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Linking the Different Coordinate Systems in the Philippines

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- Frederick Seitz

BACKGROUND

Land Administration is the process of determining, recording and disseminating information about ownership, value and use of land and its associated resources (FAO, 2018).

Cadastre is one of the fundamental dataset in land administration

Cadastral survey are activities that determine the metes and bounds of all declared parcels within a certain political boundary (DENR, 2007)

Coordinate reference system are information that determines the proper location of a parcel.

BACKGROUND

The Revised Regulations for Land Surveys recognized three (3) different coordinate systems used in the Philippines for land surveying.

Question 1

What are the coordinate systems used in the Philippines based on DENR Administrative Order 2007-29?

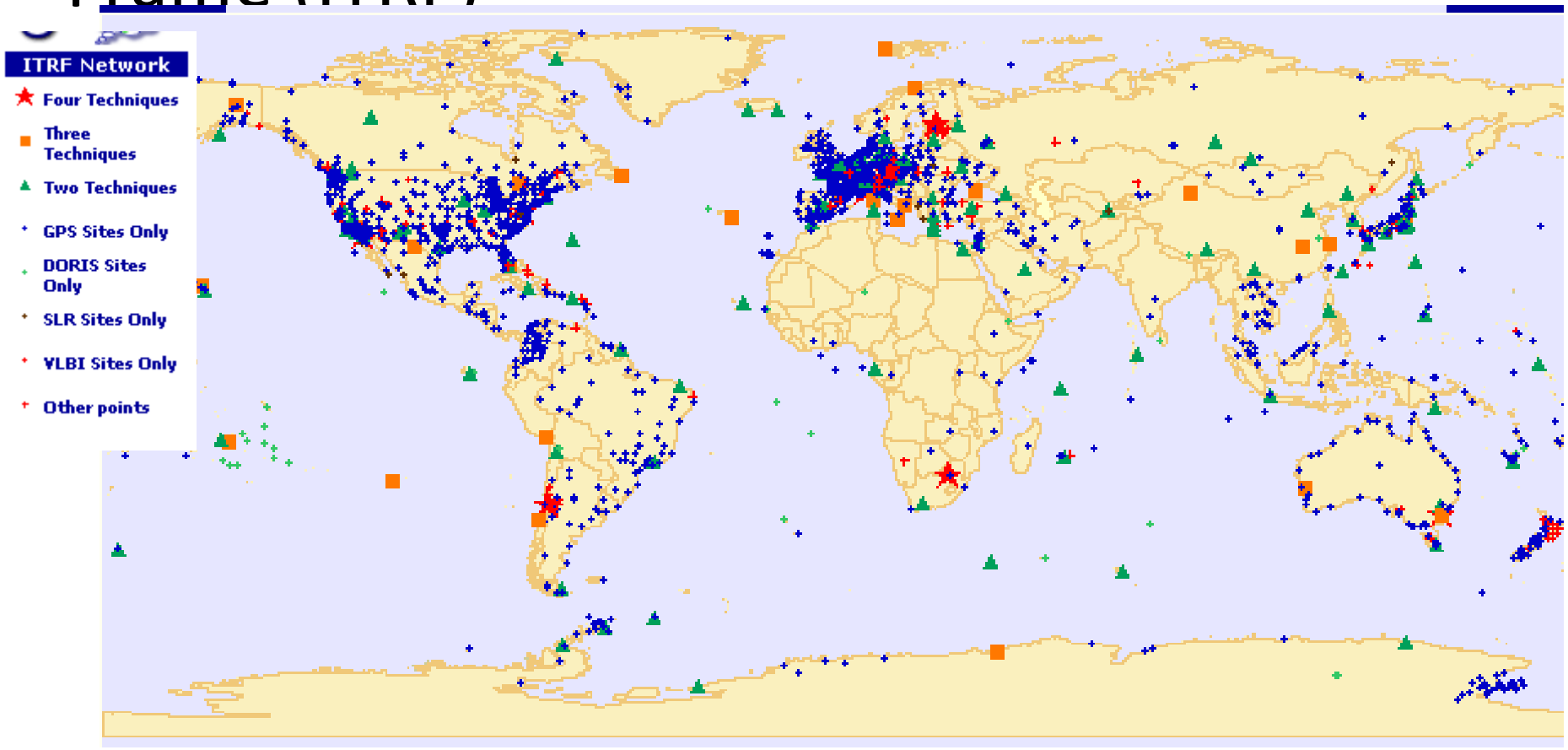
Coordinate Systems in the Philippines

- Local Plane Coordinate System
- Philippine Plane Coordinate System-Transverse Mercator/ Luzon 1911
- Philippine Plane Coordinate System-Transverse Mercator/ PRS 92
- But Wait!!! There's more….

Question 2

What does ITRF mean?

The International Terrestrial Reference Frame (ITRF)



- The ITRF is established by the Terrestrial Reference Frame Section of the Central Bureau (CB) of the International Earth Rotation Service (IERS)

The International Terrestrial Reference Frame (ITRF)

- The up to date global solutions are: ITRF88, 89, 90, 91, 92, 93, 94, 97, 2000, 2005, 2008, 2014

- Transformation parameters from ITRF website

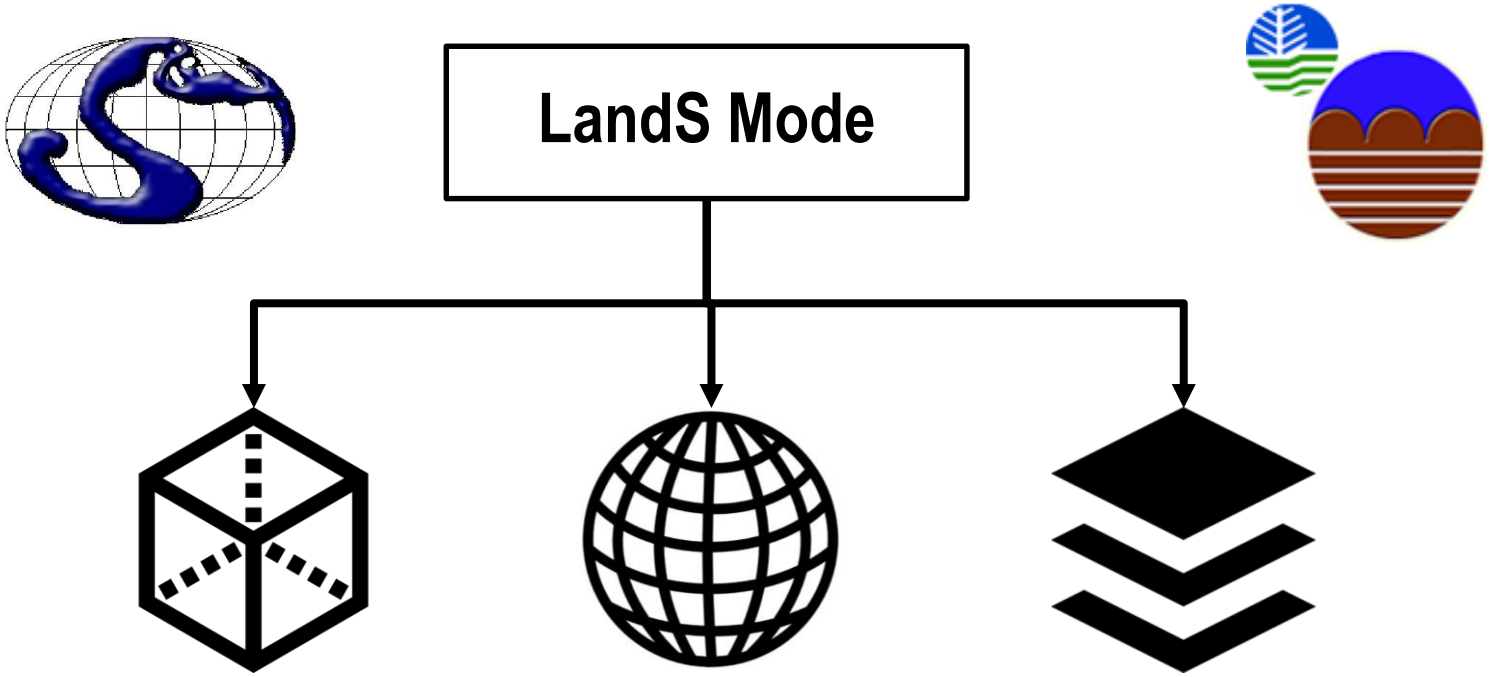
Transformation parameters from ITRF2014 to past ITRFs.

