regarding the natural and

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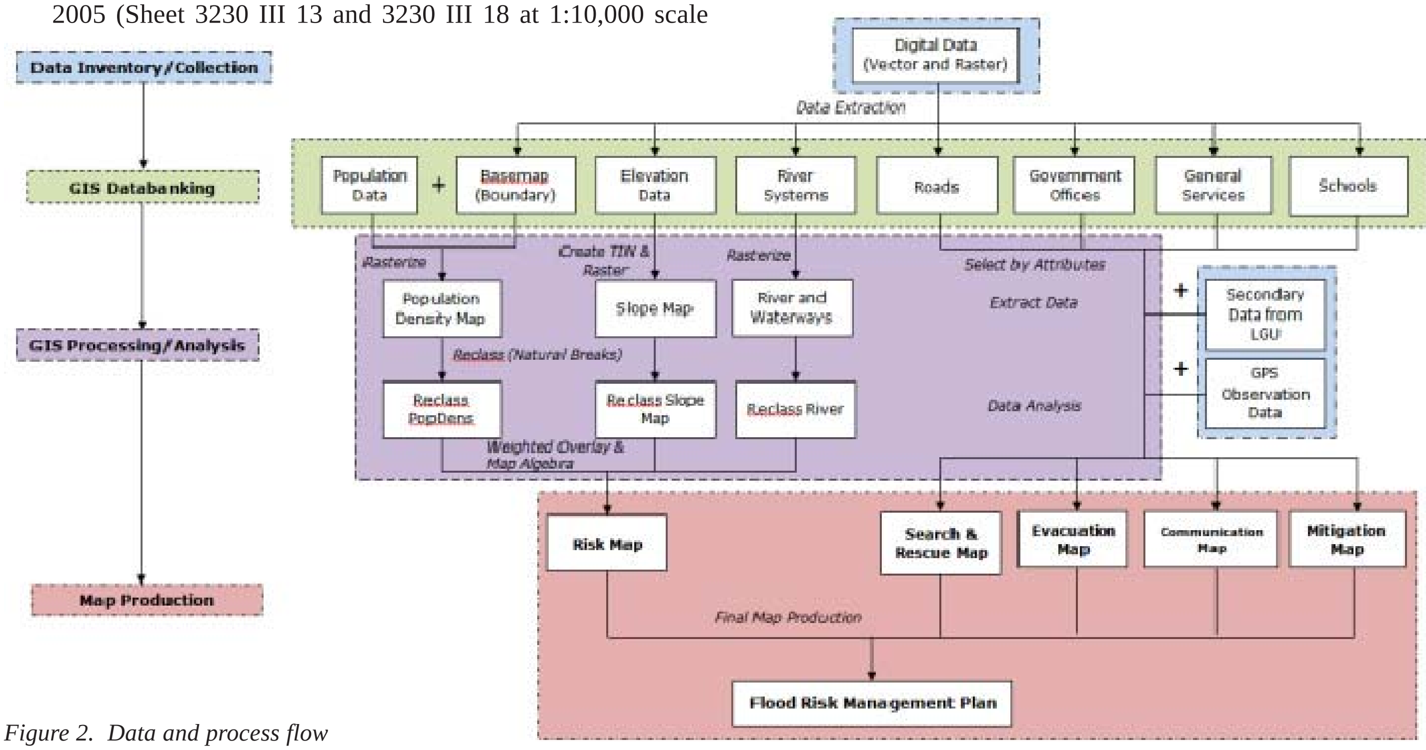


*Figure 2. Data and process flow*

## GIS in Flood-Risk ...*from page 29*

social factors which serve as indicators in defining the flood-risk index. Since most data are disaggregated only up to the municipal level and some are not readily available from the identified sources, majority of the indicators were disregarded. The data collection was instead focused on three major factors, namely, topography, geography, and demography.

Most of the spatial datasets gathered were in digital format while the non-spatial datasets were in the form of documentations, reports, and map printouts. Among the data collected were the geographic locations of some points of interest within the study area. These data were obtained through ground survey using handheld GPS. The complete list of data collected was already presented in the preceding section.

**4.2.2 GIS Databanking**

This activity incorporates data cleanup and conversion, selection and extraction of relevant data layers, omission of data which are not critical to the objectives of the study, and population of the geographic database.

Raster data were georeferenced. Vector data were converted to the acceptable GIS format and referred to the raster data. Individual shapefiles were generated for each layer. All relevant information derived from the non-spatial datasets were entered into the database to combine them with the spatial data.

A total of seven data layers were produced: basemap, elevation, river and water systems, roads, government offices, general services, and schools. The first three layers were used in the identification of high-risk areas while the remaining ones were used in the development of the flood-risk management plan components.

**4.2.3 GIS Processing/Analysis**

This activity focuses on the implementation of vector and raster dataset operations to aid spatial analysis and formulation of outputs. The two major stages in GIS are processing and analysis. The first relates to the identification of high-risk areas where the layers of basemap, elevation, river and water systems were used. The second relates to the development of the flood-risk management plan where the roads, government offices, general services, and school shapefiles were used in conjunction with the resulting risk map from the first stage.

Data were extracted first from the vector and raster datasets to form separate shapefiles or data layers as discussed under the section on GIS databanking. Raster operations were mostly applied in the determination of high-risk areas. The population data were incorporated in the basemap and the resulting population density map was converted to raster; the triangulated irregular network (TIN) was derived using the elevation spot heights; and Euclidean distances to rivers and water systems were defined. The datasets were reclassified using the natural breaks (Jenks) method of classification. These were finally combined using weighted overlay function with equal influence setting to derive the flood-risk map.

On the other hand, vector operations were used in the processing of the remaining shapefiles or data layers. Selection by attributes, buffering and creation of new data layers were applied to initial vector datasets in order to come up with the component maps of the final flood-risk management plan.

The raster and vector operations applied in this study are available in and supported by the ArcGIS software. The results of the operations and the corresponding maps were used in the analysis and formulation of conclusions.

**4.2.4 Production of Plan**

The final output of this study was a comprehensive flood-risk management plan. This plan comprises thematic maps resulting from the vector and raster data processing and spatial analysis.

**V. Discussion**

**5.1 High-Risk Area Identification**

The flood-risk indicators used in GIS processing and analysis were based on natural and social factors specifically relating to hazard and exposure. Hazard was associated with slope or elevation and the proximity to rivers or water systems while exposure was associated with population and population density, among others (Fano, 2010). Other indicators for hazard and exposure were disregarded since the available data corresponded to the municipal level (annual rainfall, proneness to typhoons, population growth, etc.). Other natural and social factors were also not considered because of the lack of data.

