PHILIPPINES-AUSTRALIA LAND ADMINISTRATION AND MANAGEMENT PROJECT

SURVEY CONTROL RECOMMENDATIONS FOR LAMP II IN URBAN SITUATIONS AS PART OF ACTIVITY 22

15 December 2002

REPORT D7

LAND equity

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ABBREVIATIONS & ACRONYMS

AO	Administrative Order
AusAID	Australian Agency for International Development
BBM	Barangay Boundary Monument
BLLM	Bureau of Lands Location Monument
CGSD	Coast & Geodetic Survey Department (NAMRIA)
CIM	Cadastral Index Mapping
CRS	Community Relations and Services
DENR	Department of Environment and Natural Resources
EDME	Electromagnetic Distance Measuring Equipment
FNSP	Field Network Survey Party (DENR)
GE	Geodetic Engineer
GEP	Geodetic Engineers of the Philippines
GPS	Global Positioning System
LAM	Land Administration and Management
LAMP	Land Administration and Management Project
LMB	Lands Management Bureau (DENR)
LEI	Land Equity International Pty Ltd
LRA	Land Registration Authority
MBM	Municipal Boundary Monument
NAMRIA	National Mapping and Resource Information Authority
NCR	National Capital Region
NRMDP	Natural Resources Management and Development Project
PIO	Project Implementation Office
PMO	Project Management Office
PRS-92	Philippines Reference System 1992
PTM	Philippines Transverse Mercator (projection)
QC	Quezon City
ROD	Registry of Deeds
TA	Technical Assistance
TOR	Terms of Reference

EXECUTIVE SUMMARY

A geodetic network is the basic spatial framework for the control and integration of surveys, mapping and all land related information. To adequately fulfill these functions it must be of sufficient quality to ensure accuracy, and be spaced such that surveyors can readily connect their surveys.

Although supposedly connected to the national geodetic network, cadastral surveys in The Philippines have in fact been connected to a variety of coordinate systems

Within Quezon City no systematic cadastral survey was performed. Surveys in different parts of the five pilot barangays within Prototype 2 for the Land Administration & Management Project (PIO2) have either been connected to control points (BLLMs) in other municipalities, or are probably not connected to any control. It was therefore assumed that the isolated surveys were unlikely to be homogeneous making the integration of survey and mapping data across the five barangays very difficult.

Accordingly a program was developed to provide accurate homogeneous geodetic control on the national coordinate reference system, throughout the six pilot municipalities.

The main activities of the International Survey Control Adviser in Activity 22 were directed at assisting the survey staff of PIO2 in identifying and evaluating alternative methods for the establishment of geodetic control such that they would be suitable for replication on any future long term LAM program.

The main outputs were defined as follows:

- *A report on the alternate survey control methods identified and their evaluation and comparison and workshops completed.*

The existing regulations governing surveying are considered, particularly in relation to control survey activities.

CGSD should have completed its survey control activities for PIO2 by 30th June 2002 but had not done so. Accordingly some activities have continued. Control for the Orthophoto Mapping was completed by the end of October. Field inspections were scheduled for December 2002 to resolve some problems with the coordinates for CIM control.

A significant number of reobservations were needed for the monumented 3rd Order control points and they were scheduled to take place in early December, but completion may be delayed.. The completion of the Adviser's assignment raises the question of responsibility for validation of the final adjustment. The Adviser has agreed that the data should be sent to him for evaluation in his own time.

An assessment has been made of the capabilities of CGSD to undertake survey control activities in support of a long term LAMP. CGSD has deficiencies in the area of equipment and software maintenance and in the level of ancillary equipment to support its GPS operations. A lack of adequate supervision has affected some of their field operations. CGSD's adjustment capabilities do not meet the required level of proficiency for the national geodetic survey organisation. In addition, CGSD has not been sufficiently responsive to the project's requirements for geodetic control.

Some of the key recommendations are that:

- ***CGSD consider the comments regarding both equipment and software, and consider upgrading its equipment and software in line with these comments.***
- ***CGSD should develop its expertise in geodetic adjustments to an advanced level, appropriate for the national geodetic agency.***
- ***A number of other issues relevant to geodetic control matters have been addressed in the report and recommendations made.***
- ***CGSD provide a prompt and efficient response to project requirements for geodetic control and that individual projects are completed without delay.***

*At a workshop held with representatives of the public and private sectors, and academic institutions the Adviser delivered two presentations titled: "**Geodetic Control Approach & Procedures Developed for PIO2"*** and ***"Geodetic Control Other Issues for PIO2"**.*

The various surveying and mapping methods and the cadastral survey techniques that may be appropriate on a long term LAMP have been identified. In turn, the geodetic control requirements have been identified.

In assessing the value of a geodetic network, the absence of such a network is seen as leading to duplication of effort at a long term economic cost to the community. An adequate and easily accessible network therefore provides long term efficiency. The conservative estimate of the ratio of benefits to costs of a network are of the order of 1.7 - 4.5 to 1. A geodetic network is seen as a valuable national resource.

The key recommendations in relation to extension of the geodetic network in support of the long term LAMP are that:

- ***In urban areas, 3rd Order control points should be established at a maximum spacing of 1km. In establishing control points in a particular area, consideration should be given to the nature of the area. In areas where either streets are short, there are many short straights between bends, there is high density development, or hilly terrain, consideration should be given to establishing control points at a reduced spacing. Each area should be treated on its merits.***
- ***Control points are not established as intervisible pairs.***
- ***To support control of the 3rd Order points, 2nd Order control should be established at approximately 5-7km spacing. These 2nd Order points will be used as reference stations for fast static GPS control.***

During November there were two workshops involving GEP members and others from the broader surveying community, including the academic sector. These workshops have started the consultation process and it is important to develop a strong cooperative working relationship with the overall surveying community on a broad range of matters related to surveying and mapping. It is recommended that:

- ***The project establish a consultative group comprised of: senior project GEs from PMO, PIO1 & PIO2; TAs who are surveyors; GEP representatives; academic representatives (from GE schools); and representatives of other government agencies involved in surveying and mapping activities. The consultative group should meet regularly to discuss matters of interest.***
- ***The establishment of a network of monumented control points within the pilot municipalities should meet the future requirements of GEs for survey control, when***

working in these areas. For the first time they will have a network of accessible, accurate and homogeneous control as the basis for controlling the position, orientation and scale of surveys. The connection of surveys to this network will facilitate the plotting of surveys on the CIM. Therefore:

- ***Guidelines must be developed for surveyors working in the pilot municipalities to ensure that all surveys are connected to the two nearest and preferably three control points.***

An instruction on the placement and maintenance of survey marks was developed during Activity 11. This instruction will not meet the long term needs in terms of a full mark maintenance program. In addition there is a need to consider the issue of access to property to carry out surveys. Accordingly it is recommended that:

- ***Consideration should be given to a full study to develop a comprehensive national mark maintenance program.***
- ***As part of this study, the issue of accessibility to property to carry out surveys should be considered. Appropriate provisions should be included in any future Survey Act.***

The existing EDM base at the University of the Philippines is inadequate for the proper calibration of modern EDM equipment and is not easily accessible to the national surveying community. There is also a need for tribrach testing facilities. It is recommended that:

- ***Suitable and accessible EDM bases, to recognized world standards, should be established within each region.***
- ***Tribrach testers should be purchased and installed within each region and should be accessible to the general surveying community.***

CGSD's geodetic database is in the process of being upgraded from the system developed under NRMDP. This is essential as it is the repository for all geodetic data in the country and any long term project will generate a very large amount of data. The project will need access to the database for data entry and retrieval, and the general survey community needs good access throughout the country. The issues of accessibility from outside CGSD have not been addressed. It is recommended that:

- ***The issue of accessibility to the CGSD Geodetic Database to update data and to obtain control information should be investigated and addressed.***

The "Revised Manual of Land Surveying Regulations in the Philippines" or DENR AO 98-12 is considered to be outdated and inappropriate. To enable the surveying profession to meet the ongoing needs of a long term LAMP very substantial reforms of survey practices are required. It is suggested that AO 98-12 should be replaced. It is recommended that:

- ***There be a full study into the control and regulation of surveying in the Philippines and that an appropriate legislative and regulatory framework is established to modernise the practice of surveying.***
- ***As part of the study, draft legislation and regulations should be developed in consultation with the appropriate survey authorities and GEP.***

To ensure the success of the proposed long term LAMP, it will be necessary for GEs and other survey personnel within both government and the private sector to upgrade their skills and modernise their equipment and techniques so that they can provide an efficient and effective response to the project's survey and mapping requirements. A proposal is being prepared for

survey curriculum development at the vocational, undergraduate and postgraduate levels, in cooperation with an Australian university. It is recommended that:

- ***The curriculum development proposal is pursued to ensure that appropriate survey education and training is available at each of the three levels.***

The Institutional Arrangements Policy Study has made a number of recommendations regarding a possible structure for the proposed Land Administration Authority (LAA). Comments and suggestions are made in relation to geodetic control functions within the LAA. It is recommended that:

- ***A Geodetic Network Section (GNS) be created in the proposed Mapping & Survey Standards Division.***
- ***A Geodetic Control Section (GCS), Regional Geodetic Control Sections (RGCS) and Mark Maintenance Sections (MMS) be created, in the proposed Mapping & Survey Services Division.***

1. INTRODUCTION

This is the final report on survey control matters as part of the Philippine Australia - Land Administration & Management Project (LAMP) Technical Assistance (TA) for Activity 22, within Prototype II (PIO2). The prototype is operating within five barangays in the Quezon City, Metro Manila. The pilot barangays are: Bagong Silangan; Batasan Hills; Commonwealth; Holy Spirit and Payatas. This report addresses survey control issues in urban areas. For rural areas the report, ***Survey Control Recommendations for LAMP II (PIO1 – Rural)*** should be referred to.