SOLUTION	Tx	Ty	Tz	D	Rx	Ry	Rz	EPOCH
UNITS---------->	mm	mm	mm	ppb	.001"	.001"	.001"	
RATES	Tx	Ty	Tz	D	Rx	Ry	Rz	
UNITS---------->	mm/y	mm/y	mm/y	ppb/y	.001"/y	.001"/y	.001"/y	
ITRF2008	1.6	1.9	2.4	-0.02	0.00	0.00	0.00	2010.0
rates	0.0	0.0	-0.1	0.03	0.00	0.00	0.00	
ITRF2005	2.6	1.0	-2.3	0.92	0.00	0.00	0.00	2010.0
rates	0.3	0.0	-0.1	0.03	0.00	0.00	0.00	
ITRF2000	0.7	1.2	-26.1	2.12	0.00	0.00	0.00	2010.0
rates	0.1	0.1	-1.9	0.11	0.00	0.00	0.00	
ITRF97	7.4	-0.5	-62.8	3.80	0.00	0.00	0.26	2010.0
rates	0.1	-0.5	-3.3	0.12	0.00	0.00	0.02	
ITRF96	7.4	-0.5	-62.8	3.80	0.00	0.00	0.26	2010.0
rates	0.1	-0.5	-3.3	0.12	0.00	0.00	0.02	
ITRF94	7.4	-0.5	-62.8	3.80	0.00	0.00	0.26	2010.0
rates	0.1	-0.5	-3.3	0.12	0.00	0.00	0.02	
ITRF93	-50.4	3.3	-60.2	4.29	-2.81	-3.38	0.40	2010.0
rates	-2.8	-0.1	-2.5	0.12	-0.11	-0.19	0.07	
ITRF92	15.4	1.5	-70.8	3.09	0.00	0.00	0.26	2010.0
rates	0.1	-0.5	-3.3	0.12	0.00	0.00	0.02	
ITRF91	27.4	15.5	-76.8	4.49	0.00	0.00	0.26	2010.0
rates	0.1	-0.5	-3.3	0.12	0.00	0.00	0.02	
ITRF90	25.4	11.5	-92.8	4.79	0.00	0.00	0.26	2010.0
rates	0.1	-0.5	-3.3	0.12	0.00	0.00	0.02	
ITRF89	30.4	35.5	-130.8	8.19	0.00	0.00	0.26	2010.0
rates	0.1	-0.5	-3.3	0.12	0.00	0.00	0.02	
ITRF88	25.4	-0.5	-154.8	11.29	0.10	0.00	0.26	2010.0
rates	0.1	-0.5	-3.3	0.12	0.00	0.00	0.02	

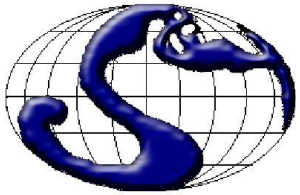
Philippine Geocentric Datum

NAMRIA is proposing the Philippine Geocentric Datum

BACKGROUND


LandS Mode
Three-Dimensional Cadastre for Lands (3DCad)
Unified Projection System for Cadastral Data (UPSCad)
Cadastral Survey Records Reconstruction (CadSRR)

BACKGROUND



R&D for PGRS

- Component 1: Selection of Most Applicable Datum Transformation Scheme from Local (PRS92) to Geocentric (ITRF2008) Datum
- Component 2: Evaluation and Assessment on the Effects of Shifting the Existing Cadastre to Geocentric Datum

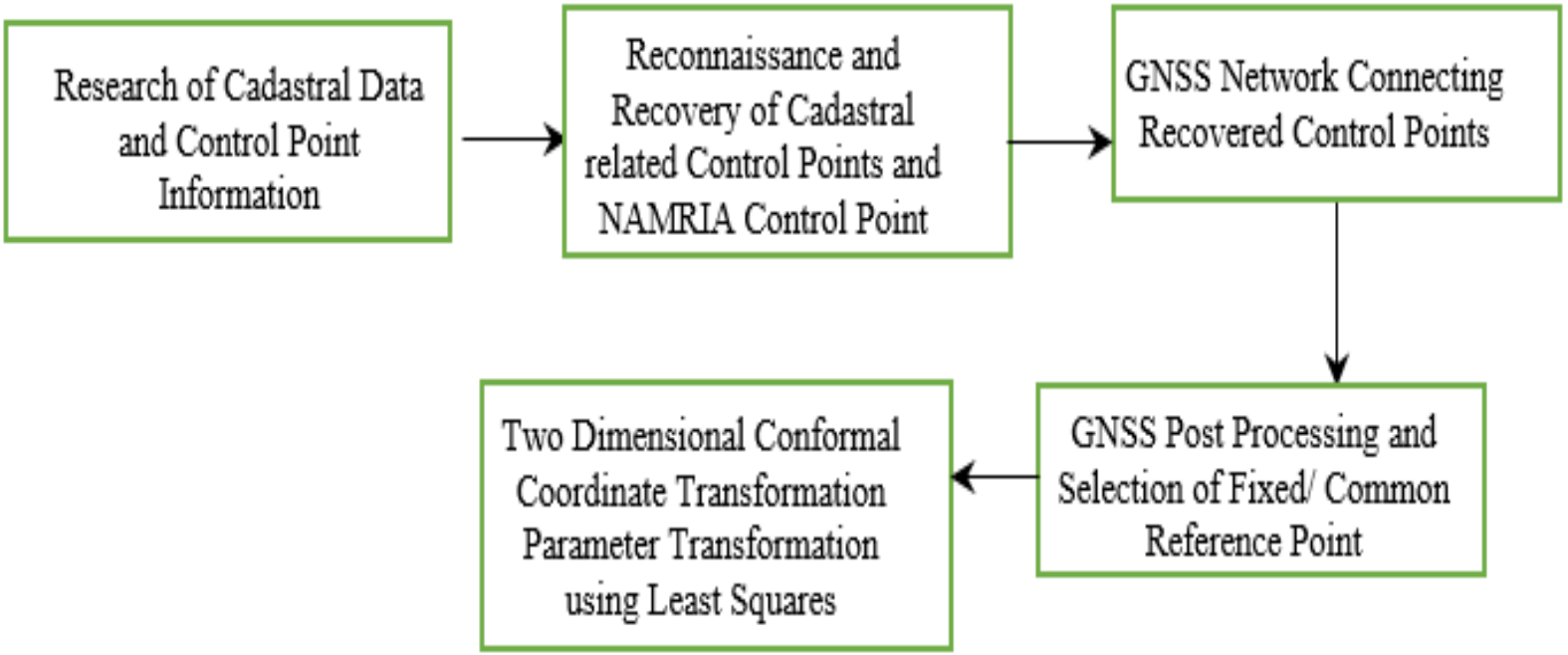
OBJECTIVES OF THE RESEARCHES

The UPSCad's objectives were to provide a methodology, test and implement, and provide analysis in linking the different coordinate reference systems used in the country.

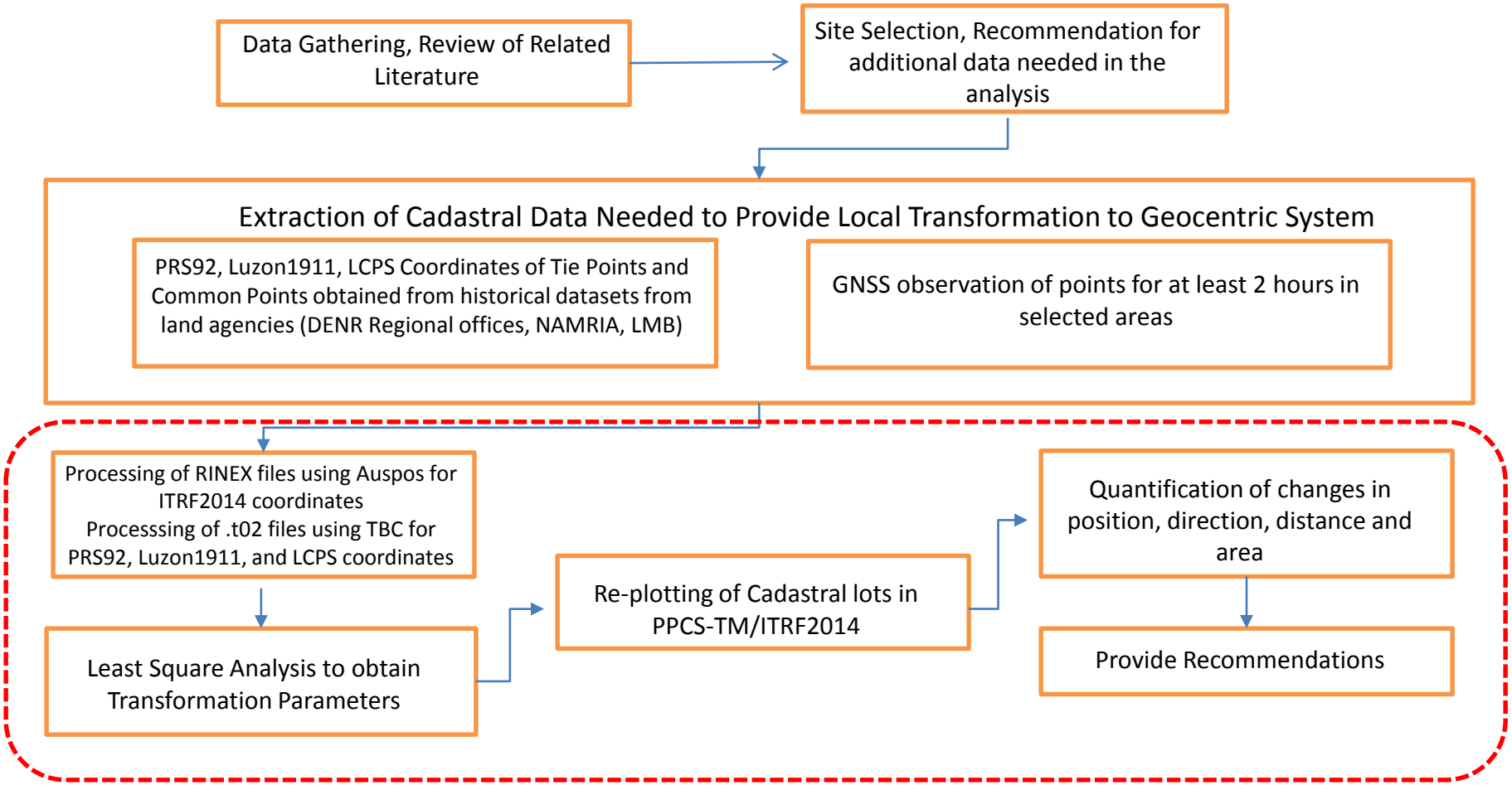
R&D with NAMRIA's objective was to provide a methodology of regenerating cadastral data into the geocentric system.