A risk map (Figure 3) was derived by overlaying three raster maps/datasets: the reclassified population density map, the slope map, and the river and waterways map. For all layers or datasets

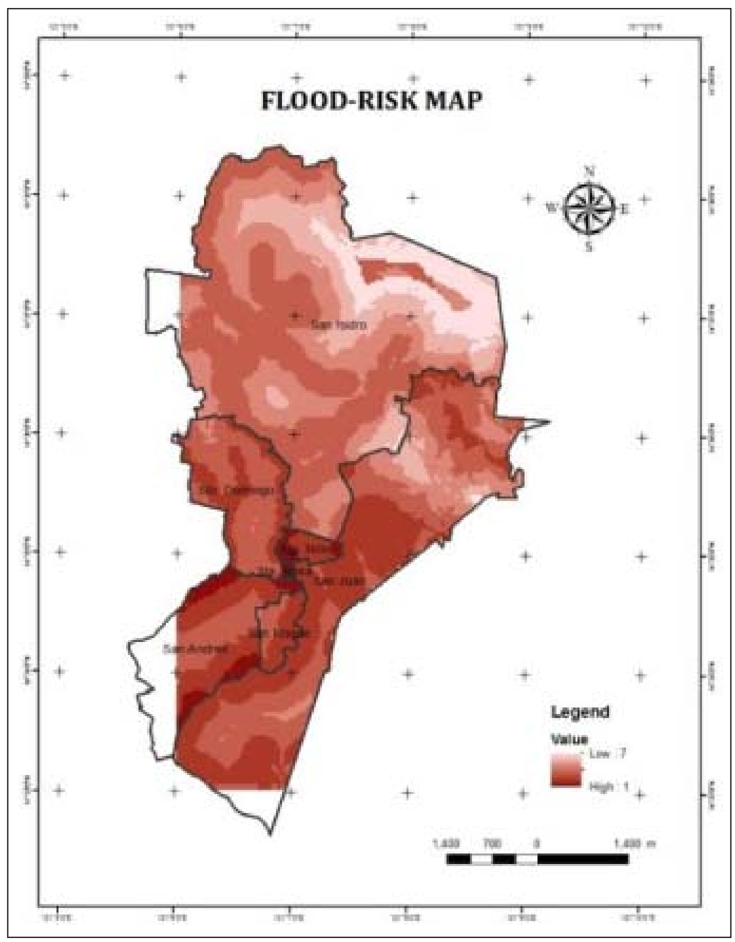


*Figure 3. Flood-Risk Map*

used, ten classes were created with the application of the natural breaks (Jenks) method of classification. In this method, class breaks were determined statistically. The value of *1* was assigned to the area with the highest risk or is the most vulnerable to floods, while the value of *10* had the least risk. Expected high-risk areas are areas with high population density, are near the river or waterways, and with low elevation or slope. The final risk map was created by combining the layers using the weighted overlay function and applying the equal influence setting. The resulting map had a scale of *1* to *7*, with the value of *1* corresponding to the area with the highest risk of flooding.

The high-risk *barangays* were identified from the resulting risk map. These include the *barangays* of San Andres, San Juan, San Roque, Sta. Rosa, and Sto. Niño. Although the assessment done was for the *barangay* level, the actual flood risk of specific sites or zones within a *barangay* was not considered. The analysis was based on the coverage of high-risk areas with respect to the entire *barangay* area. The risk was gauged using high or low criteria. Degrees of risk between the highest and the lowest values were not qualified.

### 5.2 Flood-Risk Management Plan

The municipal government through the Municipal Engineering Office prepared a contingency plan on natural disasters. This contains the incorporated LGU's search and rescue execution plan, evacuation reports, mitigation plans, and early warning system. The spatial information derived from these plans and reports were then incorporated to the working GIS layers and database. Particularly, the staging areas, critical routes, communication centers, evacuation centers, and areas for rehabilitation (i.e., dredging and improvements) were mapped out. Integrating this with the flood-risk map, four component maps were prepared for integration to the comprehensive flood-risk management plan.

First was the *Search and Rescue Map* (Figure 4) which presents the five staging areas located in different points in the municipality. These staging areas serve as the center of search and rescue operations of the Municipal Disaster Coordinating Council. Most of these areas were shown to have a risk of *3* or moderate when the present staging areas were overlaid to the flood-risk map.

It was further observed that most staging areas are located in the western portion of the municipality. This may have implications on the level of emergency response and services to the other areas or *barangays* which are relatively farther from the existing staging areas. Additional staging areas are thus needed to service the eastern parts of the municipality. The potential locations for said areas were identified through GIS. The locations selected were for staging areas near the major road and with either moderate or low risk. These are likewise presented in the *Search and Rescue Map*.

The *Communication Map* (Figure 5), on the other hand, presents the existing communication centers across the municipality. The map correspondingly presents the early warning system of the municipality. This covers information dissemination, pre-emptive evacuation, and actual operations during typhoon and flooding incidents. Assumptions were made to come up with an analysis of the LGU's early warning system. Buffers were computed to estimate the coverage or the reach of each communication center.

Drawing out a one-kilometer radius from each of the pre-identified communication centers is still not enough to cover or service the entire municipality. To address this, there is the need to set up additional communication centers and the suggested

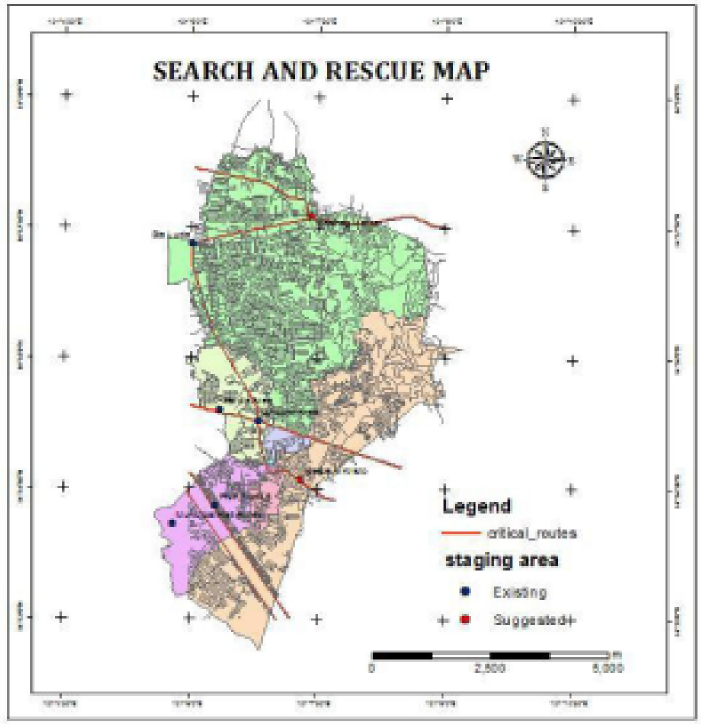


*Figure 4. Search and Rescue Map*

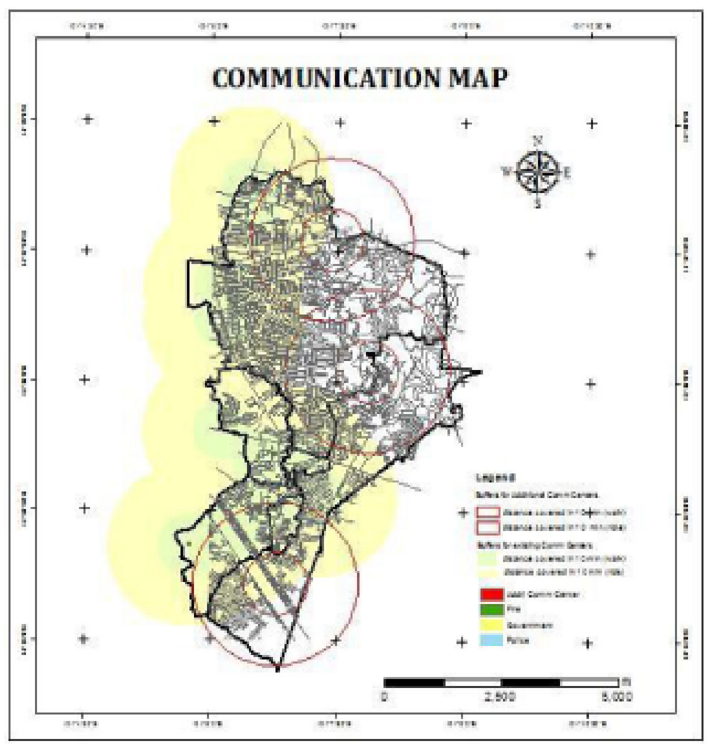


*Figure 5. Communication Map*

locations can be identified through GIS. Correspondingly, equipment (megaphones) must be secured by the LGU for each center. Specific areas of concern must likewise be assigned to each center to facilitate speedy information relay.