The Scope of Work, within the Inception Report describes Activity 22 as *"Preliminary set of Land Title validation procedures developed"*. The main output for the activity is *"Documented procedures."*

Within the "Output Terms of Reference" there is no specific reference to control surveys.

However, a more detailed Terms of Reference (TOR) for Output 3.2 has been developed by the Land Titles Records Adviser. Under this TOR, advisers, in consultation with PIO 2 and government and non-government stakeholders, were to:

- *identify all methods that have potential for the effective and efficient identification of fake, duplicate and missing titles, the resolution of those anomalies, and for improving the integrity and completeness of title and associated records.*

The activities were summarised as follows:

- *Preliminary set of land title validation procedures developed. The deliverable is a report documenting procedures by 31 December 2002.*

The main activities of the International Survey Control Adviser were directed at assisting the survey staff of PIO2 in identifying and evaluating alternative methods for the establishment of geodetic control such that they would be suitable for replication on any future long term LAM program.

Ongoing input was also provided into the National Mapping & Resource Information Authority's (NAMRIA) Coast & Geodetic Surveys Department (CGSD) Global Positioning System (GPS) activities in providing control in the pilot barangays. These activities were to be completed during Activity 13 but continual delays and problems have meant that sporadic control activities have continued since July 2002 and the adviser has been called on to provide varying degrees of input.

This report concentrates on survey control activities by Andrew Dyson, International Survey Control Adviser, in support of Activity 22. A summary of the tasks and outputs follows.

In this report, the term "cadastral survey" refers to any survey that defines boundaries, using the broad internationally accepted meaning of "cadastral" rather than the narrow local meaning referring only to surveys of extensive areas for "cadastral registration proceedings".

1.1 Overall Tasks

The overall tasks related to survey control are defined in the adviser's TOR which is included as *Appendix 1* to this report. The individual terms of reference relevant to PIO2 are as follows:

- *To assist in the identification of alternate survey methods to better support the making of the various maps required for the office and field validation processes. These maps are CIMs from the compilation of map information from various sources (DENR, Assessors, LRA) and*

control for aerotriangulation for orthophoto mapping. A workshop will be used to summarise the conclusions and lessons.

- *The main output in prototype 2 is a report on the alternate methods identified, the evaluation and comparison and workshops completed.*

1.2 Main Outputs

The main output related to survey control is defined in the adviser's TOR as follows:

A report on the alternate survey control methods identified and their evaluation and comparison and workshops completed.

1.3 Inputs

The Scope of Work for Activity 22 specified that the adviser would provide one month of input.

1.4 Outline of Report

In identifying and evaluating the various control survey options that may have potential application in the proposed long term LAMP II it is necessary to first consider the existing regulations governing surveying.

The survey control requirements to support PIO2 activities are briefly outlined and an update provided on the status of control activities since 30th June 2002.

CGSD's capabilities to provide geodetic support for a long term LAMP are considered and recommendations made for improvements and the development of their capacity to undertake geodetic control operations

The lessons learnt during the control activities are summarised.

Although the "Partnership Building Workshop" was held in Leyte and the emphasis was on PIO1 activities, nevertheless a number of matters are also relevant to PIO2 and the urban situation. Accordingly the outcomes of the workshop are considered to provide an indication of the position of the Geodetic Engineers (GEs) on control survey matters. In addition the output from the PIO2 "Control Survey Workshop" is discussed.

The various control options to support cadastral surveying, CIM production, and mapping are explored. Some thoughts are provided on the value of a geodetic network before final recommendations are made for geodetic control to support a long term project in urban areas.

A strategy is suggested for further consultation with individuals and organisations with an interest in survey and mapping matters.

A number of other issues, of relevance to geodetic survey matters, are raised including: mark maintenance; EDM bases; training and the proposed Land Administration Authority.

2. SURVEY REGULATIONS

The practice of surveying is governed by the *"Revised Manual of Land Surveying Regulations in the Philippines"*, published as the *DENR Administrative Order No 98-12 (AO 98-12).* In particular AO 98-12 is relevant to the national geodetic network and all cadastral (or boundary) surveying,

In addition *DENR Administrative Order No 98-48 (AO 98-48) – "Redefining the program thrusts of the Field Network Survey Parties"* (FNSP) contains some sections relevant to the establishment of geodetic control. The order reactivated the FNSP and redefined their role giving them responsibility for achieving the objective of providing accessible PRS-92 control for all geodetic engineers using conventional equipment and techniques.

It should be noted that the Adviser was not aware of AO 98-48 until late November 2002.

2.1 DENR AO 98-12

The portions of AO 98-12 relevant to control surveys are summarised below:

Sec. 4

Geodetic surveys are defined in this section. It stipulates that geodetic surveys shall be made to determine the geographic positions of reference points for "cadastral projects" and "expansive isolated surveys".

The establishment of the national geodetic network is to be in accordance with CGSD's specifications that follow international standards.

Sec. 38

Surveys shall be fixed in position by permanent monuments and by azimuths and distances to "points of reference" of known position. Positions are to be in PRS-92.

Points of reference are to be Bureau of Lands Location Monuments (BLLMs), Political Boundary Monuments, Triangulation Stations, Primary Project (Cadastral) Control Points, church towers etc and other stations to at least 3rd Order accuracy.

Sec. 39

BLLMs are to be established in pairs, with at least one pair per municipality

Sec. 40

Additional BLLMs are to be established along the project control, in pairs, and with average spacing of 5-6 km (between pairs).

Secs. 44, 47, 48 & 50

These sections, define the origin of PRS-92, specify that it is the national reference system, define the Clark Spheroid of 1866 as the PRS-92 spheroid, and specify the transformation parameters from WGS-84 (actually the Natural Resources Management & Development Project {NRMDP} determination of WGS-84 in the Philippines).

Sec. 54

Sec 54 specifies the relative positioning accuracy standards for the various (geodetic) orders as follows:

Positional Accuracy			
1st Order	10 parts per million	1/100000	1 cm per km
2nd Order	20 parts per million	1/50000	2 cm per km
3rd Order	50 parts per million	1/20000	5 cm per km
4th Order	100 parts per million	1/10000	10 cm per km

Sec. 55

Sec 55 specifies the accuracy standards for various surveys and connection of surveys to PRS-92 as follows:

(a) Densification of the 1st Order Network to 2nd and 3rd Order accuracy. (assumed to include BLLMs)

(b) Project controls of cadastral projects shall be at least 3rd Order accuracy.

(c) Political boundary surveys shall be at least 3rd Order accuracy.

(d) Delimitation surveys of Integrated Social Forestry Projects; mineral land surveys; relocation or delimitation of national parks and other protected areas, reservations, classified forests including buffer zones; delimitation of ancestral claims shall be 4th Order accuracy.

Sec. 56

New GPS stations on PRS-92 may be established by government agencies and accredited geodetic engineering professionals with capabilities in GPS surveying; provided their receivers are duly registered with NAMRIA or LMB.

Sec. 57

Sec 57 specifies that 1st, 2nd & 3rd Order GPS stations shall be monumented to CGSD specifications (as established on NRMDP) and using the CGSD numbering system. Numbers are to be obtained from CGSD.

Sec. 58

Under Sec 58, CGSD is responsible for evaluating the GPS equipment, techniques, design, data processing and adjustment of GPS surveys submitted to become part of the national geodetic network. Such surveys may be carried out by GEs of other government agencies or the private sector.

Secs. 60 & 61

These sections define the Philippine Plane Coordinate System (PPCS) which is also known as Philippine Transverse Mercator Grid (PTM).

Sec. 113

Surveys for 1st, 2nd & 3rd Order geodetic control are to be made in accordance with the instructions in CGSD special publications.

Secs. 114 - 117

The classification and specifications for project control surveys are outlined in these sections. Primary project controls are supposed to be spaced between 100-1000m.

Sec. 249

Sec 249 specifies that the minimum separation for each pair of BLLMs shall be not less than 100m, and whenever possible it should be about 300m.

Sec. 759

MBMs and BBMs are to be established along straight boundaries at intervals of not more than a 1000m, except where a boundary passes through forest land.

2.2 DENR AO 98-48

The portions of AO 98-48 relevant to control surveys are summarised below:

Sec. 1

The FNSP are to connect all existing control points such as: BLLMs, political boundary monuments, old triangulation stations etc to the PRS-92 geodetic network. In addition, they are to densify the above control points to a density of at least 2km, or at least a pair of location monuments are to be established within a barangay, such that the tie line of a survey should not exceed 1km.

Connection of old reference points to PRS-92 is to be to 4th Order accuracy.

Sec. 2

The FNSP may establish additional PRS-92 stations to 3rd or 4th Order accuracy by traverse or triangulation. However, the densification of the geodetic network to 2nd or 3rd Order accuracy is the responsibility of CGSD using GPS.

Sec. 7

Under Sec 7, FNSP, LMB and CGSD are to include in their annual budget requests, funding for:

Densification of the network;

Physical maintenance of the network;

Equipment repair and maintenance and hardware/software acquisition or upgrading of existing items;

Technical staffing.

Sec 7 also specifies that the FNSP are to submit data to LMB for incorporation into the National Geodetic Data Bank.