METHODOLOGY FOR UPSCad

Workflow in Linking PPCS-TM/ Luzon 1911 and PPCS-TM/ PRS92



Modified Methodology for NAMRIA R&D

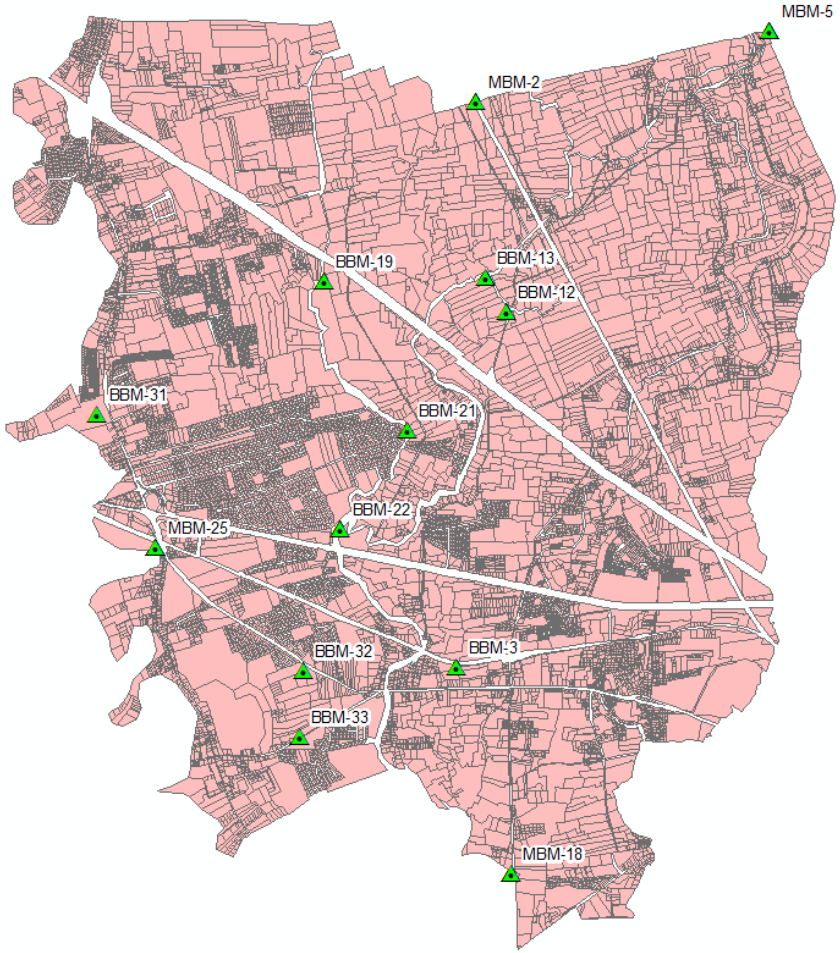


STUDY AREA 1: Guiguinto, Bulacan

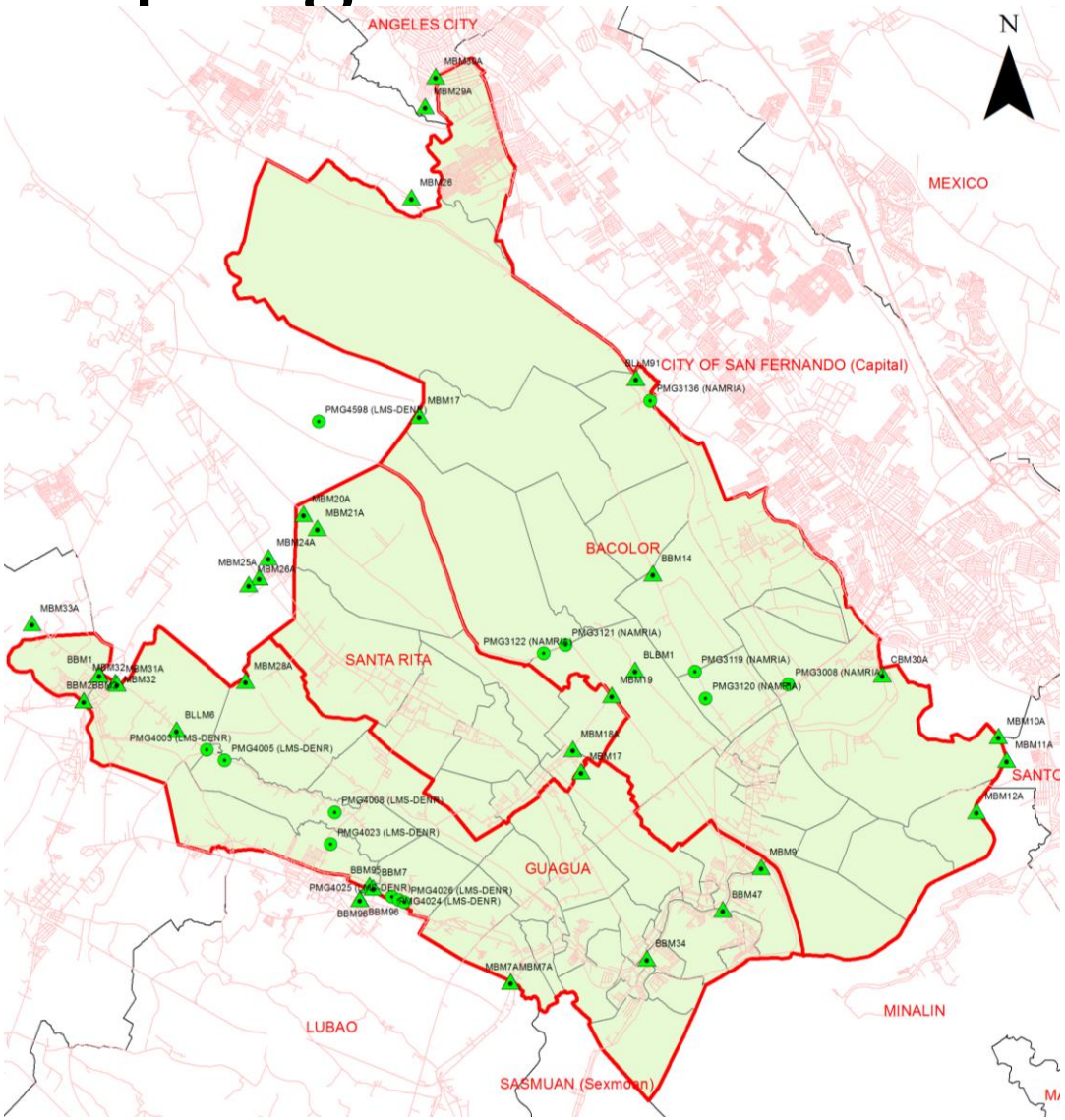
Research and Reconnaissance

- 11 boundary monuments (PTM) were recovered and 1 NAMRIA GCP (PRS92)

- BLN-3027 2008 NAMRIA
  4th Order control point l
  located in Brgy. Pritil with a
  ϕ = 14° 51’ 33.31632”,
  λ= 120° 52’ 8.96456”
  H= 48.256m (WGS84)



STUDY AREA 2: 3 Municipalities in Pampanga



- 19 boundary monuments (PTM), 7 NAMRIA GCPs (PRS92), and 1 DAR control monument (PTM) were recovered
- GNSS Survey Procedure in GTO was replicated in PMG