The *Evacuation Map* (Figure 6) presents the distribution of the evacuation centers in the municipality. The evacuation centers used are mostly public schools and government offices. These

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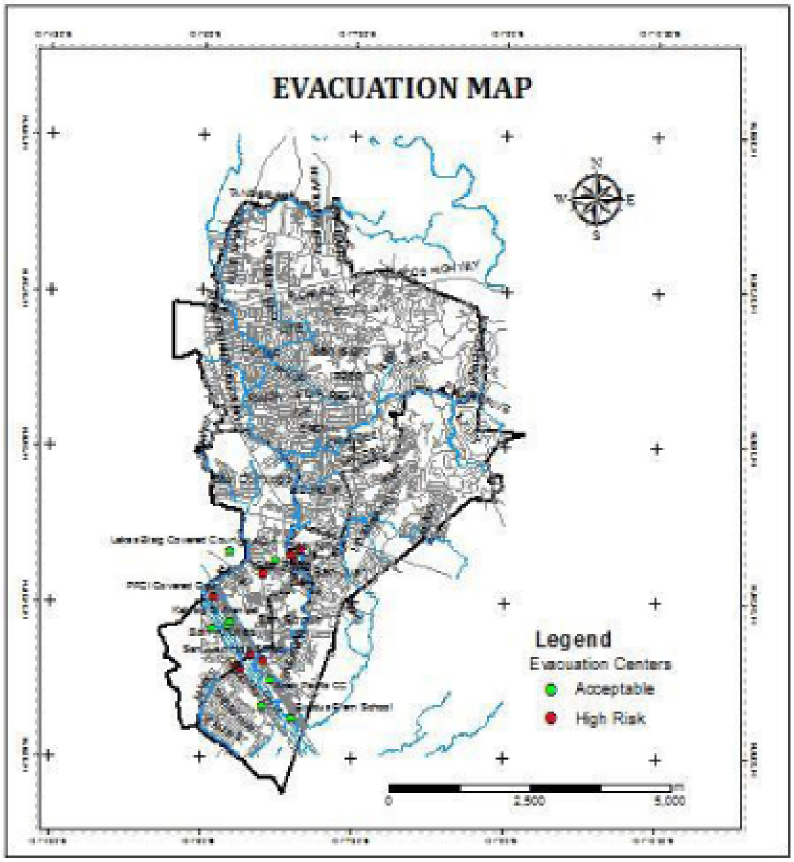


*Figure 6. Evacuation Map*

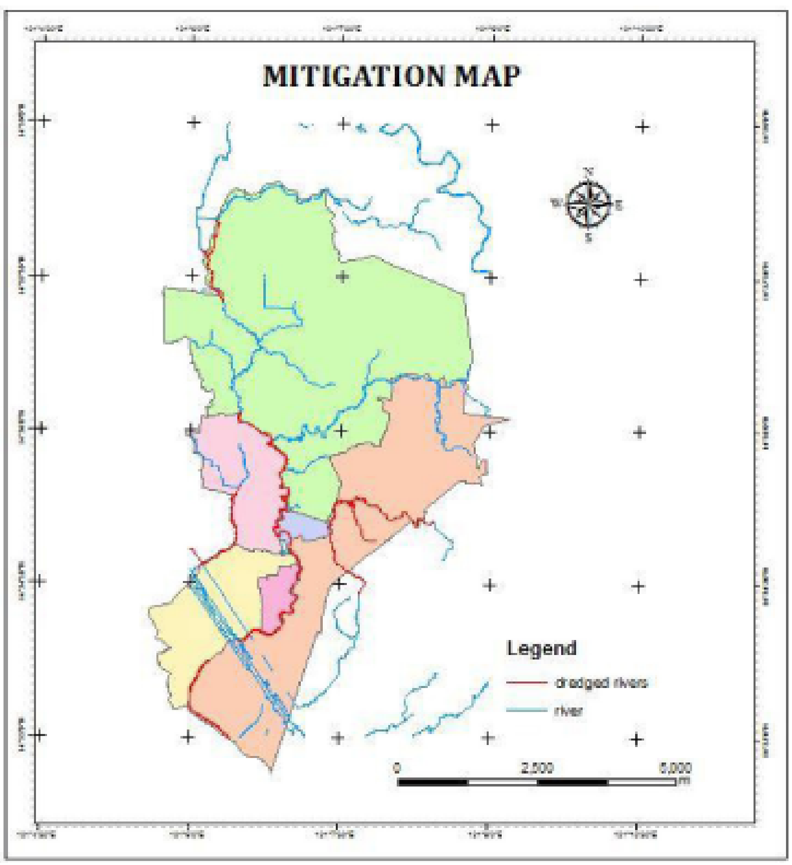


*Figure 7. Mitigation Map*

## *GIS in Flood-Risk* *...from page 31*

are where relief goods and other resources are lodged for distribution to the affected families. In the selection and assignment of evacuation centers, important consideration should be given to the level of flood risk in the area and road proximity for easy access. The present evacuation centers are shown to be either *2* for high risk or *3* for moderate risk when overlaid to the flood-risk map.

The use of evacuation centers in high-risk areas should be avoided. Additional evacuation centers must be identified in other parts of Cainta since all the existing centers are concentrated on the Floodway area. GIS can be used to identify appropriate sites for additional evacuation centers. It can further aid the management of operations in terms of defining the accommodation capacity of evacuation centers and properly organizing relief distribution.

Lastly, the *Mitigation Map* (Figure 7) presents the LGU's plan to rehabilitate through dredging some portions of the river and water systems surrounding the area. Overlaying the river and water systems and the specific areas of interest, which are subject to dredging, to the flood-risk map confirms the need to perform such an operation. Thus it is recommended that said operation be done immediately, subject to evaluation by the office concerned.

In addition to the rehabilitation of the river and water systems, the LGU should look into other existing physical factors such as the presence of informal settlers and the drainage system. Information related to these can be incorporated into the existing GIS database to aid analysis and further improve the mitigation plan of the LGU.

All these maps including the flood-risk map were integrated to come up with an integrated Flood-Risk Management Plan (Figure 8). This shall serve as a tool for the local government officials in planning, strategizing, decision making, and executing plans on flood-related concerns. In addition, the LGU can likewise use the GIS database to come up with other disaster-risk management plans as may be needed, subject to additional data and information.

The assessment results are validated by comparing them with the LGU reports on the flooding incident during the Tropical Storm *Ketsana* and the personal accounts of the residents. The accounts on the actual events, the records on the number of families affected and also on the infrastructure affected show that the *barangays* of San Andres and San Juan are among the most affected. The water levels in some portions of said *barangays* reached the highest range and were the last to subside. Other *barangays* were also affected with varying degrees of incurred damages.