2.3 Discussion

A discussion on some of the above sections of AO 98—12 & AO 98—48 follows:

2.3.1 Adequacy of Control – AO 98-12 - Sec 38, 40 & 249; AO 98-48 - Sec 1

AO 98—12 - Sec 38 specifies that surveys are to be "fixed in position" by connection to a pair of BLLMs.

The practice of connecting surveys (if in fact they are connected) to two BLLMs that may be as close as 100m apart and a number of kilometres from the survey in question is not appropriate. It does not provide adequate control on the position, scale or orientation of surveys. Surveys are left to swing with inadequate azimuth control because of very short backsights and many traverse legs over a substantial distance. Additionally, there is no check on the scale or position of the survey. This practice is regarded as unsound and very dangerous and inevitably leads to the creation of gaps and overlaps between adjoining surveys.

In accordance with world's best practice, all surveys should be conducted by working **"from the whole to the part"** not **"from the part to the whole"**.

Even if control is spaced at 5-6kms as specified in AO 98-12 - Sec 40, for pairs of BLLMs, it is totally unrealistic to expect surveyors to traverse to two such pairs of control points to adequately control their surveys. Advice from both private and government GEs indicates that, in most cases, they do not connect to one pair of BLLMs, but instead show calculated connections on survey maps.

Accordingly it was decided during 2001 that a more appropriate spacing for 3rd Order control would be at approximately 1km intervals in urban areas and approximately 2km intervals in rural areas. In addition it was decided that it was not necessary to establish control points in pairs to provide azimuth control.

The decision to adopt 2km spacing for control in rural areas complies with the requirement of AO 98-48 - Sec 1.

With control established in this manner it is necessary for surveyors to traverse between adjacent control points surrounding their project to establish position, orientation and scale control. It is desirable to connect to a third control point to provide an independent check.

Orientation has to be established by calculation, by adjusting the azimuth of the survey to the PRS-92 coordinate system. Jan van der Kevie, International Parcel Mapping Adviser, has developed Traverse Calculator software to assist surveyors in orienting and adjusting their surveys to the PRS-92 coordinate system. This software should be made freely available to surveyors.

2.3.2 BLLMs – AO 98-12 - Sec 39 & 40

Sec 39 & 40 specify that at least one pair of BLLMs is to be established in each municipality and additional pairs at approximately 5-6km spacing.

No BLLMs have ever been established in Quezon City. Experience in other areas, such as Leyte, indicates that in many municipalities they have not been established at 5-6km spacing.

2.3.3 Specifications for Political Boundaries and Project Control – AO 98-12 - Sec 55

Anecdotal evidence suggests that primary project control on cadastral projects and political boundaries are not usually established to 3rd Order geodetic specifications, despite Sec 55.

2.3.4 Numbering of Geodetic Control Points – AO 98-12 - Sec 57

Despite the requirement to comply with CGSD's numbering system and clear instructions in support of this requirement, the CGSD survey team used a different numbering system for the 3rd Order control points established throughout the pilot barangays in Quezon City.

2.3.5 CGSD Evaluation of Geodetic Control – AO 98-12 - Sec 58

An assessment of CGSD's capabilities in the area of adjustments (see *4.4.3 - Data Processing and Adjustment* below) raises serious questions about their ability to be responsible for the evaluation of geodetic control data from other organisations.

Nevertheless it is entirely appropriate that as the national geodetic agency they should be responsible for the setting and monitoring of geodetic standards and they should be responsible for the integrity of all data that constitutes part of the national geodetic network and is in the national

geodetic database. The fact that they lack some of the essential capabilities does not mean that they should not have this monitoring role and responsibility, but rather that they need to upgrade their capabilities

3. SURVEY CONTROL REQUIREMENTS TO SUPPORT LAMP PIO2

A program was developed to provide geodetic control throughout the pilot barangays on the national coordinate reference system, to support the following activities:

Production of orthophoto mapping;

Control of all future cadastral surveys.

Plotting of the existing isolated surveys on the CIM within the barangays of Batasan Hills and Holy Spirit;

The preferred method of survey was to utilise GPS technology, supplemented by observations with Total Stations when circumstances prevented GPS observations.

Full details of the control program and the requirements can be found in the ***"Final Report on Survey Control Activities as part of Activity 13"***.

In summary these requirements were:

3.1 Control Requirements for production of Orthophoto Maps

The Technical Specifications for orthophoto mapping at 1:1000 scale stipulated that horizontal and vertical control was required around the perimeter and within the photogrammetric block at a spacing of not more than 2km. The specified accuracies being:

Horizontal	+/-0.05m;
Vertical	+/-0.15m

The preferred approach to provide control was to establish three second order control points and then use fast static GPS techniques to coordinate the photo control points to third order specifications. Photo control points were features selected by the photogrammetrists from the aerial photography.

3.2 Control Requirements to Support Cadastral Surveying

To enable any future surveys in the five pilot barangays to be recorded onto the CIM it is important that all new surveys be connected to at least two control points on the PRS-92 coordinate system. For this constraint to be reasonable for geodetic engineers, it was proposed that the Project provide new control at approximately 1km spacing in the 5 barangays. It was not a requirement that the control points be placed such that they are intervisible.

This amounted to about 40 monumented third order control points. The points were to be established in safe and secure locations where the monuments have the maximum chance of survival, with minimal obstructions above 15 degrees elevation. They were coordinated using fast static GPS from the three second order reference stations.

The establishment of these control points will provide a good network of third order control points that should meet the future requirements of all survey practitioners working in the five barangays.

For the first time they will have a network of accessible, accurate and homogeneous control as the basis for controlling the position, orientation and extent of their surveys. The connection of surveys to this network will facilitate the plotting of surveys on the CIM.

Guidelines must be developed for surveyors working in these barangays to ensure that they do in fact connect to the two nearest and preferably three of these control points.

3.3 Control Requirements to Support CIM activities

In the absence of the orthophoto mapping, boundaries within the barangays of Batasan Hills and Holy Spirit were coordinated to control the plotting of the CIM on PRS-92.

It was decided that a boundary point should be coordinated near the corner of each CIM. About 60 points were required in Batasan Hills and about 40 points in Holy Spirit.

In the office, PIO2 staff were to select the preferred locations for control by inspecting the preliminary CIM in Batasan Hills and the survey plans in Holy Spirit. Reconnaissance teams then attempted to identify the preferred boundary locations in the field and determine if the locations were suitable for GPS observations.

Wherever it was possible to set an antenna above the selected location, control would be provided directly on the boundary. Where not possible because of restricted satellite visibility, or for some other reason, it was proposed that GPS control be provided as close as possible to the boundary point. A connection would be made from the GPS point to the boundary point by compass and tape.

To support the boundary control and the other control activities, three second order control points were required within the pilot area. These second order points were used as the reference stations for fast static observations.

3.4 Procedures for Control Surveys

Procedures were established to support these control activities during Activity 13 and they have been documented in the ***"Manual for Densification of the Geodetic Network to Support Land Records Management & Cadastral Surveying"*** prepared by the adviser in consultation with the relevant staff of PIO2 and CGSD.

In addition the following Field Sheets were developed to support the survey activities:

Reconnaissance Information Sheets;

GPS Station Visibility Sheets;

Traverse Pages.

4. SURVEY CONTROL ACTIVITIES

It was decided, during 2001, that CGSD would undertake the geodetic control activities with some assistance from PIO2 staff, in particular with the coordination of boundary points where PIO2 staff would assist in the location of boundary features. PIO2 was not to be equipped or trained for geodetic control surveys as their staff were to be mainly concerned with the CIM production.

All survey control should have been completed by 30th June however as indicated in the Adviser's ***"Final Report on Survey Control Activities as part of Activity 13"*** of 17th July, only the survey

activities for the CIM boundary control were thought to have been completed and the coordinates submitted to PIO2 by this date.

Subsequently PIO2 staff and the International Parcel Mapping Adviser advised that there were some problems with some of the coordinates and requested that CGSD investigate.

A summary of activities since 30th June follows:

4.1 Control for Orthophoto Maps

Initially there were delays in completing the photo control because NAMRIA's Mapping Department requested levelling for vertical control. The ***"Final Report on Survey Control Activities as part of Activity 13"*** of 17th July indicated that the matter had been resolved and that 13 additional GPS control points would be observed for vertical control.

CGSD finally delivered the coordinates to the Mapping Department during the first week of September. Mapping discovered some problems with the data, mainly related to identification of the control points and referred them back to CGSD.

It was not until 29th October that all problems were resolved and Mapping Department was able to resume its activities.

4.2 Control for Cadastral Surveying

As at 17th July, a large proportion of the control points were still to be established and coordinated. At a meeting between PIO2, CGSD and the Adviser on 29th October, CGSD advised that reobservations were required for seven points and that the observations, data processing and adjustments would be completed by 8th November. It was agreed that the adjustment files would be transmitted to the Adviser for validation and acceptance.

At this meeting, the Adviser became aware that CGSD had not adhered to the proper numbering system for the control points. A serious mistake, given that it is CGSD's numbering system; project instructions to use the system; and Sec 57 of AO98-12 stipulates that CGSD's numbering system is to be used for 3rd Order and higher control points.

The Adviser received the data on 9th November and completed the analysis on 17th November. Analysis took longer than anticipated because of the quality of the data and inconsistencies between some data files and the results file. The latter problem wasted considerable time.

A report detailing the problems, seeking a response to some questions and requesting additional observations for eleven control points was forwarded to Lt Brandes of CGSD on 17th November, together with adjustment files. In addition, EDM distances were requested between four pairs of points less than 250 metres apart, provided that they are intervisible. A copy of the email was faxed to Eng. Macaspac, Chief of Geodetic & Geophysics, CGSD on 18th November.