Static Differential GNSS Technique

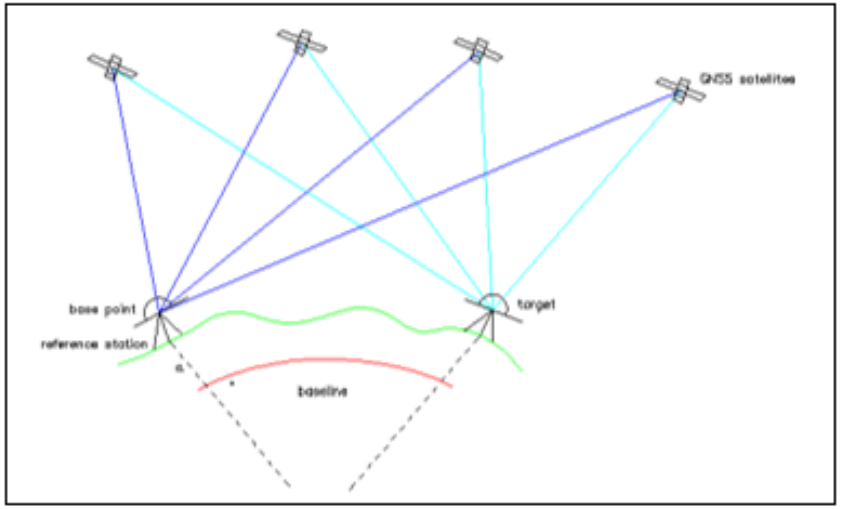


Fig. 3 Differential Rapid-Static GNSS Survey

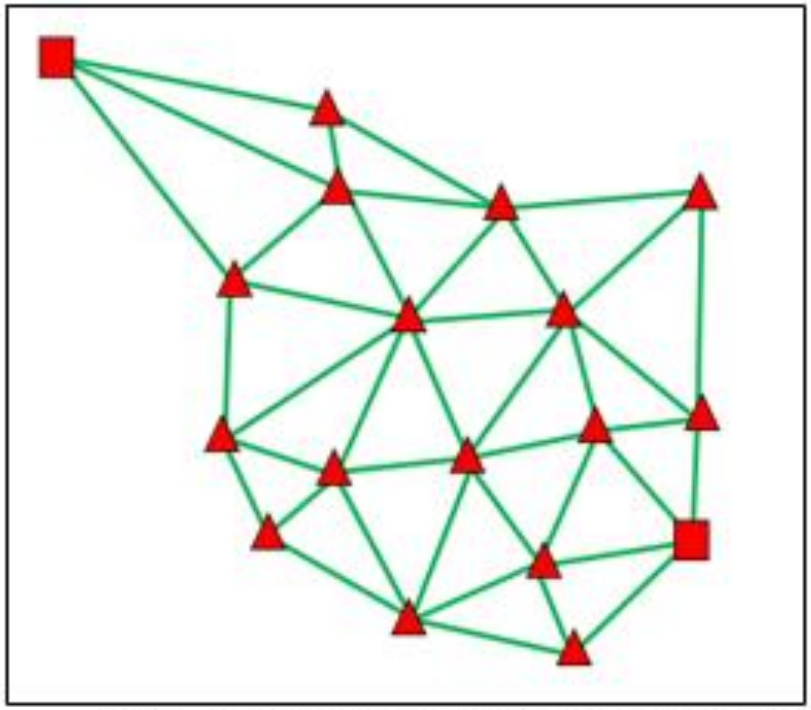


Fig. 4 Typical GNSS Network

Question 3

How long do you observe static GNSS for your surveys (at least for project controls)?

Static Differential GNSS Technique

Table 1 Typical Session Lengths for Static and Rapid Static Surveys (Ghilani & Wolf, 2008)

Method of Survey	Single Frequency	Dual Frequency
Static	30 min + 3min/km	20 min + 2min/km
Rapid Static	20 min + 2min/km	10 min + 1min/km

GNSS OBSERVATIONS in Guiguinto

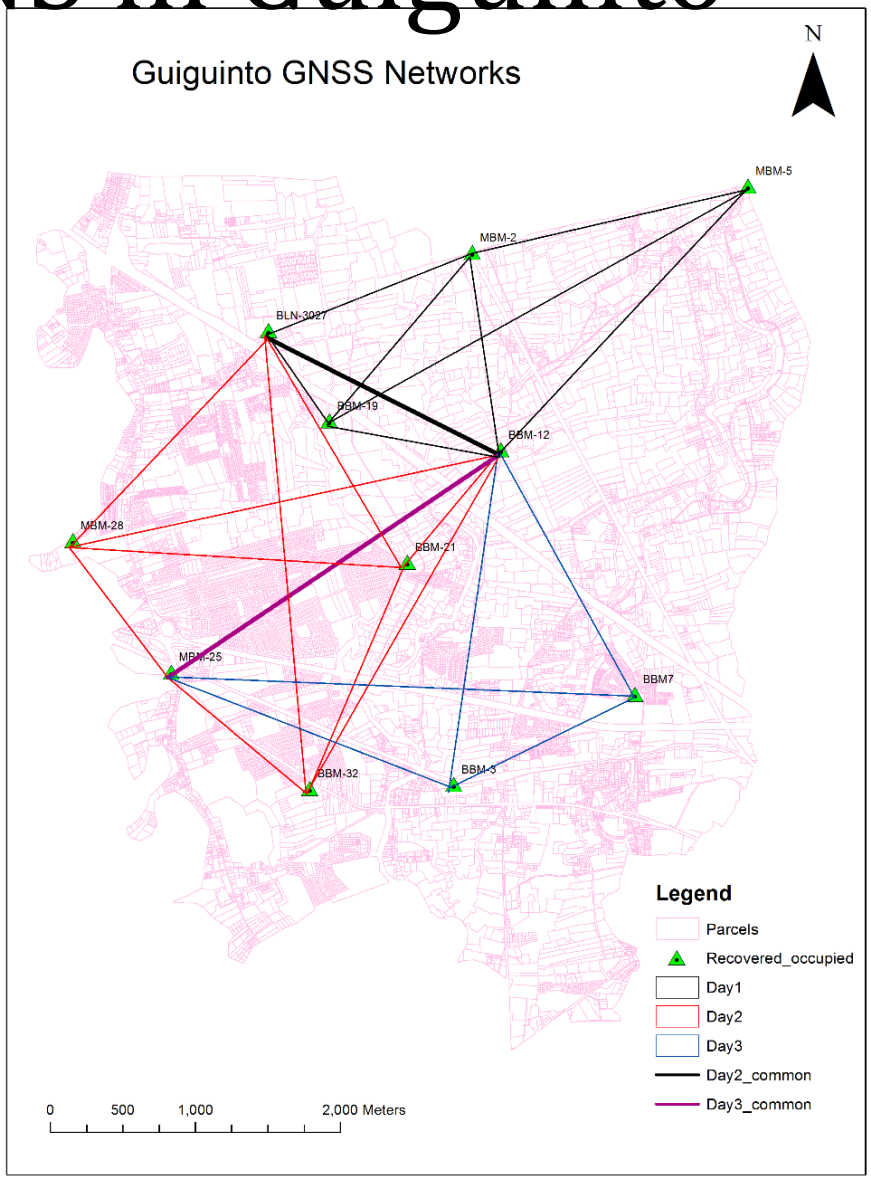
- Not less than two (2) hours of observation





GNSS OBSERVATIONS in Guiguinto

- GNSS Network Configuration
  - 2-hr Static GNSS Observations
  - Line BLN3027-BBM12 as common line for Day1 and Day2 GNSS networks
  - Line MBM25-BBM12 as common line for Day2 and Day3 GNSS networks
  - BBM12 occupied for all days