### VI. Conclusion and Recommendations

Upon evaluation and validation of the results of the study and of the corresponding outputs produced, it can be concluded that GIS is indeed a valuable and robust tool for flood-risk management. The technology can be

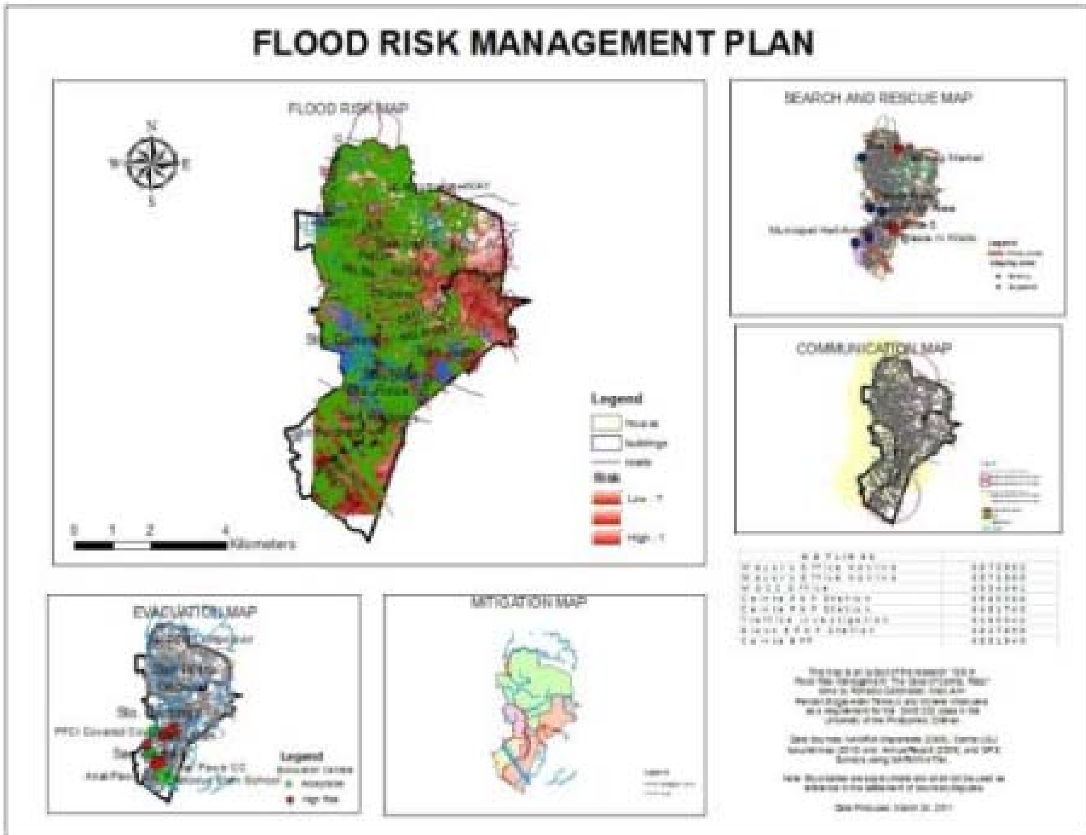


*Figure 8. Flood-Risk Management Plan*

specifically used in the following: (1) Consolidating spatial and non-spatial information related to floods; (2) Analyzing spatial data and determining risk areas and appropriate evacuation/emergency areas; (3) Querying potential mitigation measures; and (4) Producing a comprehensive map to aid planning and decision making especially in the local government level. Recommendations for further study include the consideration of other natural and social factors in determining the flood-risk index and extending the flood-risk analysis to zonal or parcel level.•

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# Global Mapping: One Map, One World[*]

*by Mary Jane R. Montemor[**]*

Global Mapping is a unified mapping scheme that will produce Global Map Datasets, which will be made available to the public for free. The Global Mapping Project is an international cooperation to address global environment issues, mitigate large-scale disasters, and achieve sustainable development. It is a collaboration of countries to produce the Global Map as reliable geographic information with global coverage and standard specifications. It is an instrument for fully understanding and monitoring the status and changes in the environment.

## History

During the Earth Summit (United Nations Conference on Environment and Development) in 1992, the Agenda 21 was adopted and Japan advocated the "Global Mapping Project" as the international contribution to global environmental issues from the survey and mapping sector. In 1996, the International Steering Committee for Global Mapping (ISCGM) was established and the then Geographical Survey Institute (GSI) of Japan served as the Secretariat. The following year, the UN General Assembly 19th Special Session stated the necessity of Global Mapping so that in 1998, the United Nations issued a recommendatory letter to all national mapping organizations. In 2002, the World Summit on Sustainable Development in Johannesburg encouraged initiatives and partnerships for Global Mapping in its implementation plan.

There has been a significant increase in the number of participating countries in the Project since 1998. The global datasets produced from the Project have covered almost 60% of the total land area of the world. Presently, the GSI of Japan has assisted in the development of Global Maps of several countries.

## The Global Map Data

Map specifications for the global map dataset are established to standardize global maps produced by each participating country. The Global Map dataset will be at 1:1,000,000 scale which is equivalent to one-kilometer spatial resolution. It will consist of eight layers: boundaries, drainage, transportation, population centres, elevation, land cover, land use and vegetation (percent tree cover).

Global Map Version 1 was released in 2008 and Version 2 is planned for release in 2013. It is available in user-friendly data formats (e.g., shapefiles and TIFF) and is freely downloadable for non-commercial use in the ISCGM website (http://www.iscgm.org).

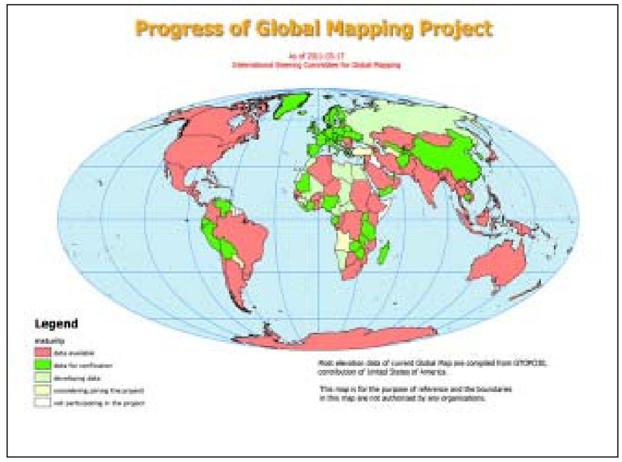


*Figure 1. **Progress of Global Mapping Project as of March 2011** - The current status of activities of each country participating in the Project*

## Global Map Applications and Beyond

The global map datasets can be used in applications such as the following: (1) climate change policy framework; (2) simulations for adaptation measures such as sea-level rise, inundation, and drought; (3) global flood analysis; (4) global land cover monitoring to reduce forest degradation; and (5) natural disasters. The applications are focused more on consequences of environmental changes with respect to worldwide activities and natural phenomena. The availability of this data smoothens the progress of digital data sharing among nations and facilitates cooperation for the common good among participating countries.•