Lt Brandes reported on 26th November that he is to conduct some additional GPS observations and will measure the distances with EDM as requested. This work was expected to take place in early December 2002. Advice from CGSD on 13th December indicates that the work might not be completed until after Christmas.

As the Adviser was to depart for Australia on 5th December, Eng. Pereira, Head, CIM Unit has expressed concern that there will not be any technical assistance available for quality control and validation of the adjustment. The Adviser agrees that this is a serious problem that must be

addressed if the project is to have confidence in the quality of the final coordinates of these control points.

At the Adviser's final meeting with PIO2 and CGSD personnel on 4th December 2002, it was agreed that in the absence of other arrangements, the data should be sent to the Adviser in Australia for validation in his own time. It should be noted that the Adviser's assignment was completed on 6th December and accordingly he has no further scheduled inputs into the project.

It is recommended that:

- *Support be provided for PIO2 in the evaluation and quality control of the adjustment of data for the 3rd Order control points.*

4.3 Control for CIM Production

Problems with the coordinates of the boundary control for the CIM had not been resolved by 29th October. At the meeting on that day, it was resolved that CGSD and PIO2 would conduct joint field inspections on some of the points to confirm that the correct points had been observed in the field. Inspections were to take place during the week 4-8 November 2002.

As at 26th November, the inspection had not taken place and has been scheduled together with the reobservations and other survey activities above for December.

4.4 Assessment of CGSD Capabilities

In assessing CGSD's capabilities to support a long term LAMP with geodetic control activities, the following areas should be considered:

Equipment

Field operations

Data processing and adjustment

Responsiveness to the project's requirements.

4.4.1 Equipment

CGSD is quite well equipped with a number of dual frequency GPS receivers, however their operations are not well supported with the necessary ancillary equipment or with the proper maintenance of its equipment. CGSD is using expensive high precision GPS receivers but not taking the maximum advantage from the equipment. To reliably achieve accurate results, the observations should be supported by the appropriate level and quality of ancillary equipment and properly maintained equipment.

Early in 2002, funding difficulties created long delays in repairing a faulty Trimble 4000SSE receiver that was urgently needed for ongoing operations. These receivers are no longer available, yet they are, in the Adviser's opinion, the best GPS receiver for geodetic operations and in particular for fast static observations so it is critical that they are well maintained to give the maximum possible service life.

Comments follow on specific items of ancillary equipment, these comments (apart from those on boxes and bags) were transmitted to CGSD on 26th March 2002:

Tripods

Unsuitable tripods are being used. Experience on recent observations indicates that setups are usually too low because the tripods are too short. In addition, aluminium tripods are not considered appropriate for high precision observations as they are prone to expansion and twisting in the sun. The tripods are also in a poor state of repair.

Tripods should be sturdy and of wood or fibre glass construction and enable reasonable setup heights in most circumstances.

To maximise GPS signals in areas where there are some obstructions and to minimise multi-path higher antenna setups are often required. It is also recommended that consideration be given to equipping GPS teams with extra long extendable tripods such as the Leica GST20 Type II. Such tripods enable the antenna to be set at well over two metres above the ground. To set up such a tripod, a short step ladder is required.

Tribrachs

Tribrachs are in a poor state of repair and require maintenance and regular checking.

Range poles & bipods

For third order fast static observations it is recommended that the rover antennae should be mounted on a 2.5m range pole supported by a bipod. The use of a range pole and bipod permits quick antenna setup and enables the antenna to be set at a reasonable height to avoid some obstructions and minimise multi-path.

Batteries

The 4000SSE camcorder batteries do not hold their charge and need replacing. The use of reliable well charged camcorder batteries in the battery cradle is essential to provide a backup and an appropriate level of protection against the loss of data in the event that the main battery or the connection to it fails.

Antenna & Power Cables

Each GPS team should be equipped with spare power and antenna cables to minimise the risk of missing observations due to a cable or connector failure, either power or antenna.

Boxes & Bags for Equipment

Apart from the GPS receivers, none of the other equipment is adequately housed in protective boxes and bags for storage and transportation. It is vital that equipment is properly protected from damage in storage and transit by being kept in proper containers. Equipment such as tripods and tribrachs, regardless of how well they are made, will not function properly if they are worn and damaged. There is little point in using high precision GPS equipment if the ancillary equipment is not maintained in a state that will maintain high precision results.

Similarly batteries and cables need adequate protection for storage and transportation.

It is recommended that:

- *CGSD consider upgrading its equipment in line with the above comments.*

4.4.2 Field Operations

CGSD has demonstrated a reasonable degree of competence in its field operations. Its field operators are reasonably proficient in the use of their GPS equipment and they have adapted to the

procedures required for fast static operations. These procedures were developed during the project and all field parties were provided with some field training.

They have however been hampered by a lack of sufficient ancillary equipment such as spare batteries, range poles and good quality tripods and tribrachs.

In addition, there has been a lack of adequate supervision of some activities and a failure to properly instruct field parties on the correct procedures. An example is the failure to comply with the approved numbering system for 3rd Order control points.

It is recommended that:

- *CGSD provide adequate supervision of field activities to ensure that they comply with the correct procedures.*

4.4.3 Data Processing & Adjustments

Data Processing

CGSD's two senior GPS officers have acquired a reasonable level of proficiency in the processing of GPS observations to produce baselines for adjustment. CGSD should ensure that it has sufficient well trained officers, in data processing, to ensure that each GPS party leader is able to process all observations at their field base camp. Data should be processed on a daily basis and regularly adjusted in the field to ensure that any necessary reobservations can be made while the field parties are in the locality. In other words, before moving to a new area or back to their headquarters in Manila. It is important that verification of the data takes place in the field as it is not only expensive to remobilise but there seem to be extraordinary delays in securing the necessary approvals.

CGSD has not maintained its processing software by regularly acquiring software updates. In particular it is still using Trimble Geomatics Office V1.0 whereas a much improved V1.5 has been available for some considerable time. The later software provides more powerful tools for analysing the quality of the observations and baseline processing. These features are of considerable assistance in processing problematic data.

It is recommended that:

- *CGSD upgrade it GPS processing software to the latest version of Trimble Geomatics Office.*

Adjustments

CGSD's adjustment capabilities do not meet the required level of proficiency for the national geodetic survey organisation.

It was unfortunate that Lt. Brandes of CGSD was unable to attend the Advanced Adjustment training conducted at PIO1 from 9th September – 4th October 2002. {A full evaluation of the training can be found in ***Survey Control Recommendations for LAMP II (PIO1 – Rural)***}. He had attended the basic adjustment training in June 2002 and was considered to be their most experienced GPS surveyor. He had overall responsibility for the conduct of the GPS surveys in both PIO1 & PIO2 and was responsible for the adjustments. Therefore every effort should have been taken to ensure his participation in the training course to further develop his adjustment capabilities.

Some of the data sets that he had been responsible for adjusting were used during the training. The analysis of some of these data sets revealed that although they had been deemed acceptable by Lt. Brandes, in fact they were not up to an acceptable standard. Some baselines had to be removed

from the data sets necessitating further reobservations by PIO1, as CGSD no longer had equipment or personnel in Leyte.

Similar problems were encountered with the data set for the Quezon City monumented control (see *4.2 - Control for Cadastral Surveying* above).

The deficiencies in these data sets highlight that he does not have sufficient expertise to be taking full responsibility for adjustments and data validation for CGSD. In the adviser's opinion, Lt. Armengol now has a greater level of expertise in adjustments and in particular in the use of *GeoLab*.

If CGSD is to be responsible for the certification of all GPS data to be incorporated into the national geodetic data base it needs assistance to develop its level of expertise in adjustments to an advanced level. CGSD should also purchase more copies of *GeoLab* so that all adjustments can be done with *GeoLab*.

It is recommended that:

- *CGSD should purchase more copies of GeoLab so that all adjustments can be done with the same software and develop its expertise in geodetic adjustments to an advanced level, appropriate for the national geodetic agency.*

4.4.4 Responsiveness to the Project's Requirements

Throughout the project CGSD has demonstrated an inability to respond in a timely manner to the project's needs for prompt mobilisation of field teams to undertake GPS surveys for geodetic control, in both Quezon City and Leyte. There have been significant delays in commencing activities and they have often been suspended before completion. On such occasions it has sometimes taken months to remobilise teams.

It would appear that many of these delays have been caused by bureaucratic and financial problems within NAMRIA and between NAMRIA and LAMP.

In addition, CGSD has delayed mobilising because their resources have been allocated elsewhere on other projects.

As an example of the frustrations experienced by the project, CGSD field teams have to go through the lengthy procedure of obtaining approvals for travel orders from the Director, CGSD to travel to Quezon City to undertake a field inspection or some reobservations to complete a project that they have commenced with approval. Why can't field teams operate with the verbal approval of their supervisor, once a project is approved? Why must every little operation have the direct approval of the Director? There is a clear need for streamlining and efficiency and delegation of authority to a lower level.

CGSD's adjustment capabilities do not meet the required level of proficiency for the national geodetic survey organisation.

It is recommended that:

- *CGSD should purchase more copies of GeoLab so that all adjustments can be done with the same software.*
- *CGSD develop its expertise in geodetic adjustments to an advanced level, appropriate for the national geodetic agency, as a matter of urgency.*

- *CGSD provide a prompt and efficient response to project requirements for geodetic control and that individual projects are completed without delay.*

5. LESSONS LEARNT

A *Lessons Learnt Session* was part of the *PIO2 Survey Control Workshop* of 28th May 2002. This session provided an opportunity for PIO2 staff, CGSD staff and Technical Advisers to review control activities to that time. They were also able to share their lessons learnt since the commencement of survey control activities in October 2001.