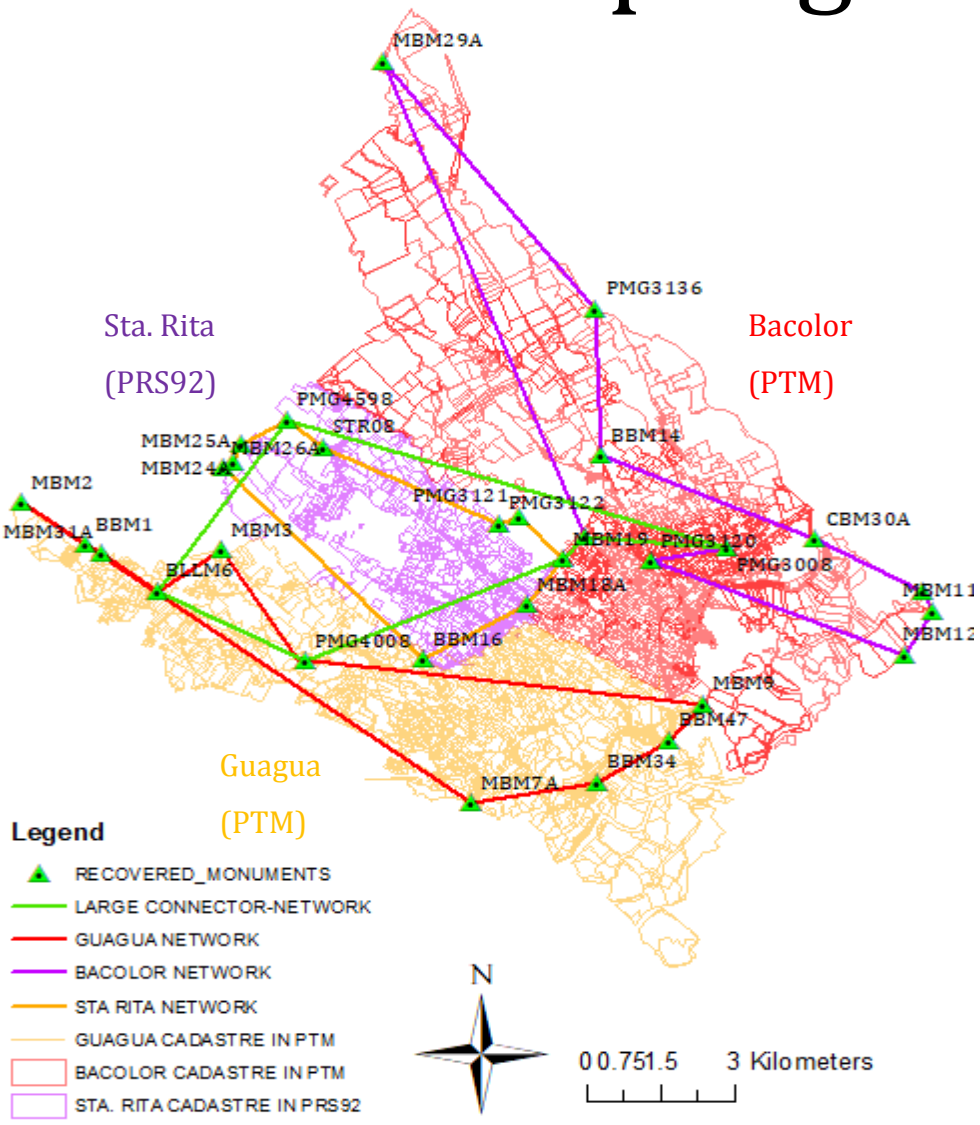


GNSS OBSERVATIONS in Pampanga

GNSS OBSERVATIONS in Pampanga

GNSS Network Configuration

- 2-hr Static GNSS Observations
- A Large Network connecting 2 points from each municipality was observed first
- The 2 points from each municipality was treated as a common baseline
- The other points in the municipalities were then observed



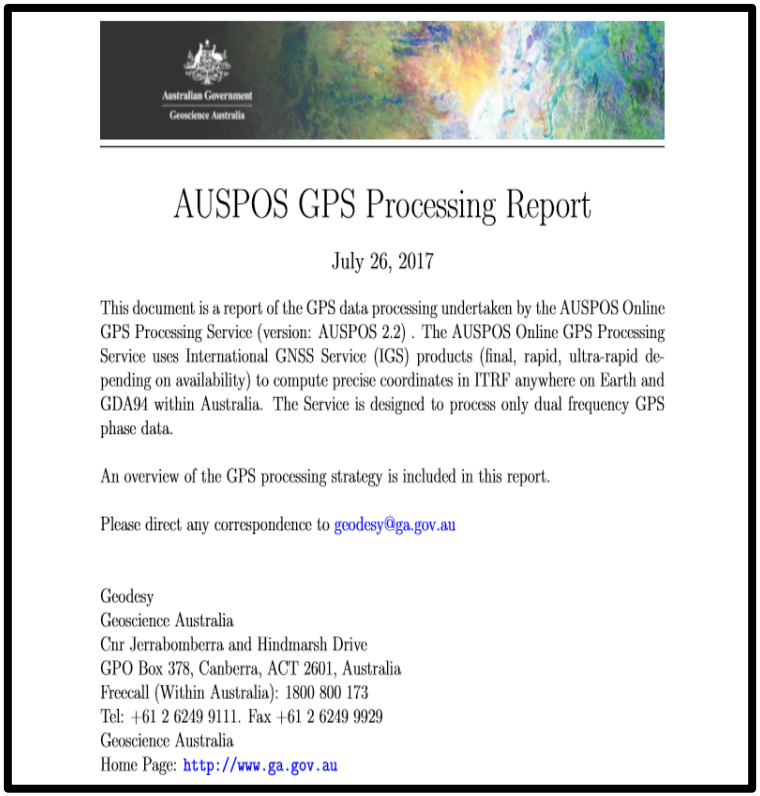
GNSS Processing

Trimble Business Center

At least 2 hrs of RINEX observation files (.XXo) are uploaded to http://www.ga.gov.au/bin/gps.pl

Heights of Instrument and antenna types are also inputted on the interface before submission

A post-processing report is sent to registered email if no errors were encountered in the submission



Australian Government
Geoscience Australia

AUSPOS GPS Processing Report

July 26, 2017

This document is a report of the GPS data processing undertaken by the AUSPOS Online GPS Processing Service (version: AUSPOS 2.2) . The AUSPOS Online GPS Processing Service uses International GNSS Service (IGS) products (final, rapid, ultra-rapid depending on availability) to compute precise coordinates in ITRF anywhere on Earth and GDA94 within Australia. The Service is designed to process only dual frequency GPS phase data.

An overview of the GPS processing strategy is included in this report.

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3 Computed Coordinates, ITRF2014

All coordinates are based on the IGS realisation of the ITRF2014 reference frame. All the given ITRF2014 coordinates refer to a mean epoch of the site observation data. All coordinates refer to the Ground Mark.

3.1 Cartesian, ITRF2014

Station	X (m)	Y (m)	Z (m)	ITRF2014 @
3008	-3142010.785	5300580.994	1641585.955	08/05/2018
3120	-3140701.318	5301438.687	1641311.640	08/05/2018
3136	-3139020.667	5300776.856	1646737.767	08/05/2018
B14_	-3139520.888	5301440.859	1643577.942	08/05/2018
BL1_	-3139485.024	5302007.129	1641812.418	08/05/2018
M29A	-3134603.458	5301761.170	1652054.820	08/05/2018
BJFS	-2148744.502	4426641.172	4044655.815	08/05/2018
BJNM	-2154287.730	4373439.988	4098885.609	08/05/2018
CKSV	-2956619.335	5075902.182	2476625.535	08/05/2018
CNMR	-5087757.726	3465029.031	1664653.848	08/05/2018
DAEJ	-3120042.371	4084614.699	3764026.799	08/05/2018
GUAM	-5071312.675	3568363.642	1488904.400	08/05/2018
HKKS	-2429526.499	5377816.429	2412152.521	08/05/2018
HKLM	-2414046.543	5391602.126	2396878.668	08/05/2018
HKOH	-2423817.506	5386056.886	2399883.156	08/05/2018
LSBO	-2967207.545	5010439.187	2593842.947	08/05/2018
PIMO	-3186293.583	5286624.397	1601158.381	08/05/2018
PPPC	-3022676.597	5511839.349	1075517.492	08/05/2018
PTAG	-3184318.637	5291065.526	1590418.250	08/05/2018
SHAO	-2831733.919	4675665.781	3275369.273	08/05/2018
XMIS	-1696344.694	6039590.008	-1149275.174	08/05/2018

GNSS Processing

In the Case of Guiguinto, Bulacan

- GNSS post-processing was done using Trimble Business Center, a proprietary software used to process Trimble GNSS related output in *.T02 file format.
- Network Analysis was done to determine which among the occupied points can be considered relatively stable or not (common point analysis_.

POINT ID	1 POINT	2 POINTS	3 POINTS	4 POINTS	5 POINTS
MBM28	1	1	1	1	1
MBM2		1	1		
MBM25			1	1	1
MBM2				1	1
BBM19				1	
BBM12					1
MBM5					1

List of Control points used as reference/ fixed points

- PRS92 coordinates was obtained by fixing BLN-3027
- ITRF coordinates were obtained by processing the data using AUSPOS

GNSS Processing

In the Case of Guiguinto, Bulacan

Fixed Point Combination	ΔN (m)				ΔE (m)				Linear Error (m) (sqrt ($\Delta N^2 + \Delta E^2$)			
	min	max	mean	std. dev.	min	max	mean	std. dev.	min	max	mean	std. dev.
1 Point	0.006	0.685	0.220	0.289	0.020	0.586	0.218	0.255	0.074	0.694	0.358	0.2174
2 Points	0.009	0.694	0.255	0.304	0.007	0.691	0.269	0.275	0.163	0.715	0.433	0.2507
3 Points	0.046	0.741	0.215	0.276	0.075	0.610	0.277	0.254	0.248	0.753	0.412	0.2533
4 Points	0.063	0.722	0.260	0.279	0.082	0.573	0.263	0.247	0.292	0.727	0.434	0.2602
5 Points	0.261	0.699	0.541	0.306	0.055	0.454	0.225	0.187	0.267	0.708	0.599	0.3392

Question 4

What data are needed in linking the different coordinate systems?

Coordinate System Transformation

Set of points with coordinate values referred to the coordinate systems to be linked.