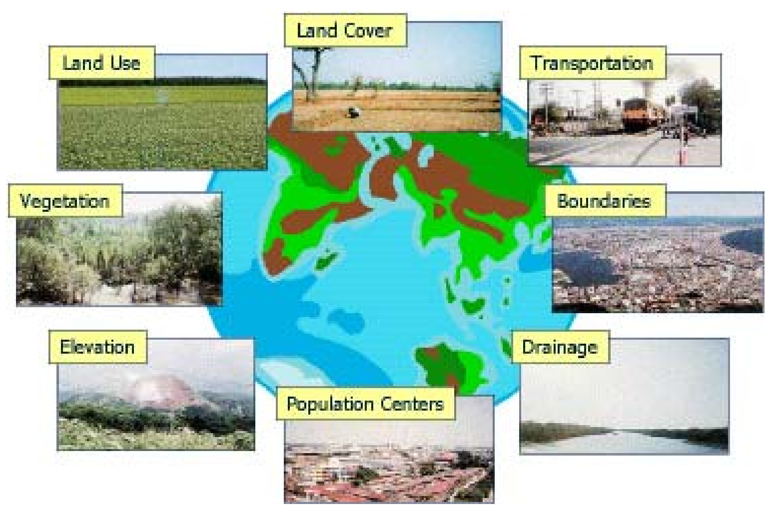


*Figure 2. **Global Map Data –** Eight-layer global datasets at one-kilometer spatial resolution*

[*]*Reference: GSI of Japan*

[**]*Engineer II, Cartography Division, NAMRIA Mapping and Geodesy Department. Ms. Montemor attended the group training course "Global Mapping for Sustainable Development on 22 June -03 September 2010 in Tsukuba, Japan. She also wrote an article on Global Mapping in the ISCGM Newsletter No. 59 dated 25 October 2010.*

## News

# NAMRIA set to receive LIDAR data and orthoimage from GA

*by Benjamin P. Balais**

NAMRIA and other Collective Strengthening of Community Awareness for Natural Disasters (CSCAND) agencies are to implement the project *Enhancing Risk Analysis Capacities for Flood, Tropical Cyclone, Severe Wind, and Earthquake for Greater Metro Manila (Risk Analysis Project)*. The CSCAND group is under the National Disaster Risk Reduction and Management Council which is working on the Hazard Mapping and Community-based Disaster Management (READY) Project.

Under the Risk Analysis Project, NAMRIA is set to receive Light Detection And Ranging (LIDAR) data and orthoimage from Geoscience Australia (GA). The dataset covers the Greater Metro Manila Area (GMMA). The data will be used in various activities of the project such as exposure-database buildup, multihazard-risk assessments, and development of risk-analysis models for severe wind, flooding, and earthquake. The exposure database for Taguig City will be generated for the year, which hopefully will be replicated by the different cities under the GMMA.

Data collection and aerial photography were completed in the first week of April 2011 which was earlier than the expected date. These activities were done by the Australian-based company FUGRO in collaboration with F. F. Cruz and Co., Inc. A total of 31 flying hours was spent to cover the areas jointly identified by PHIVOLCS, PAGASA, and the DENR-Mines and Geosciences Bureau in view of their priority areas.

The dataset is currently being processed in the GA office in Australia before its turnover to NAMRIA in August 2011. The major outputs to be turned over to NAMRIA include Digital Elevation Model (DEM) and orthophotos. These datasets are vital and integral in the development of the previously mentioned models.

Hardware and software to process and manage the dataset shall also be provided to NAMRIA as the custodian of the dataset. Trainings to enhance the capability of the Agency's staff to optimize the use of the data have already been identified.

There are already requests for the dataset from other CSCAND agencies since the dataset is a fundamental input to the development of geospatial-based applications covering hazard mapping, engineering and infrastructure development, urban and land use planning, among others.

NAMRIA itself is keenly awaiting the dataset which plays a significant role in the development of the Philippine Geoportal Project, both as a source of information for large-scale mapping of the GMMA and as a showcase fundamental data that can be viewed by potential users of the envisioned web-enabled GIS-based viewer.•

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# NAMRIA in DENR flagship program efforts on climate change

*by Saldivar B. Asprit***

The NAMRIA Remote Sensing and Resource Data Analysis Department-Physiography and Aquatics Division is undertaking the first-year implementation of the three-year research project entitled ***"Mapping of Low-Lying Areas Vulnerable to Sea Level Rise"***. This project is in support of the flagship program of the DENR Climate Change Commission. The project aims to map the extent of low-lying areas vulnerable to different sea-level rise (SLR) scenarios using high-resolution elevation data; generate detailed land cover/land use maps using recent satellite images; and identify the highly vulnerable areas based on land cover/land use and infrastructure, demographic profile, and socioeconomic conditions under different SLR scenarios.

The expected outputs of this project include 1:10,000-scale maps of low-lying areas; maps showing land cover/land use, SLR vulnerability, and coastal resources; and statistics. The list of 30 identified cluster-sites is given in the table at right. •

| Cluster | Coverage |
|---|---|
| **LUZON** | |
| 1 | Ilocos Norte |
| 2 | Ilocos Sur |
| 3 | La Union |
| 4 | Pangasinan |
| 5 | Cagayan |
| 6 | Bataan, Bulacan, Pampanga,Cavite, NCR |
| 7 | Occidental Mindoro |
| 8 | Quezon |
| 9 | Camarines Norte |
| 10 | Camarines Sur |
| **VISAYAS** | |
| 11 | Iloilo |
| 12 | Aklan, Capiz |
| 13 | Capiz |
| 14 | Negros Occidental |
| 15 | Cebu |
| 16 | Bohol |
| 17 | Leyte |
| 18 | Northern Samar |
| 19 | Western Samar |
| 20 | Leyte |
| **MINDANAO** | |
| 21 | Zamboanga del Sur |
| 22 | Zamboanga del Sur |
| 23 | Zamboanga del Sur, Misamis Occidental, Lanao del Norte |
| 24 | Misamis Oriental |
| 25 | Sarangani, South Cotabato |
| 26 | Davao del Norte, Davao del Sur |
| 27 | Lanao del Norte |
| 28 | North Cotabato, Cotabato City, Maguindanao |
| 29 | Surigao del Norte |
| 30 | Agusan del Norte |

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*Officer In Charge, Database Management Division, NAMRIA Information Management Department

**Senior Remote Sensing Technologist, Physiography and Aquatics Division, NAMRIA Remote Sensing and Resource Data Analysis Department

# Ongoing NAMRIA inventory of islands, land area, and coastline measurement

*by Ltsg. Carter S. Luma-ang, Hydrography Department*

NAMRIA is currently working towards performing the following significant undertakings for the nation: (1) to come up with standard definitions for islands, islets, rocks, and other relevant geographical features; (2) to conduct its inventory and update the Philippine Islands database; and (3) to conduct systematic measurements of the Philippine coastlines. NAMRIA Administrator Peter N. Tiangco created the *Task Group on the Inventory of Islands, Land Area, and Coastline Measurement* through Special Order No. 003, dated 07 May 2010.

The establishment of the task group was in connection with NAMRIA's membership in the Technical Working Group (TWG) created per Oversight Committee on Devolution Resolution No. 1, series of 2005 for the validation of the land area master list of LMB, and in view of the need to update the Philippine Islands Database and relevant statistics. The NAMRIA Special Order designated Commodore Romeo I. Ho, Director of the Hydrography Department as Chairman. The other members are: Deputy Administrator Jose C. Cabanayan, Jr.; Mapping and Geodesy Department Director Jose Galo P. Isada, Jr.; Information Management Department Director John S. Fabic; and Engineering Services Department Director Enrique A. Macaspac. The members are supported by subcommittees created within their respective departments to assist them.

One of the major undertakings of the NAMRIA Task Group is to validate the total number of islands of the country as listed in the *Philippine Gazetteer*. It has long been accepted that the Philippines has 7,107 islands. The recent count made by the group, however, shows otherwise. The final statistics can only be published after undergoing several processes of validation including field inspection and approval by the TWG. The group is using several references including topographic maps, nautical charts, and remote sensing images. Field survey teams are also deployed to verify the existence of certain islands.