Reports on the workshop and lessons learnt were appended to the ***"Final Report on Survey Control Activities as part of Activity 13"***. A summary of the lessons learnt was contained within the report.

5.1.1 Lessons Learnt to June 2002

The lessons learnt to June 2002 are summarised below:

CRS Activities

There is a need to identify who will be responsible for CRS.

As part of the CRS public meetings that the participants should be asked to sign letters approving the proposed activities.

CGSD representatives should attend barangay public meetings.

Selection of Boundary Points for CIM Control

The selection of boundary points should be a cooperative exercise between CGSD and PIO2 staff.

Operational Funding

The project must provide sufficient funding, vehicles and equipment to enable its staff to participate efficiently in field operations.

Responsibility for Control Surveys in an Expanded Lamp

CGSD lacks the resources to properly support LAMP's requirements for large scale densification.

In an expanded program a Geodetic/Control Survey Section should be created with full responsibility for control surveys.

Reconnaissance Information Sheets

In preparing the Reconnaissance Information Sheets particular care must be taken to ensure that the descriptions are adequate for the GPS teams to locate the points without assistance.

5.1.2 Lessons Learnt since June 2002

Additional lessons learnt since June 2002 are as follows:

Monitoring of Field Activities

The discovery that CGSD field teams had not used the proper numbering system for the 3rd Order control points in the pilot barangays has highlighted the need to monitor activities to ensure that they are in compliance with the procedures and to initiate appropriate checking procedures.

CGSD Capabilities

To maximise productivity and to ensure that it reliably achieves accurate results, CGSD should ensure that its GPS operations are supported by the appropriate level and quality of ancillary equipment and that all equipment is properly maintained.

CGSD must properly supervise its field operations to ensure that they comply with established procedures.

Although the national geodetic agency, CGSD lacks the necessary expertise in the area of geodetic adjustments. Personnel responsible for adjustments require further training and supervised work experience.

The continuing failure of CGSD to complete the control activities in Quezon City in a timely manner highlights the problems that a long term LAMP is likely to encounter if it relies on CGSD for all control activities.

Validation of Adjusted Data

PIO2 cannot rely on CGSD to produce the final coordinates for the 3rd Order control points in Quezon City without some technical assistance to validate the quality of the adjustment.

6. PARTNERSHIP BUILDING WORKSHOP

The "***LAMP Partnership Building Workshop with Geodetic Engineers & DENR Surveys Personnel"*** was held in Leyte on 10th & 11th November 2002. The workshop sought to:

- Provide a better understanding of the project, particularly in relation to PIO1; and
- Develop a framework for participation relevant to LAMP policy reform agenda as well as technical approaches and innovations

Although held in Leyte and some of the matters presented and discussed were specifically concerned with PIO1, many of the control survey issues are relevant to PIO2 and any expanded and long term LAMP.

As part of the proceedings, the Adviser delivered a presentation titled, "***Implications for Geodetic Control Requirements of adopting alternative Cadastral Survey Techniques"***. The participants were divided into discussion groups to consider some of the alternative approaches suggested by the technical advisers on: systematic adjudication, cadastral surveying and control surveys. They were to focus on *"Agreements, Apprehensions and Recommendations on Options and Alternative Approaches"*.

A summary of the output from the group considering "Control Survey" matters is attached as *Appendix 5*. This summary was prepared by PIO1 and is a correct transcript of the material provided by the group.

The Adviser has edited the transcript in *Appendix 5* to provide clarification and expand on some points as the adviser considered appropriate. A copy of the edited transcript was transmitted to several members of the discussion group for their comments. Mr Reynaldo Adorador, Vice President, Certeza Surveying, provided a written response. Taking these comments into account, the Adviser has made some small changes to the edited transcript and this is included as *Appendix 6*.

The output of the group is briefly summarised below:

6.1 Spacing of Control

It was hoped that the group discussion would focus on the various spacing options for geodetic control which essentially are as follows for rural areas:

- 30km 1st Order Specifications
- 5-7km 2nd Order Specifications
- 2km 3rd Order Specifications

The group didn't comment on these options in their output but apparently all the responses were based on the premise that the geodetic network should be densified to a spacing of 2km in rural areas. This was confirmed by two participants, Mr Adorador and Mr Eduardo Sarmiento of Thetan Computerized Mapping.

6.2 Densification

The group suggested the implementation of a National Densification Program with appropriate funding support, under an Inter Agency Task Force (IATF). All control points not already included in the national geodetic network, including points established by other agencies and the private sector to be incorporated into the network.

The group mentioned DENR AO 22 and suggested that it should be reviewed and amended. Later investigation has revealed that they were referring to DENR AO 94-22 which has been superseded by DENR AO 98-12 and DENR AO 98-48.

6.3 Permanency of Points

The group suggested that all 3rd Order and higher control points, whether established by government or private sector should be properly monumented in accordance with national standards set by the IATF.

6.4 Maintenance of Control Points

The group suggested that NAMRIA should be responsible for maintaining the network, including the re-establishment of disturbed/destroyed control points, under the proposed densification program., with appropriate funding for these activities. Those disturbing/destroying monuments to be penalised.

6.5 Interconnection of Control Points

The group supported the re-establishment of destroyed BLLMs and the incorporation of all BLLMs into the national network.

6.6 Appropriate Methodologies

The group suggested the revision of procedures for densification, and incorporation in the Manual of Land Surveys, the objective being to update/upgrade the GE profession. It was further suggested that NAMRIA should be the sole authority for evaluation and verification of GPS data.

6.7 Geodetic Database

The group suggested that NAMRIA should maintain the database under a memorandum of understanding with other agencies and appropriate funding. The database should be regularly updated and made accessible to all GEs and regions via electronic means.

7. PIO2 CONTROL SURVEY WORKSHOP

The "***Survey Control Workshop"*** was held in Quezon City on 25th November 2002. Project staff, technical advisers, NAMRIA and representatives of the public and private sectors, and academic institutions participated in the workshop. The workshop sought to:

Share the experiences of LAMP in control establishment activities with the concerned agencies.

Review, comment on the draft proposal by the different agencies and private practitioners as well as institutions.

Solicit inputs from the participants based on their experiences and current practices.

Start building the awareness and consensus among agencies on survey control establishment.

A copy of the workshop proposal is attached as *Appendix 7*.

As part of the proceedings, the Adviser delivered two presentations titled: "***Geodetic Control Approach & Procedures Developed for PIO2"*** and ***"Geodetic Control Other Issues for PIO2"***. Comments and suggestions were sought from the participants in the following areas:

7.1 Feedback Sought

DENR AO 98-12

What are the realities of existing control established to support cadastral surveying, in respect to?

BLLMs

Political boundaries

Primary project control

Consider matters such as:

Density (or spacing of marks)

Specifications

Any other comments in relation to AO98-12.

Quezon City – Survey Situation

The survey situation in Quezon City, had it been summarised correctly?

Any additional information?

Proposed Control Spacing

Comments were sought on the proposed 1km spacing of monumented control points in urban areas.

How will it affect future survey operations?

Advantages & disadvantages of control at 1km spacing.

Feasibility of connecting all cadastral surveys to a minimum of two and preferably three such control points.

Any other suggestions.

Other Issues

Survey Mark Maintenance

Accessibility

National Geodetic Database

EDM & Equipment Calibration

Training & Education

Guidelines for GEs in pilot areas.

Consultation Strategy.

7.2 Feedback

Limited feedback was received concerning the above. A summary of the feedback has been prepared by the Adviser in consultation with Eng. Pereira, Head CIM Unit. It is attached as *Appendix 8*. The main points to arise are:

Quezon City

The participants confirmed that there have been no political boundary surveys within Quezon City and indicated strong support for the survey of all political boundaries.

Mark Spacing

Referring to the suggestion for densification to 1km in urban areas and 2km in rural areas, clarification was sought on how locations would be designated as urban or rural areas.

It was suggested that it may be appropriate to consider a greater density of marks in some urban areas such as the pilot barangays with very dense settlement, and where traverse legs would be very short.

Several participants expressed strong support for establishing pairs of marks (ie azimuth marks, a requirement under AO98-12).

Training & Education

The National GEP Board has recently discussed the variation between the content of the undergraduate GE courses and the Licence/Board Exams. They are planning to sponsor a conference of Heads of GE Schools and GEP to consider this matter. They sought assistance from the project in this matter.

Coordination of existing control points

There was support for coordination of all existing control points (BLLMs, MBMs etc).

7.3 Report on Proceedings

PIO2 staff have prepared a report on the proceedings of the workshop which is attached as *Appendix 9*.

8. EVALUATION OF ALTERNATIVE SURVEY CONTROL METHODS

The International Land Parcel Mapping Adviser, with some assistance from the Survey Control Adviser, has identified the various Cadastral Survey Techniques that may be appropriate on a long term LAMP. These are listed in *Appendix 2 - Survey Methods for Cadastral Surveys*. The recommended methods are listed at the end of *Appendix 2*. These methods cover both urban and rural situations. For a detailed discussion and evaluation of these methods refer to the International Land Parcel Mapping Adviser's report, ***"Cadastral Surveys & Cadastral Index Mapping as part of Activity 22".***

Of these techniques, it is suggested that only the three traversing methods and differential phase GPS will provide the accuracies necessary for surveys in urban areas where land values are high and lot sizes are small.