Coordinate System Transformation

4 versions of coordinates used in the analysis

1. PTM Theoretical (based on Luzon 1911)
- coordinates base from the records

2. PTM Observed
-recomputed coordinates based from the adopted fixed points from cadastral reference points

3. PRS92
-recomputed coordinates of old points based from a NAMRIA PRS92 reference point

4. ITRF2014
-recomputed coordinates using ITRF points obtained using AUSPOS

GNSS Processing Results

Guiguinto, Bulacan

	PPCS-TM/LUZON1911 (THEORETICAL		PPCS-TM/LUZON1911 (OBSERVED)		PPCS-TM/PRS92		PPCS-TM/ITRF2014	
POINT NAME	NORTHING	EASTING	NORTHING	EASTING	NORTHING	EASTING	NORTHING	EASTING
BBM3	1640118.420	487051.400	1640118.624	487051.193	1640118.974	487053.740	1640056.143	487198.503
BBM7	1640741.890	488302.870	1640741.982	488302.530	1640742.283	488305.098	-	-
BBM12	1642427.500	487375.520	1642426.674	487375.390	1642427.016	487378.004	1642364.085	487522.632
BBM19	1642626.350	486192.170	1642626.215	486191.852	1642626.595	486194.482	1642563.598	486339.090
BBM21	1641651.460	486731.070	1641651.428	486731.375	1641651.791	486733.967	1641588.834	486878.622
BBM32	1640089.480	486057.480	1640089.657	486057.559	1640090.039	486060.104	1640027.082	486204.813
BLN3027	-	-	1643252.184	485770.745	1643252.479	485773.446	1643189.481	485918.042
MBM2	1643790.830	487179.680	1643790.728	487179.727	1643791.079	487182.385	1643728.127	487326.956
MBM5	1644247.640	489083.240	1644247.590	489082.636	1644247.885	489085.314	-	-
MBM25	1640893.430	485100.540	1640893.430	485100.540	1640893.843	485103.107	1640830.861	485247.795
MBM28	1641801.710	484421.630	1641801.568	484421.610	1641801.995	484424.212	1641738.970	484568.897
	*AS LISTED ON OLD TRAVERSE LIST		*PROCESSED IN TBC WITH		*PROCESSED IN TBC WITH BLN3027		*ITRF2014 GRS80 LAT-LONG	
			MBM25-MBM28-MBM2 AS BASE		AS BASE		PROJECTED TO PPCS-TM	

GNSS Processing Results

3 Municipalities in Pampanga

		THEORETICAL PTM		OBSERVED PTM		PGRS	
		NORTHING	EASTING	NORTHING	EASTING	NORTHING	EASTING
BACOLOR	PMG-3008					1660458.023	463229.629
	PMG-3120					1660177.343	461665.477
	PMG-3136					1665789.191	460565.956
	BBM14	1662586.669	460507.713	1662586.819	460507.686	1662523.199	460652.597
	BLBM1	1660761.063	460182.357	1660760.653	460185.223	1660697.061	460330.181
	MBM29A	1671359.063	456128.280	1671359.115	456128.249	1671295.279	456273.006
	CBM30A	1660720.397	464865.668	1660720.938	464865.656	1660657.586	465011.689
	MBM10	1659571.910	467059.529	1659571.821	467059.353	1659508.433	467204.308
	MBM11	1659127.259	467227.503	1659127.170	467227.327	1659063.771	467372.338
	MBM12	1658161.409	466662.160	1658161.458	466662.058	1658098.060	466807.064
GUAGUA	PMG-4008					1657962.547	454683.170
	BBM34	1655325.818	460456.844	1655325.704	460455.330	1655262.129	460600.484
	BBM47	1656257.527	461889.887	1656257.266	461888.204	1656193.750	462033.286
	BBM1	1660596.924	450085.762	1660596.870	450085.882	1660533.842	450230.408
	BLLM6	1659565.973	451538.177	1659565.883	451538.002	1659501.390	451675.571
	MBM31A	1660420.719	450414.004	1660420.677	450413.962	1660356.810	450558.923
	MBM7A	1654864.674	457898.026	1654864.843	457896.786	1654801.201	458041.951
	MBM2	1661545.686	448794.070	1661545.644	448794.367	1661481.710	448939.330
	MBM3	1660490.266	452825.659	1660490.062	452825.455	1660426.321	452970.563
STA. RITA	PMG-3121					1661164.741	459010.887
	PMG-3122					1660998.524	458604.772
	PMG-4598					1663314.054	454308.286
	BBM16	1658063.400	456911.071	1658063.311	456910.896	1657999.639	457055.949
	MBM19	1660290.242	459750.173	1660290.242	459750.173	1660226.628	459895.165
	MBM25A	1662452.425	453075.544	1662452.432	453075.549	1662388.614	453220.501
	MBM26A	1662306.327	452861.739	1662306.336	452861.752	1662242.506	453006.738
	STR8	1662774.868	454885.308	1662774.498	454884.262	1662710.759	455029.056

Coordinate System Transformation

Two dimensional conformal coordinate transformation or the four parameter similarity transformation retains the true shape of the entity after the transformation typically used for surveying specifically surveys into a common reference system (Ghilani & Wolf, 2006).

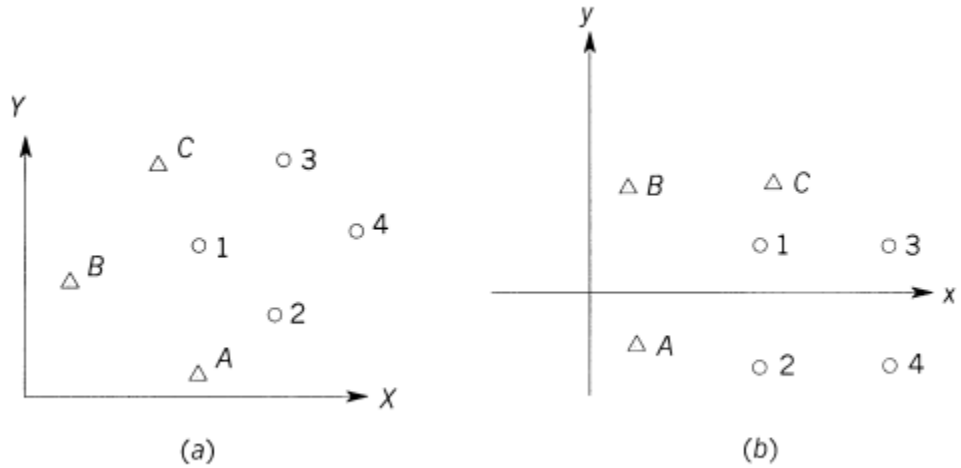


Figure 18.1 Two-dimensional coordinate systems.

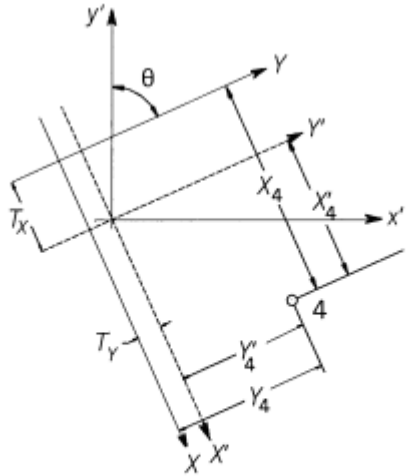


Figure 18.2 Superimposed coordinate systems.

Coordinate System Transformation

$$E_2 = kE_1\cos\theta - kN_1\sin\theta + Tx \quad \textit{(Equation 1)}$$
$$N_2 = kE_1\sin\theta + kN_1\cos\theta + Ty \quad \textit{(Equation 2)}$$

where:
N_1 and E_1 = *the Northings and Eastings of the point on the source coordinate system;*
N_2 and E_2 = *the Northings and Eastings of the point on the destination coordinate system;*
k = *the scale parameter;*
θ = *the rotation parameter; and*
Tx and Ty = *the translation parameters for Easting and Northing, respectively*

Equation 1 and 2 can be simplified further as shown below:

$$E_2 = aE_1 - bN_1 + Tx \quad \textit{(Equation 3)}$$
$$N_2 = aN_1 + bE_1 + Ty \quad \textit{(Equation 4)}$$

where:
a = kcosθ and b = ksinθ (McCoy P.E. & Robert, 2012)

In Section 6.1.2 of DMC 2010-06, it was indicated that the 2D conformal transformation to be implemented between PTM and PRS92 is as follows:

$$E = A * X + B * Y + C_E \quad \textit{(Equation 5)}$$
$$N = -B * X + A * Y + C_N \quad \textit{(Equation 6)}$$

where:
A and B = *scale and rotation constants*
C_E and C_N = *shift constants*
X and Y = *PPCS-TM/Luzon 1911 coordinates*
E and N = *PPCS-TM/PRS92 coordinates*

Note: Difference between the formula from literature and published equation in DMC2010-06. No worries, they provide the same results

Question 5

Why is 2D conformal coordinate transformation for surveying purposes?

Nota Bene

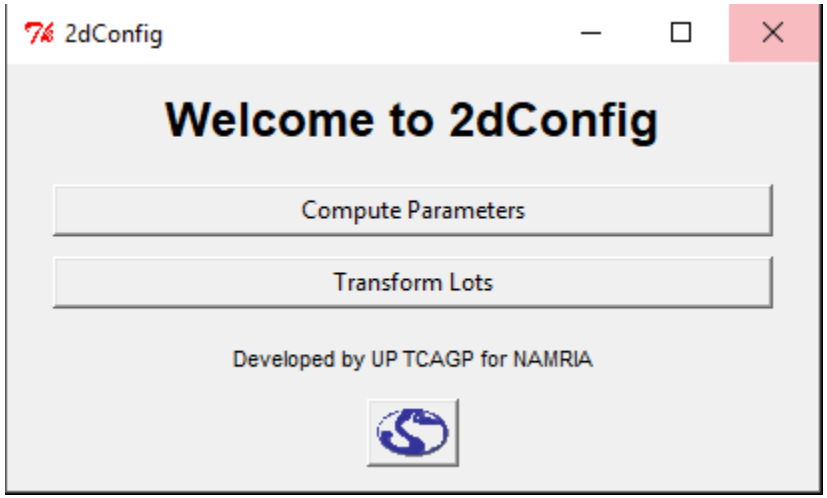
Two dimensional conformal coordinate transformation or the four parameter similarity transformation **retains the true shape of the entity after the transformation** typically used for surveying specifically surveys into a common reference system (Ghilani & Wolf, 2006).