The task group conducts regular meetings including dialogues with other agencies such as the LMB. The work of the group is critical since the statistics will be used as official data in declaring the number of islands, the total area, and the length of coastline of the Philippines. The land area statistics will also be the basis by the Department of Budget and Management (DBM) for the allocation of the Internal Revenue Allotment of local government units (LGUs).

The task group, however, has its difficulties. For example, the members' points for argument include the diverse definition of geographical features (e.g., islands and extent of mouth of river) among different technical groups. As a result of this, the task group chose to adopt the most common and internationally accepted definitions based on the United Nations Convention on Law of the Sea (UNCLOS) guideline and the International Hydrographic Organization (IHO) dictionary. The land area in the respective reports to the DBM also fluctuates and shows inconsistencies. This is based on the TWG's computation of land area using several methodologies. Despite all the conflicts, however, the task group remains hopeful that they will be able to accomplish their mission.•

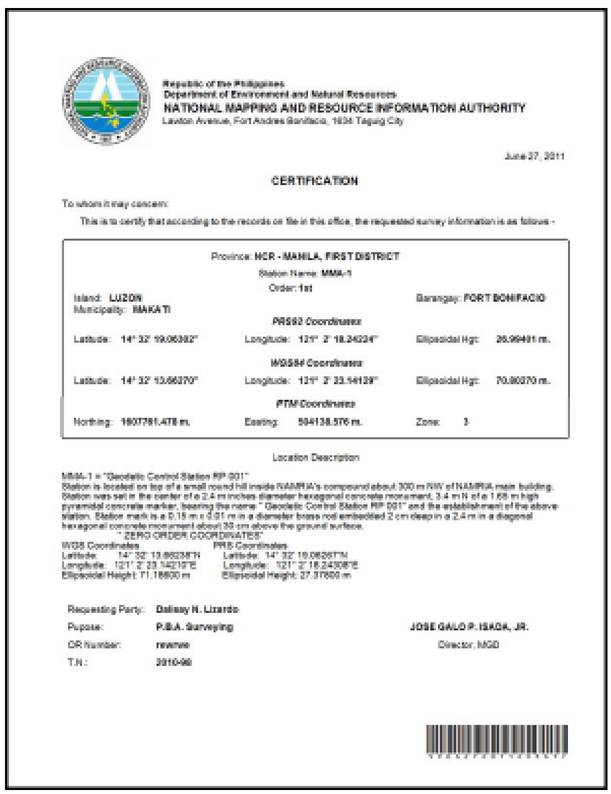
# Securing the GCP Certificate

*by Gerardo B. Tanabe[*]*

Even in today's electronic age, the use of hard copy documents cannot be disregarded. However, what can be done to address the problem of the unscrupulous creation of altered documents that can deceive any unsuspecting individual?

Forgery can cause significant damage in terms of trust and authenticity. Therefore, it is essential that the integrity of important documents be maintained. A case in point is the certification for each GCP being issued to surveyors or mapmakers who need to geographically reference their surveys. NAMRIA, which is maintaining a Geodetic Network Information System (GNIS) containing among others a description of each GCP, has incorporated a document security feature into the GNIS. When printing the GCP certificate, each printing transaction will be recorded into the database. This can help determine the date when the certificate was printed and the actual information on the certificate. Each document record will then be given a unique tracking number which will be printed on the certificates as a barcode.

The system has been tested to date and experimentally proven as capable of providing reliable integrity verification for the GCP hard copy document. Document security protection is now assured with the addition of the barcode identifier. •


Republic of the Philippines
Department of Environment and Natural Resources
NATIONAL MAPPING AND RESOURCE INFORMATION AUTHORITY
Lawton Avenue, Fort Andres Bonifacio, 1634 Taguig City

June 27, 2011

CERTIFICATION

To whom it may concern:

This is to certify that according to the records on file in this office, the requested survey information is as follows -

Province: NCR - MANILA, FIRST DISTRICT
Station Name: MMA-1
Order: 1st
Island: LUZON
Municipality: MAKATI
Barangay: FORT BONIFACIO

PRS92 Coordinates
Latitude: 14° 32' 19.06382" Longitude: 121° 2' 18.24224" Ellipsoidal Hgt: 26.99491 m.

WGS84 Coordinates
Latitude: 14° 32' 13.66270" Longitude: 121° 2' 23.14129" Ellipsoidal Hgt: 70.80270 m.

PTM Coordinates
Northing: 1607781.478 m. Easting: 504138.576 m. Zone: 3

Location Description

MMA-1 = "Geodetic Control Station RP 001"
Station is located on top of a small round hill inside NAMRIA's compound about 300 m NW of NAMRIA main building. Station was set in the center of a 2.4 m inches diameter hexagonal concrete monument, 3.4 m N of a 1.65 m high pyramidal concrete marker, bearing the name " Geodetic Control Station RP 001" and the establishment of the above station. Station mark is a 0.15 m x 0.01 m in a diameter brass rod embedded 2 cm deep in a 2.4 m in a diagonal hexagonal concrete monument about 30 cm above the ground surface.
" ZERO ORDER COORDINATES"
WGS Coordinates — Latitude: 14° 32' 13.66238"N; Longitude: 121° 2' 23.14210"E; Ellipsoidal Height: 71.18800 m
PRS Coordinates — Latitude: 14° 32' 19.06387"N; Longitude: 121° 2' 18.24308"E; Ellipsoidal Height: 27.37800 m

Requesting Party: Dalisay N. Lizardo
Purpose: P.B.A. Surveying
OR Number: rewrwe
T.N.: 2010-98

JOSE GALO P. ISADA, JR.
Director, MGD

[*] *Computer Programmer II, Systems Development and Programming Division, NAMRIA Information Management Department*

# An Overview of the Unified Mapping Project

*by Aubrey George T. Corpuz*

There are two primary considerations why the Unified Mapping Project was envisioned: to promote effective governance and to save government funds. For the past years, a lot of taxpayers' money was being wasted because government agencies allocate millions of funds to acquire aerial photographs and satellite imageries for their respective mapping projects. This flawed practice will be finally put to an end through the Unified Mapping Project.

Out of the more than 20 certified priority bills by President Benigno S. Aquino III, two were initiated by the DENR. These are the bills on Total Log Ban and on the Unified Mapping Project. The Unified Mapping Project will involve the updating of the 1:50,000-scale topographic map series for the entire country using high-resolution satellite imagery. It also includes the implementation of more detailed 1:10,000-scale maps of 50 percent of the country's land mass. Maps with larger scale are useful for the production of more detailed plans and projects that require more accurate datasets. They can also be used for cadastral applications. A great percentage of planning, decision making, and operations in the different government agencies are being influenced by locations. The government uses the geospatial data for legislation, policy development for the allocation and management of resources, conservation of natural resources, protection of the environment, land use and disaster management, agricultural production, urban planning, zoning and development, communications, transport, defense, and public safety.