The International Land Parcel Mapping Adviser has also identified the various CIM production methods. They are presented in *Appendix 3 Advantages & Disadvantages of CIM Production by Various Methods.* For a detailed discussion refer to his report.

In turn the Survey Control Adviser has identified the appropriate geodetic control requirements to support the recommended cadastral techniques and CIM production methods. These are to be found in *Appendix 4 – Geodetic Control Methods – Advantages & Disadvantages.*

In addition the geodetic control requirements to support the production of base mapping, whether from aerial photography or satellite imagery, have been identified.

A discussion of the various options for geodetic control follows:

8.1 Mapping Control

See *Appendix 4 – Geodetic Control Methods – Advantages & Disadvantages, Table 3* for the details and the various advantages and disadvantages.

The only real option for establishing photo/imagery control for large scale mapping is to use GPS differential phase observations, possibly supplemented by total station traversing. However it is considered unlikely that traversing would be required on more than rare occasions as the selected identifiable photo/imagery control points should in most cases be suitable for GPS observation.

The preferred GPS method would be by fast static observations from two reference stations within about 5-7km of the individual control points. This provides for the most efficient use of the GPS resources. As a general rule a minimum of three dual frequency P code receivers would be required, one as the reference receiver and the other two as rovers. If there are very many control points, additional rover receivers could be deployed.

In summary, the requirement for monumented control is a 2nd Order network at approximately 5-7km spacing to support mapping control.

8.2 Cadastral Survey Control

As mentioned above, the only suitable survey options in urban areas are the three traversing methods and differential phase GPS. See *Appendix 4 – Geodetic Control Methods – Advantages & Disadvantages, Table 1* for the details and the various advantages and disadvantages.

GPS differential phase will meet the necessary accuracy requirements but there are two drawbacks. First, most GEs do not have access to GPS and second, in many urban situations where there is high density, multiple storey development and possibly tree cover, GPS would not be very practical.

The traversing options are seen to be the most likely survey techniques in urban areas for some time to come. To properly control traversing, it is necessary to have a network of accessible control points. Surveys should be connected to a minimum of two and preferably three control points to provide adequate control on position, orientation and extent of individual surveys.

The specification for the control established in Quezon City was to place marks at approximately 1km spacing across the pilot barangays. Marks are not placed in pairs to provide a starting azimuth for surveys.

It was suggested at the PIO2 Survey Control Workshop that consideration should be given to more dense control in some urban areas. There is justification for this in very closely settled areas, where streets have few long straights, the terrain is hilly and it is difficult to establish and observe reasonable length traverse legs. In such situations, the time taken to connect to three control points would be considerable and there may be a temptation to avoid adequate connection. By providing monumented control at a closer spacing, it should ensure that the quality of surveys is maintained.

The practice in establishing the 3rd Order Network throughout the urban areas of South Australia is that the maximum spacing of marks is 250m. In situations where streets are short, with many corners and in hilly terrain, marks are established at a much closer spacing. The provision of such dense control has dramatically increased the quality of cadastral surveys in South Australia.

The issue of establishing control in pairs to provide a starting azimuth is contentious. Some GEs at the PIO2 Survey Control Workshop expressed strong support for establishing intervisible pairs. Such a practice would effectively double the number of control points.

The common survey practice has been to start from a pair of control points, eg a pair of BLLMs in areas where they are established which might be only a hundred metres or so apart and to run long traverses to the site of the survey. This practice is inappropriate and provides inadequate control on position, orientation and extent of surveys. By not providing pairs of control points, GEs will be compelled to traverse to the next control point.

GEs are concerned that they will not have a starting azimuth for their surveys as they are unfamiliar with the proposed technique. However the method of traversing between control points and then calculating the azimuth is actually quite simple, once it is understood. This technique is commonly used by surveyors in Australia. To make it easier, the International Land Parcel Mapping Adviser has written some software that will swing a traverse between coordinated points onto PRS92. It is intended that this software should be freely available to the survey profession. However, it is important that GEs understand the process very clearly before they start using the software.

It is suggested that in urban areas, control points should be established at a maximum spacing of 1km. In establishing control points in a particular area, consideration should be given to the nature of the area. In areas where either streets are short, there are many short straights between bends, there is high density development, or hilly terrain consideration should be given to establishing control points at a reduced spacing. Each area should be treated on its merits.

8.3 Control for CIM Production

See *Appendix 3 - Advantages & Disadvantages of CIM Production by Various Methods*, for the various CIM production methods.

See *Appendix 4 – Geodetic Control Methods – Advantages & Disadvantages, Table 2* for the various geodetic control requirements to support CIM production.

Where direct survey of boundary features is required as happened in the two barangays of Batasan Hills and Holy Spirit in Quezon City, the preferred methods of providing the control would be by GPS. In Quezon City, CGSD used differential phase techniques as they were using Trimble geodetic receivers. An alternative would be to use differential code GPS. Although much lower in accuracy, the accuracies attainable with this technique of +/-0.5 to 1.0m would be quite acceptable for CIM control.

The procedures developed for establishing control for CIM production, as documented in the ***"Manual for Densification of the Geodetic Network to Support Land Records Management & Cadastral Surveying",*** are based upon the use of differential phase GPS. In the event that differential code techniques are to be used, it would be necessary to develop the appropriate procedures.

The control requirements to support differential code observations are minimal. All that is required is control within about 30km for a differential base station.

If differential phase observations were to be used, control would be required at about 5-7km spacing to support fast static observations.

8.4 Value of a Geodetic Network

In considering the recommended control options for urban areas, the various project requirements for control must be considered. As importantly, some other issues should also be considered.

Some of the following comments are based on material in ***"The Use and Value of a Geodetic Reference System"*** *by Earl F. Epstein and Thomas D. Duchesneau at the University of Maine, 1984.*

A geodetic network is the basic spatial framework for the control and integration of surveys, mapping and all land related information. A national geodetic network is a fundamental component of a nation's infrastructure. It is not an end in itself, but derives a benefit by providing valuable support for other processes.

Its value lies in the ability to integrate any number of different data sets, provided that the different data sets are spatially based on the same geographic reference system by adequate connection to a homogeneous geodetic network. To enable adequate geo-referencing, the network must be of sufficient quality to ensure accuracy, and be spaced such that surveyors can readily connect their surveys.

In the absence of such an accessible network, users must provide their own connection to more sparse control, usually of a higher order, if their surveys, projects or data sets are to be accurately positioned on the same reference framework. This leads to duplication of the measurement process by all organizations needing to inter-relate data sets. Such duplication results in an economic cost to the community in the long term, although there might be short term savings. An adequate and easily accessible geodetic network therefore provides long term efficiency.

The avoided costs could be quite considerable, effectively amounting to the cost of remeasuring the network several times over without gaining any benefit. In addition there is the risk that different data sets may effectively be on different and unrelated reference systems, thus preventing their integration.

Investigations into the value of a geodetic network were undertaken in the United States of America and detailed in ***"The Use and Value of a Geodetic Reference System"***. It endeavored to quantify the avoided costs resulting from network availability through analysis of case studies. The case studies included projects involving: land use and development plans; watershed and related water studies; and construction of capital works, in particular highway construction. The study concluded that the ratio of benefits to costs from the network were in the range of 1.7 - 4.5 to 1. The study suggested that these figures were conservative due to the unavailability of some data relevant to the study.

An accurate, accessible and homogeneous geodetic network is therefore a major national resource. Through a well maintained network of control points, the position of surveys, engineering works, physical features and all land related information can be easily determined in the national reference system. In turn, these data sets can be easily and economically integrated for the overall benefit of the community.

In summary, the national geodetic network should be seen as a valuable national resource that will repay its establishment costs many time over.

8.5 Overall Recommendations

In considering the recommended control option for urban areas, one must consider all the various requirements for control discussed above. To meet all the requirements it is necessary to select the option that needs the most dense control.

It is recommended that:

- *In urban areas, 3rd Order control points should be established at a maximum spacing of 1km. In establishing control points in a particular area, consideration should be given to the nature of the area. In areas where either streets are short, there are many short straights between bends, there is high density development, or hilly terrain, consideration should be given to establishing control points at a reduced spacing. Each area should be treated on its merits.*
- *Control points are not established as intervisible pairs.*
- *To support control of the 3rd Order points, 2nd Order control should be established at approximately 5-7km spacing. These 2nd Order points will be used as reference stations for fast static GPS control.*

9. STRATEGY FOR CONSULTATION

Until very recently there has been very little consultation with individuals or organisations outside the project on survey control matters. In the ***"Final Report on Survey Control Activities as part of Activity 13",*** a recommendation was made for consultation with GEP in relation to surveying and mapping matters on LAMP.

During November there have been two workshops involving GEP members and others from the broader surveying community, including the academic sector. These workshops have started the consultation process and have been valuable in laying the foundations for a cooperative approach. There is little doubt that a long term LAMP will require considerable surveying and mapping activities and will involve the overall surveying community, not just those from the government sector.

It is therefore important to develop a strong cooperative working relationship with the private sector, other government agencies and academic sector for consultation on a broad range of matters related to surveying and mapping.

It is recommended that:

- *The project establish a consultative group comprised of: senior project GEs from PMO, PIO1 & PIO2, TAs who are surveyors, GEP representatives, academic representatives (from GE schools) and representatives of other government agencies involved in surveying and mapping activities. The consultative group should meet regularly to discuss matters of interest.*

10. OTHER MATTERS

There are a number of other issues, most of which were raised in the ***"Final Report on Survey Control Activities as part of Activity 13"*** that are still relevant and it is worth repeating them here. All these matters should be considered as topics for discussion with the proposed consultative group.