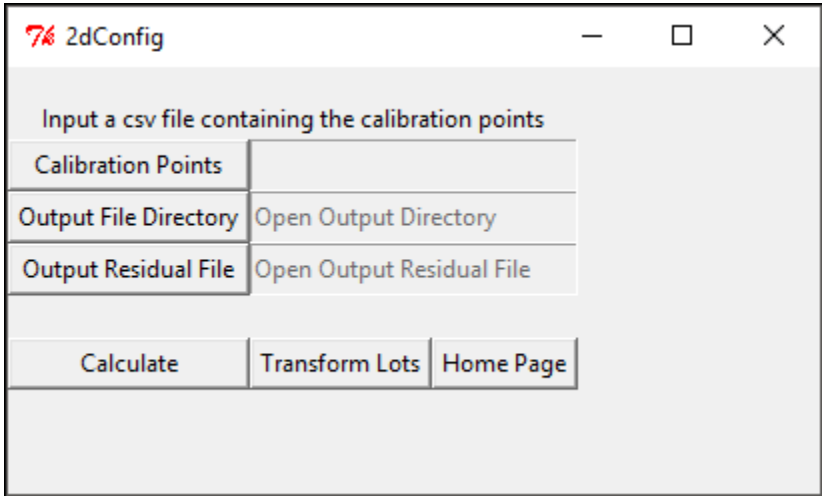
Transformation Script Development and Testing

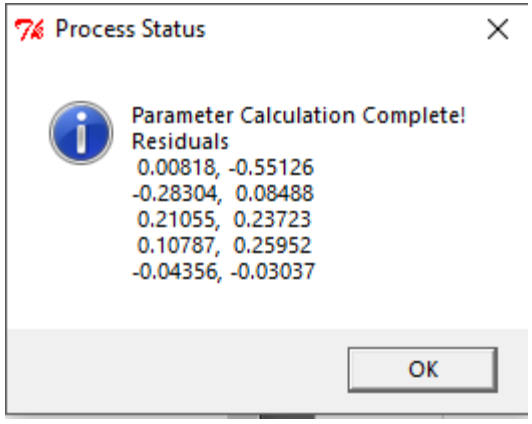
- Developed a script solving for 4 parameter transformation
- Calibrated the script by inputting data with known 4 parameters
- Implemented the script in a sample area → Solve the 4 parameters for the area
- Assess changes in distances, bearings, area.

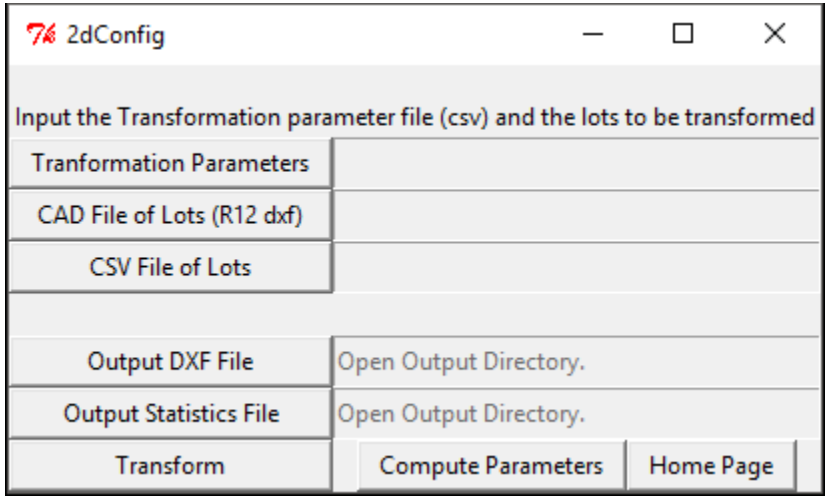
Transformation Software

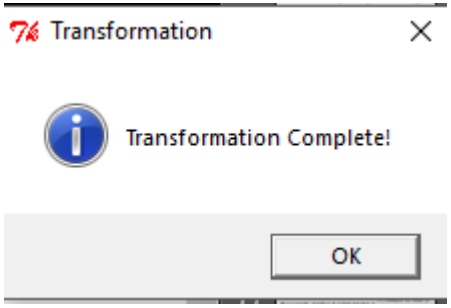
- Program developed using Python language
- Takes CSV and DXF files as inputs
- Outputs Statistics and Transformed DXF











Results: Guiguinto, Bulacan

It is recommended that choosing the optimal calibration points for transformation needs to consider the minimization of residuals with respect to known coordinates

Derived Parameters on Different Scenarios

Guiguinto	PTM (THEORETICAL) to PPCS-TM/ITRF2014	PTM (OBSERVED) to PPCS-TM/ITRF2014	PRS92 to PPCS-TM/ITRF2014
Scale	0.99992	0.99996	0.99998
Rotation	7.3”	3.2”	9.5”
Tx	126.232	187.850	230.263
Ty	81.988	-20.012	-52.600

Results: Guiguinto, Bulacan

Aside from the minimization of residuals, it is also recommended that choosing the optimal calibration points for transformation needs to consider the preservation of technical description of lot parcels

Summary of Effects on Cadastral Data as Simulated on Different Scenarios

Guiguinto	PTM (THEORETICAL) to PPCS-TM/ITRF2014	PTM (OBSERVED) to PPCS-TM/ITRF2014	PRS92 to PPCS-TM/ITRF2014
Change in Positions	Northings: -62.589m Eastings: 147.267m	Northings: -62.802m Eastings: 147.182m	Northings: -62.939m Eastings: 144.649m
Significant Change in Bearings? (> 1 minute)	None	None	None
Significant Change in Distances? (> 1 cm)	Yes (for sides > 130m)	None	None
Significant Change in Areas? (> 1 sqm)	Yes (for areas > 6500sqm)	Yes (for areas > 16000sqm)	Yes (for areas > 25000sqm)

Results: Bacolor, Pampanga

Summary of Effects on Cadastral Data as Simulated on Different Scenarios

Bacolor	PTM (THEORETICAL) to PPCS-TM/ITRF2014	PTM (OBSERVED) to PPCS-TM/ITRF2014	PRS92 to PPCS-TM/ITRF2014
Change in Positions	Northings: -65.43m Eastings: 152.138m	Northings: -64.001m Eastings: 148.060m	Northings: -63.548m Eastings: 145.142m
Significant Change in Bearings? (> 1 minute)	None	None	None
Significant Change in Distances? (> 1 cm)	Yes (for sides > 160m)	None	None
Significant Change in Areas? (> 1 sqm)	Yes (for areas > 1000sqm)	Yes (for areas > 73000sqm)	Yes (for areas > 38000sqm)

Results: Guagua, Pampanga

Derived Parameters on Different Scenarios

Guagua	PTM (THEORETICAL) to PPCS-TM/ITRF2014	PTM (OBSERVED) to PPCS-TM/ITRF2014	PRS92 to PPCS-TM/ITRF2014
Scale	1.00071	1.00015	1.00015
Rotation	-29.7”	13.8”	19.8”
Tx	-412.770	193.632	232.240
Ty	-1168.235	-337.578	-367.787

Results: Guagua, Pampanga

Summary of Effects on Cadastral Data as Simulated on Different Scenarios

Guagua	PTM (THEORETICAL) to PPCS-TM/ITRF2014	PTM (OBSERVED) to PPCS-TM/ITRF2014	PRS92 to PPCS-TM/ITRF2014
Change in Positions	Northings: -62.058m Eastings: 146.776m	Northings: -55.251m Eastings: 151.655m	Northings: -63.883m Eastings: 143.571m
Significant Change in Bearings? (> 1 minute)	None	None	None
Significant Change in Distances? (> 1 cm)	Yes	Yes (for sides > 65m)	Yes (for sides > 60m)
Significant Change in Areas? (> 1 sqm)	Yes	Yes (for areas > 3700sqm)	Yes (for areas > 3500sqm)