The project will be considered as a multiagency collaboration. There will be pooling and sharing of resources among different government agencies engaged in mapping and GIS activities. This will eliminate duplication of work and optimize the utilization of government funds. The project which is fully supported by the government's other line departments will be undertaken by NAMRIA. The purchase of aerial photographs and satellite imageries will be made by DBM.•

*DENR Secretary Ramon Jesus P. Paje informs the participants on the approval by President Aquino of the Unified Mapping Project as one of the priority bills during the 2011 DENR Budget Reprogramming held at Fontana Convention Center in Clarkfield, Pampanga.*

# Efforts under way for ISO 9001:2008 QMS certification for NAMRIA

*by Maria Romina dR. Pe Benito*

NAMRIA is currently working to achieve an agencywide certification on the International Organization for Standardization (ISO) requirements for 9001:2008 Quality Management System (QMS). ISO, from the Greek word *isos* meaning equal, is a plan of standards and guidelines for voluntary adoption by industries, whether in manufacturing or services. The ISO is a Swiss-based worldwide organization, established in 1947, of national standard bodies from over 150 countries.

The Agency's adoption of ISO 9001:2008 QMS is pursuant to Executive Order No. 605, series of 2007, which institutionalizes the structure, mechanisms, and standards to implement the Government Quality Management Program. The Agency is tapping the services of the Development Academy of the Philippines for ISO 9001:2008 consultancy. Administrator Peter N. Tiangco is ensuring the fast-tracking of activities in order for NAMRIA to attain the milestone achievement of being awarded certification by the prestigious body.•

*Whole-day exploratory meeting/seminar on ISO 9001:2008 QMS certification for NAMRIA at the Agency Boardroom on 31 March 2011*

## PageNET ...*from page 5*

works 24 hours a day, data collection can be conducted day and night.

*Contribution to international GNSS initiatives.*

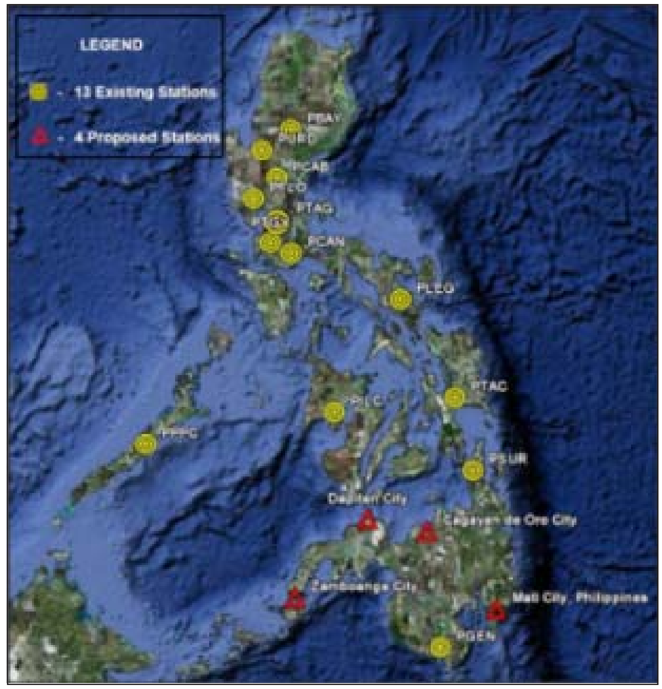
Aside from joining the IGS Network, the PageNET also has participated in other international geodesy projects, especially those that concern the Asia Pacific region. Since 2008, through the stations of the PageNET, NAMRIA has been an active participant in the yearly GNSS campaign of the APRGP. The APRGP, which is under the supervision of the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP), aims to establish (a) station coordinates and velocities in an international reference frame, and (b) a regional horizontal and vertical datum and develop transformation parameters between each local system and the regional datum. It includes a seven-day continuous GNSS observation of different points within the region.

The Agency also contributes to the Asia Pacific Reference Frame (APREF) Project wherein daily data from the PTAG station are transmitted to the organizing committees of the Project, i.e., PCGIAP and the International Association of Geodesy. The APREF Project aims to create and maintain an accurate and densely realized geodetic framework, based on continuous observation and analysis of GNSS data from the region.

**Future Plans**

So far, the PageNET can provide single-base real-time solutions only. With the total target of 38 AGSs nationwide, a networked real-time solution in major development areas is aspired to be provided by the PageNET in the future.

NAMRIA is constantly finding ways to improve the delivery of mapping and surveying services to the public. To fully realize the objectives in establishing the PageNET, plans are under way to install additional stations in the southern part of the country. The addition of these stations will enhance the robustness and coverage of the fiducial network of the PageNET.




*Existing vis-à-vis proposed stations for FY-2011*

**In a Nutshell**

Three years since its inception, the PageNET has been providing online positioning service and real-time positioning solutions to its users; serving as a modern fundamental referencing infrastructure to applications such as mapping, GIS, and geophysics; and contributing to local and international GNSS initiatives in support of Earth observation and scientific studies.

All in all, the PageNET has accomplished much of its goals. However, the best is yet to come as improvements can still be made to enhance the Network's overall performance.•

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## Editorial ...*from page 2*

is the Infrastructure Mapping Project for establishing a common map which will reflect the existing facilities, programs, and other map-based requirements of the Senate Committee on Finance. The output datasets are likewise inputs to the Philippine SDI. The project is a collaborative activity with the Departments of Public Works and Highways, Agriculture, Tourism, Transportation and Communications, Environment and Natural Resources, and Interior and Local Government.

Thankfully, the funds are already available for the big work to implement the Philippine Geoportal Project and finally establish the SDI for the Philippines. The tasks include the establishment of a data clearinghouse network connecting data custodians all over the country; formulation of the technical standards, policies, and protocols; building up the geographic database and in this respect, massive information and education campaigns; and capacity building of data producers and custodians. As the project implementation has started this year, there are the attendant challenges such as those on acquisition of equipment; the need for good technical expertise in the implementation; putting to the test the policies developed; increasing the Internet speed; gathering and sustaining the support and commitment of stakeholders; maximizing the available resources; and broadcasting about the Project to the most number of people, stakeholders, and the general public alike.

The Philippine Geoportal Project is not just NAMRIA's undertaking. It calls for different agencies to plan and work together to come up with more informative maps, geographically-referenced information that are very much useful for national strategic planning and critical decision making. It seeks the cooperation of all those to be asked to participate and to see the project through and beyond its period of implementation. It took a great deal of patience and resoluteness to traverse the long road towards realizing the NSDI. A great deal more is required to champion the goals of the Philippine Geoportal and in the end realize the noble aspirations of the Aquino Administration for the nation. Everyone stands to benefit from the Philippine Geoportal.

Cheers for the celebration of NAMRIA's 24th foundation day this year. Cheers for all efforts to bring progress to our nation. •

# Harmonizing LAMS and LSDMS

*by Joselito T. Reasol, MT**

**Background of the Systems**

The Land Administration and Management System (LAMS) is a system developed for the LMS of the DENR Regional Offices through the Land Administration and Management Project (Phase 2). The Land Administration and Management System (LAMS) is the information system that supports the activities of the Land Administration and Management Project Phase 2 (LAMP2), component 3 – land tenure security. Specifically, LAMS aims to: enhance land record integrity within and between land agencies; utilize ICT to provide better land management services; support the Government's One-Stop-Shop Approach to improve service delivery (EO 467); and provide an information system framework for the continual integration of the whole of government land information. The system has modules for Titles, Work in Progress, Approved Survey, and Public Land Application

A similar system, the Land Survey Database Management System (LSDMS), is also currently being implemented through the PRS92 Project in the LMS. It is a system that manages the cadastral lot survey database, delineates the political boundaries generated from the lot/parcel surveys, and provides a map-based query facility for easy accuracy checking of new and old surveys. Its facilities include: Database Maintenance; Spatial and Textual Query; and Report Generation modules (Technical Description/Lot Data Computation per Lot, Dynamic Reports thru the Textual Query Module, and Map Layout thru the Spatial Query Module).