10.1 Guidelines for Geodetic Engineers to connect to PRS-92 control

The establishment of a network of monumented control points within the pilot barangays should meet the future requirements of GEs working in these areas for survey control. For the first time they will have a network of accessible, accurate and homogeneous control as the basis for controlling the position, orientation and scale of surveys. The connection of surveys to this network will facilitate the plotting of surveys on the CIM.

It is recommended that:

- *Guidelines be developed for surveyors working in the pilot barangays to ensure that all surveys are connected to the two nearest and preferably three control points.*

10.2 Mark Maintenance Issues

Third order control points are being established throughout the pilot barangays for the control of all future surveys. No consideration has been given to the ongoing maintenance and protection of these marks. It is important that steps are taken to protect these marks before any are damaged or destroyed.

Within PIO1 an instruction has been prepared regarding the placement and maintenance of survey marks. However this is not regarded as sufficient to ensure the long term protection of the marks, nor does it address the urban situation. A recommendation has been made regarding a full study into mark maintenance. It would be appropriate to extend the study to cover not only Quezon City but the whole country.

The issues that should be considered in the development of a mark maintenance program are:

(i) The specifications for construction of survey marks;

(ii) The witnessing of survey marks (placement of physical structures that mark the location and provide some protection);

(iii) The preferred locations for survey marks;

(iv) Consultation with utility/construction agencies and local authorities to obtain clearances for the selected locations and to ensure that the proposed monuments are not likely to be disturbed by their construction activities in the near future;

(v) Ongoing cooperation with utility/construction agencies and local authorities to ensure that after survey marks are constructed they are not likely to be disturbed in the long term by construction activities;

(vi) Education of local officials and residents to ensure that they understand the significance and value of survey marks;

(vii) The need for realistic penalties to discourage damage or destruction of survey marks.

(viii) Accessibility problems for the survey teams highlights the absence of a law allowing geodetic engineers and assistants, whether government or private, to enter property to carry out legitimate survey operations.

It is recommended that:

- *Consideration should be given to a full study to develop a comprehensive national mark maintenance program.*
- *As part of a mark maintenance study, the issue of accessibility to property to carry out surveys should be considered. Appropriate provisions should be included in any future Survey Act.*

10.3 EDM Bases and Equipment Calibration

The existing EDM base at the University of the Philippines is inadequate for the proper calibration of modern EDM equipment and is not accessible to the broad surveying community across the entire country. Given the capabilities of modern survey equipment there is the need to properly and regularly calibrate EDMs over a 1 kilometre (7 pillar) base and a cyclic error base.

The optical plummet of a tribrach is critical for the centring of instruments, targets and antennae over ground marks. They must be kept in a state of adjustment and should be checked regularly. The best method of checking is with a tribrach tester.

It is recommended that:

- *Suitable and accessible EDM bases, to recognized world standards, should be established within each region.*
- *Tribrach testers should be purchased and installed within each region and should be accessible to the general surveying community.*

10.4 Geodetic Data Base

CGSD is in the process of acquiring appropriate software for an updated Geodetic Database but the issues of updating the database, from the regions as control is established, and accessibility to the database from the regions for all potential users, have not been properly addressed.

These issues should be addressed as updating the database and accessibility to control data are critical issues for the long term LAM program.

It is recommended that:

- *The issue of accessibility to the CGSD Geodetic Database to update data and to obtain control information should be investigated and addressed.*

10.5 Regulation of Surveying

The *"Revised Manual of Land Surveying Regulations in the Philippines"* or *DENR AO 98*-12 is considered to be outdated and inappropriate. It is overly prescriptive and it has been said that in places it is like a text book of surveying.

A long term LAMP will rely very heavily upon the survey profession for the survey and mapping activities necessary to support land titling and land records management. To enable the surveying profession to meet the ongoing needs of a long term LAMP very substantial reforms of survey practices are required. It is suggested that AO 98-12 should be replaced. It is further suggested that there is a need for a modern Survey Act and Regulations to control the profession and a Manual of Survey Practice with specifications and guidelines for cadastral surveys, plan preparation etc.

This is the type of model used in South Australia and it is suggested that the assistance of an Australian with expertise in this field, should be sought.

There is also a need for a publication containing geodetic specifications, and guidelines for control surveys.

It is recommended that:

- *There be a full study into the control and regulation of surveying in the Philippines and that an appropriate legislative and regulatory framework is established to modernise the practice of surveying.*
- *As part of the study draft legislation and regulations should be developed in consultation with the appropriate survey authorities and GEP.*

10.6 Training

To ensure the success of the proposed long term LAMP, it will be necessary for GEs to upgrade their skills and modernise their equipment and techniques so that they can provide an efficient and effective response to the project's survey and mapping requirements.

10.6.1 GPS

Any large scale densification of the geodetic control network will be dependent upon the use of GPS technology. GPS has the proven capability to rapidly and efficiently extend geodetic control and provide the high levels of accuracy demanded. A major limitation on the effective use of GPS relates to the knowledge and skills of those using it.

Like any black box technology, it is very powerful but unless it is used appropriately it is also very dangerous technology. When geodetic surveys were observed with high precision traditional survey equipment and the calculation processes were long, difficult and tedious, untrained persons did not attempt geodetic surveying. However using GPS technology it is not difficult to operate the equipment and get some results from the baseline processing software. The results are displayed to a number of decimal places, implying high precision, and many people can be fooled into believing GPS surveying is easy. It is critical that practitioners have a good understanding of GPS, data

processing, adjustment and data analysis and use the appropriate procedures if they are to produce reliable results.

To ensure that the technology is employed properly and that the results are reliable it is imperative that GPS practitioners have comprehensive training. GPS is three dimensional geodetic surveying. Therefore as a prerequisite for training and future use of the technology, GPS surveyors should have a good background in geodesy and adjustments.

Experience in a number of organisations and countries highlights the main requirement for effective GPS training to support sustainable GPS operations. The necessary expertise cannot be acquired over a short period so the training must be delivered over a long period of GPS operations. This is particularly so where the trainees start from a low knowledge base in the areas of geodesy and adjustments.

10.6.2 Total Stations

There is also an urgent need for the survey profession to upgrade its capabilities in other modern survey techniques. GEs should replace the "Transit & Chain" with "Total Stations" and adopt computerisation and the powerful software that can be used to process the data recorded by total stations. The project is actively promoting the use of total stations for its surveys. GEs should be educated on the benefits of upgrading their equipment and provided with comprehensive training on the use of modern equipment and data processing.

10.6.3 Assessment of Formal Training

An assessment was made of the formal training situation in relation to survey education as part of the Adviser's earlier reports. A summary of the assessment follows:

Undergraduate GE Courses

The existing GE undergraduate courses are seen to be inadequate to produce graduates with the necessary education in higher surveying, and modern survey techniques and instrumentation. The universities are poorly equipped to give students adequate exposure to modern survey equipment and techniques, and most academic staff lack expertise in these areas. This problem is even more acute at regional universities.

A long term LAMP will need many well educated GEs capable of effectively utilizing modern survey technology for the efficient establishment of geodetic control, and the conduct of cadastral surveys for titling. There is therefore a need to upgrade the undergraduate courses.

Postgraduate GE Courses

No universities are offering postgraduate survey education. From discussions with Professor Lopez, at UP, it is clear that they do not have the capacity to provide this type of course. There is a need to develop an in-country capability to offer appropriate higher surveying/geodesy/GPS education, to enable sustainability in these areas for a long term LAMP.

Vocational Survey Training

There is no formal training or education for any of the survey staff below the geodetic engineer level. Most surveying activities rely upon sub-professional staff to set up equipment and carry out observations and many organizations rely on such staff for many of their field operations. With the introduction of modern survey equipment there is a need for appropriate training in the use and

maintenance of this equipment and general survey practices. The type of training required is at the technical or vocational level.

10.6.4 Previous Recommendations on Formal Training

A number of recommendations were made in relation to the overall long term needs of both the project and the survey industry in general. The major recommendations in relation to PIO2 and long term sustainability were:

- *The appropriateness of the existing GE courses within Philippine universities should be investigated with a view to modernising the courses to provide relevant up to date survey education.*
- *Development of in-country capability for a university to offer postgraduate studies in geodesy/GPS should be further investigated and supported as a matter of priority to provide a pool of well qualified geodetic surveyors in the academic, government and private sectors.*
- *Formal training courses should be established for "survey men" and "engineering aides" in the use and care of modern survey equipment, within technical or vocational colleges.*

10.6.5 Response to Recommendations on Formal Training

In response to these recommendations, a proposal is being prepared for survey curriculum development at each of the three levels. It is proposed that curriculum development would be undertaken in cooperation with an Australian university that offers appropriate and up to date survey education. This should see the development of modern vocational, undergraduate and postgraduate survey education to enable universities and colleges to provide relevant up to date survey education. It should include the development of the in-country capability to offer appropriate and relevant postgraduate education.

It is recommended that:

- *The curriculum development proposal is pursued to ensure that appropriate survey education and training is available at each of the three levels.*

10.6.6 Recent Developments

In recent developments, the Leyte State University (LSU) has embarked upon a program to develop and deliver a Bachelor of Science in Geoinformatics and Geodetic Engineering, commencing in academic year 2004-2005. They have been in consultation with PIO1 and have developed a "ladderised curriculum that provides for the award of certificate and diploma level qualifications for completion of parts of the course.

The interest and action by LSU in moving towards offering such a course in Leyte is commendable and could be of great benefit to the project. However the Adviser is concerned that the development of the curriculum might pre-empt the proposed national curriculum development project and that LSU is unlikely to have either the academic capacity or suitable modern survey and associated equipment.