Results: Sta. Rita, Pampanga

Derived Parameters

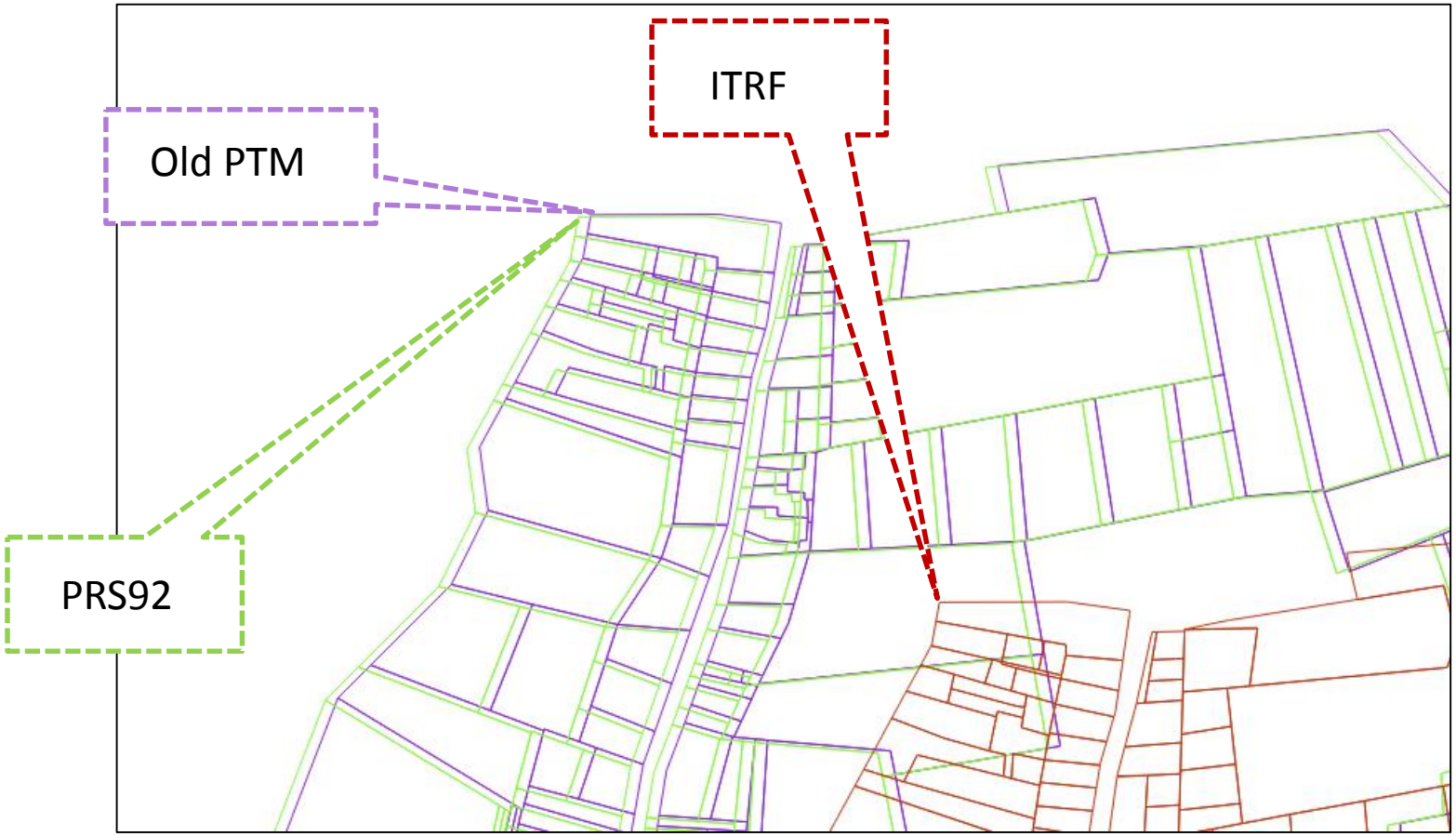
Sta. Rita	PRS92 to PPCS-TM/ITRF2014
Scale	0.99999
Rotation	6.5”
Tx	198.050
Ty	-77.061

Results: Sta. Rita, Pampanga

Summary of Effects on Cadastral Data

Sta. Rita	PRS92 to PPCS-TM/ITRF2014
Change in Positions	Northings: -63.727m Eastings: 144.941m
Significant Change in Bearings? (> 1 minute)	None
Significant Change in Distances? (> 1 cm)	None
Significant Change in Areas? (> 1 sqm)	None

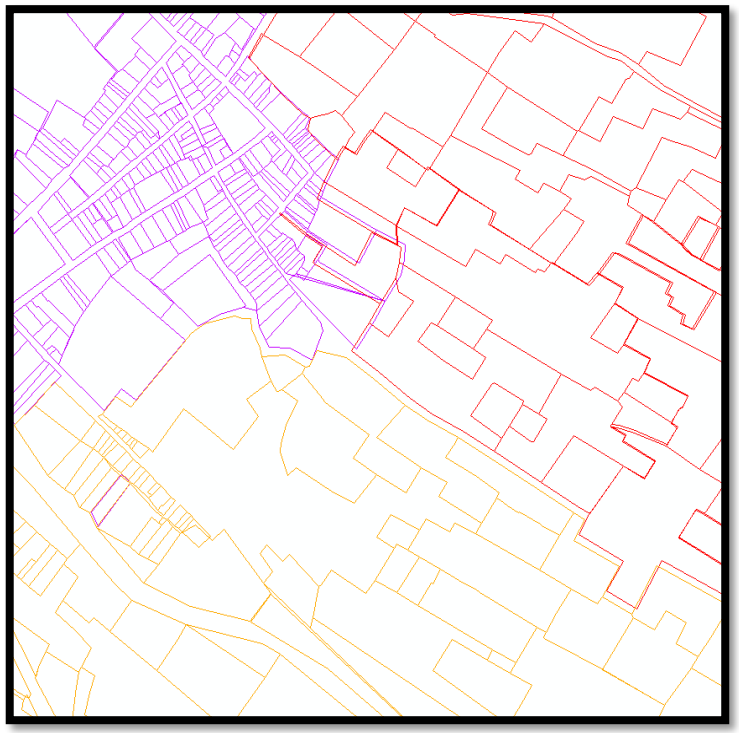
Results: Guiguinto, Bulacan



Snapshot of the Cadastral Maps of Guiguinto overlaying the Luzon 1911, PRS92 and ITRF versions.

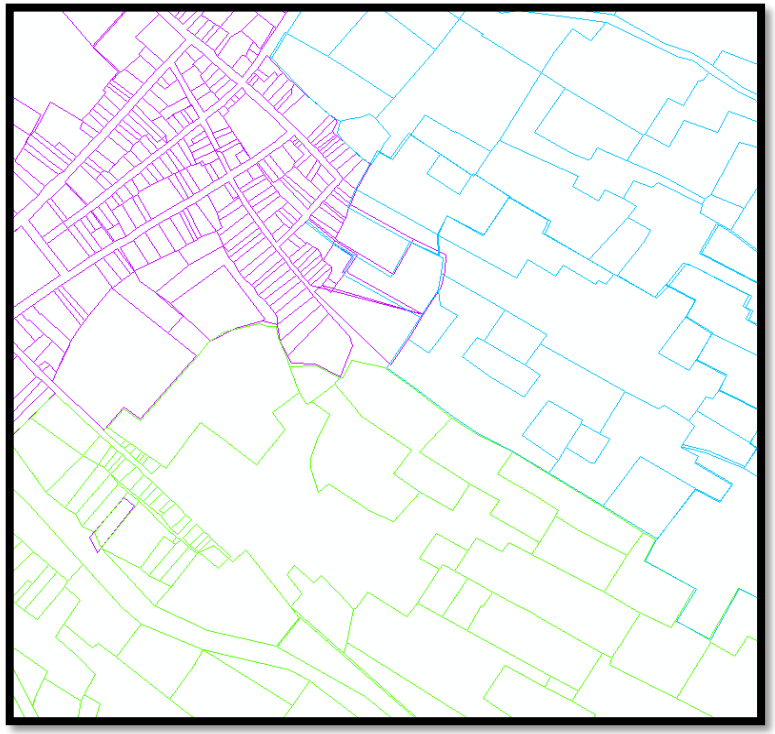
Results: Municipalities of Pampanga

Raw Cadastral Data



a 12m gap was present between the Guagua and Bacolor cadastres, and an 8m overlap in the cadaster of Bacolor and Sta. Rita

After Transformation



the 12m gap was reduced to 1.7m and the overlap was also reduced significantly, from 8m to 4m

CONCLUSIONS

- A homogeneous coordinate system is a basic requirement to obtain a reliable cadastral information system.

- The Lands Mode and R&D for PGRS, a joint research project between the DENR-LMB-UPTCAGP and NAMRIA-UPTCAGP provided the opportunity to study and provide innovations on different issues and problems in the land sector. These include the problem of having multiple coordinate systems.

CONCLUSIONS

- A methodology was developed to link one coordinate system to another.

- One of the significant and critical process in the research methodology is the recovery of the monuments of the control points.

- With the results it can be concluded that linking the different coordinate system can be done by providing the appropriate data needed for the transformation from one coordinate system to another.

CONCLUSIONS

- Consistent GNSS observations are necessary. Latest ITRF release requires at least 2hrs of GNSS observations for AUSPOS processing

- Validation of existing Luzon1911 and PRS92 coordinates are necessary as indicated in the records of land agencies

- While the rotational parameter does not affect technical descriptions significantly, it was observed that the scale parameter affects side distances and areas of parcels at a certain level. Precautionary analysis is advised before transformation of cadastral data

- Regardless of reference system used, technical descriptions are preserved (bearing/ azimuth/ distance and land area) except possibly for the tie-line information (question on the validity of the recorded tie-line due to some erroneous data)

RECOMMENDATIONS

- It is suggested that database for old and recomputed coordinates of the reference points be kept by the respective land agency

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Thank you for your attention!!!

Try not to become a person of success, but rather try to become a person of value ***- Albert Einstein***