**Similarities between LAMS and LSDMS**

These systems may differ in their facilities but their similarities are explicit in the data capture of land survey data (parcel data). LSDMS was mainly developed to capture land survey data for eventual transformation into PRS92, while LAMS was designed to deal with the day-to-day land transactions at the LMS, as issued under DAO 2010-18.

At a glance, there seems to be no concern about harmonizing these systems. In reality, however, the volume of data encoded through LSDMS should be a great consideration for harmonization, as well as the requirement that surveys be under the PRS92. Per pertinent provisions of DAO 20010-18, data produced under the PRS92 Project shall be used as inputs. However, records created through LSDMS are not complete as far as LAMS is concerned, thus, would be required a "work back" (encoding of other attributes and scanning of documents) under LAMS. As regards PRS92 compliance, LAMS has no PRS92 transformation facility, thus it is dependent on LSDMS. In terms of manpower capability, LSDMS technical staff are capable of operating the system; while at this point, LAMS technical staff are in the formation and capability- buildup stage. Relative to the aforementioned issues, the need to put in place harmonization strategies is necessary for the co-operation of the two systems mentioned.

**Harmonizing the System Implementation**

The harmonization strategies would include the following: Revision of LAMS facility to access and write the database under LSDMS to allow synchronization of non-PRS92 compliant records in both systems; Improvement of import/export facility between the two systems; Utilization of LSDMS technical team (Regional) in LAMS operations; Training of additional technical personnel from the survey units in LMS; Issuance of policies for co-operation of both systems; Planning for "work back" activities under LAMS; In addition, periodic evaluation of systems operations should be pursued in the region in order to determine the necessity of intervention. LMB is expected to take the lead role in partnership with NAMRIA.•

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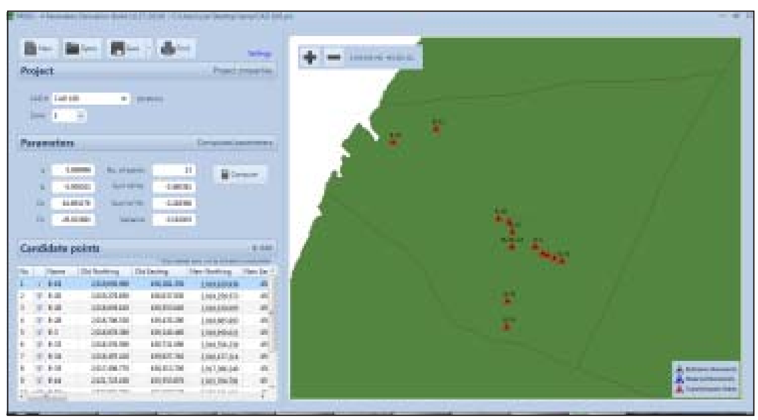
## *PRS92 Four-...from page 17*

**Validation of Parameters**

Although the application is designed to be portable, the application still has the ability to connect to the PRS92 database found in the network. This means that not only can it extract existing GCPs from the database, it can also upload the computed parameters to the database for storage. The computed parameters, however, have be validated first by NAMRIA. A software control was put in place to prevent inadvertent uploading of non-validated parameters.

The spreadsheet template prepared by the NAMRIA MGD provided a very good starting point for the four-parameter derivation application. As a matter of fact, half of the work is considered already done. It was just a matter of translating the formulas in the spreadsheet into C# codes.

Migrating the spreadsheet template into a stand-alone application further increased the usefulness and value of the four-parameter derivation application. The application also demonstrated the use of open-source libraries which can be a point of interest for other similar applications in the future.•




*The LSDMS four-parameter derivation program*

*Chief, Systems Development and Programming Division, NAMRIA Information Management Department

# Status of Land Cover Mapping in the Philippines

*by Olivia M. Vigneault[*]*

The first satellite land cover mapping of the Philippines was done in 1987. The forest cover in the country is an indicator of the actual condition of forest resources; the planted/regenerated area; and the areas needing immediate rehabilitation, protection, conservation, and management. The latest forest/land cover maps and statistics covering the whole country date back to 2003. These were based on Landsat TM with a resolution of 30 x 30 meters and published by the DENR-Forest Management Bureau in 2005. The Food and Agriculture Organization (FAO) categories were used and are now the official forest/land cover classification categories used by DENR.

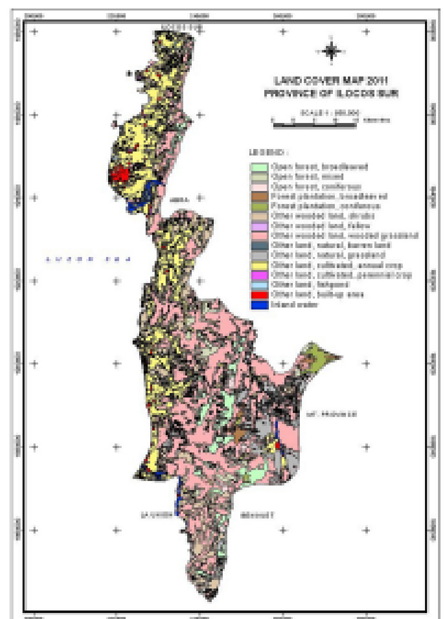
Innovation of the land cover maps in NAMRIA involves the acquisition of high-resolution satellite imageries such as Advanced Visible and Near Infrared Radiometer (AVNIR), Panchromatic Remote-Sensing Instrument for Stereo Mapping (PRISM), and *Satellite Pour l'Observation de la Terre* (SPOT) to generate or update the forest/land cover of the country. These imageries have a ten-meter resolution. A total of 245 AVNIR scenes cover the whole country, and as of 30 June 2011, a total of 185 scenes or 76% have been downloaded and 174 or 71% have been interpreted.

Updating of forest cover information extracted from the latest remote sensing data/satellite imageries and the generation of forest/land cover maps and statistics per province are two of the functions entrusted to the NAMRIA Remote Sensing and Resource Data Analysis Department- Land Resource Division.

For the year 2011, the RSRDAD is expected to produce Updated Forest/Cover Maps covering the following 30 provinces: Abra, Aurora, Bataan, Benguet, Biliran, Bulacan, Cagayan, Camarines Sur, Cavite, Eastern Samar, Guimaras, Ilocos Norte, Ilocos Sur, Iloilo, Isabela, La Union, Laguna, Leyte, Masbate, Mindoro Occidental, Negros Occidental, Negros Oriental, Northern Samar, Nueva Vizcaya, Pangasinan, Quirino, Samar, Southern Leyte, Tarlac, and Zambales.

The preliminary forest/land cover map of Region 1 was presented to the Regional Office during their Management Conference in Alaminos, Pangasinan. Their comments were on the respective total areas of their forests and non-forests and the respective locations of their mangroves, plantation forests, pine forests, and reforestation projects. The updated forest/land cover maps will serve as sources of vital information in the formulation of the developmental activities in the region, specifically the identification of sites for the National Greening Program of the government for CY 2011-2016.

A technical discussion with the regional staff was also held in San Fernando, La Union, specifically to discuss the forest/land cover in relation to all tenurial instruments issued by the DENR, such as Contract Reforestation Projects, Community-Based Forest Management Agreements, Integrated Social Forestry areas, and Socialized Industrial Forest Management Agreements. Field validation of the remaining 50 provinces is scheduled for next year. •


*Imagery index map (left) and land cover map of Ilocos Sur (right)*

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