It is important that the proposed course complies with the requirements for high quality modern and relevant survey education.

The concept of a ladderised curriculum is supported by the adviser but great care needs to be taken to ensure that it meets the needs for a vocational course, diploma and bachelors degree without too much compromise.

The Adviser is not an expert on survey courses and is reluctant to provide comment on the course content despite a request from PIO1. Advice should be sought from experts in this field. However, there would appear to be some unsuitable subjects offered over the first two years as part of the certificate qualification and a lack of technical survey subjects. In addition there seems to be too much emphasis on totally unrelated subjects.

It is recommended that:

- *The resources of the Technical Assistance HRD team be utilised to discuss this matter with LSU.*

10.7 Land Administration Authority

The *Institutional Arrangements Policy Study* has made a number of recommendations regarding a possible structure for the proposed Land Administration Authority (LAA). Comments and suggestions follow in relation to some possible sections and their functions and responsibilities for survey control matters:

Geodetic Network Section

It is suggested that a Geodetic Network Section (GNS) be created, with responsibility for the data in the National Geodetic Database (NGDB). It would be responsible for setting standards, adjusting and auditing all data in the NGDB, operation, upgrading and maintenance of the NGDB and making it accessible to the broader user community throughout the nation. It would also be responsible for all national geodetic matters such as datum maintenance and geodetic investigations. It would need sufficient copies of the latest version of the GeoLab adjustment software and data base software, anti virus software and all the support software. It would need adequate computers and internet access.

GNS would be in the Mapping & Survey Standards Division of the proposed LAA.

The operation of the NGDB may be placed under the proposed LIS Division, but GNS must be responsible for the integrity of the data.

Geodetic Control Section

It is suggested that a Geodetic Control Section (GCS) be created, with responsibility for GPS surveys for the primary and secondary network and some third order control work. It would need strong GPS and conventional survey capabilities to observe and complete minimally constrained adjustments to verify the quality of field data which would be submitted to the GNS for final adjustment and incorporation into the NGDB. The section should be well equipped with up to date GPS equipment, Total Stations, etc and all necessary ancillary equipment, and computers. Adequate latest version software must be provided for data processing (GPS and total station), GeoLab adjustment software, and anti-virus software. All software must be maintained and updated regularly and equipment must be maintained and regularly replaced. The section would need trained instrument technicians to maintain equipment and adequate storage facilities. It should be equipped with adequate boxes, bags etc to protect equipment in storage and transit. Ample suitable four wheel drive vehicles would be needed to ensure that the section can operate efficiently and they must be well maintained and allocated sufficient running expenses.

GCS would be in the Mapping & Survey Services Division of the proposed LAA.

Regional Geodetic Control Sections

Most third order control should be a regional responsibility, to be executed by Regional Geodetic Control Sections (RGCS) and by qualified private sector practitioners provided that adequate quality control is put in place. The RGCS would be responsible for the administration and supervision of contracts and the initial quality control. All data would be submitted to GNS for auditing, final adjustment and incorporation into NGDB. The RGCS would need to be equipped and funded in a similar manner to the GCS.

RGCS would also be responsible for the control requirements for mapping, and other surveys etc.

RGCS would be in the Mapping & Survey Services Division of the proposed LAA.

Mark Maintenance Sections

Mark Maintenance should be a regional/provincial/local responsibility with adequate funding at this level for a regular maintenance and education program. Properly equipped and funded Mark Maintenance Sections (MMS) should be created at one of these levels. If a provincial or local responsibility, the mark maintenance functions should be quality controlled by the RGCS.

MMS would be in the Mapping & Survey Services Division of the proposed LAA.

It is recommended that:

- *Consideration be given to the above suggestions regarding survey control functions within the proposed Land Administration Authority.*

11. RECOMMENDATIONS

A summary of the recommendations made throughout this report follows:

11.1.1 Validation of Data for Monumented Control

It is recommended that:

- *Support be provided for PIO2 in the evaluation and quality control of the adjustment of data for the 3rd Order control points.*

11.1.2 CGSD GPS Equipment

It is recommended that:

- *CGSD consider the comments regarding equipment and consider upgrading its equipment in line with these comments.*

11.1.3 CGSD Field Operations

It is recommended that:

- *CGSD provide adequate supervision of field activities to ensure that they comply with the correct procedures.*

11.1.4 CGSD Data Processing & Adjustments

It is recommended that:

- *CGSD upgrade it GPS processing software to the latest version of Trimble Geomatics Office.*
- *CGSD should purchase more copies of GeoLab so that all adjustments can be done with the same software and develop its expertise in geodetic adjustments to an advanced level, appropriate for the national geodetic agency.*

11.1.5 CGSD Response to the Project's Requirements

It is recommended that:

- *CGSD provide a prompt and efficient response to project requirements for geodetic control and that individual projects are completed without delay.*

11.1.6 Control Spacing in Urban Areas

It is recommended that:

- *In urban areas, 3rd Order control points should be established at a maximum spacing of 1km. In establishing control points in a particular area, consideration should be given to the nature of the area. In areas where either streets are short, there are many short straights between bends, there is high density development, or hilly terrain, consideration should be given to establishing control points at a reduced spacing. Each area should be treated on its merits.*
- *Control points are not established as intervisible pairs.*
- *To support control of the 3rd Order points, 2nd Order control should be established at approximately 5-7km spacing. These 2nd Order points will be used as reference stations for fast static GPS control.*

11.1.7 Strategy for Consultation

It is recommended that:

- *The project establish a consultative group comprised of: senior project GEs from PMO, PIO1 & PIO2, TAs who are surveyors, GEP representatives, academic representatives (from GE schools) and representatives of other government agencies involved in surveying and mapping activities. The consultative group should meet regularly to discuss matters of interest.*

11.1.8 Guidelines for Geodetic Engineers to connect to PRS-92 control

It is recommended that:

- *Guidelines be developed for surveyors working in the pilot barangays to ensure that all surveys are connected to the two nearest and preferably three control points.*

11.1.9 Mark Maintenance Issues

It is recommended that:

- *Consideration should be given to a full study to develop a comprehensive national mark maintenance program.*
- *As part of a mark maintenance study, the issue of accessibility to property to carry out surveys should be considered. Appropriate provisions should be included in any future Survey Act.*

11.1.10 EDM Bases and Equipment Calibration

It is recommended that:

- *Suitable and accessible EDM bases, to recognized world standards, should be established within each region.*
- *Tribrach testers should be purchased and installed within each region and should be accessible to the general surveying community.*

11.1.11 Geodetic Data Base

It is recommended that:

- *The issue of accessibility to the CGSD Geodetic Database to update data and to obtain control information should be investigated and addressed.*

11.1.12 Regulation of Surveying

It is recommended that:

- *There be a full study into the control and regulation of surveying in the Philippines and that an appropriate legislative and regulatory framework is established to modernise the practice of surveying.*
- *As part of the study draft legislation and regulations should be developed in consultation with the appropriate survey authorities and GEP.*

11.1.13 Formal Training

It is recommended that:

- *The curriculum development proposal is pursued to ensure that appropriate survey education and training is available at each of the three levels.*
- *The resources of the Technical Assistance HRD team be utilised to discuss with LSU their proposal to offer a ladderised GE course.*

11.1.14 Land Administration Authority

It is recommended that:

- *Consideration be given to suggestions in this report regarding survey control functions within the proposed Land Administration Authority.*

- *A Geodetic Network Section (GNS) be created in the proposed Mapping & Survey Standards Division.*
- *A Geodetic Control Section (GCS), Regional Geodetic Control Sections (RGCS) and Mark Maintenance Sections (MMS) be created, in the proposed Mapping & Survey Services Division.*

Appendix 1 Terms of Reference for Survey Control Adviser

TERMS OF REFERENCE

INTERNATIONAL SURVEY CONTROL ADVISER
Second Part of Long Term Assignment (2001/2002)

The PA-LAMP foreshadows a potential 15-20 year program to improve land administration in the Philippines. It is a strategic GOP initiative which aims to support an efficient land market and alleviate the present low level of confidence in the system of formal land registration and the lack of tenure security.

The Goal of AusAID assistance, through support of the TA program, is to assist the GOP to improve the effectiveness, transparency and efficiency of land administration to achieve the resultant flow of economic and social benefits in the Philippines.

The Purpose of the TA program is to assist the GOP to establish structures and operating procedures for a long term program to reform the land administration system in the Philippines.

The Survey Control adviser to the LAMP Project will work at both Prototype 1 (Leyte) and 2 (Quezon City). The exact timings will be determined month by month depending on the work needs. It is expected that more time will be spent at prototype 1.

The adviser will report administratively to the TA team leader and for work coordination with the systematic registration adviser. The survey control adviser will work closely with Project counterparts at each Project site.

The approach at all times will provide the Project with best practice, a safe working situation and be Gender sensitive. The adviser will cooperate with the members of the Quality Assurance Panel whose job it is to verify that TA outputs are of a suitable standard and completeness. To this end, the adviser shall maintain an up to date work plan and have regular review meetings with counterparts on progress, issues and changes to the plan. A monthly report will be submitted to the team leader.

This TOR addresses the second period of the assignment.

The overall objective of the assignment is to identify, describe and evaluate alternate methods for establishing survey control for the various possible types of cadastral surveys and for producing photomaps and CIMs.

The survey control is to ensure that all project surveys and all maps produced (including Cadastral Maps, CIM and photomaps / satellite image maps) are on the one uniform coordinate system so that all land information may be integrated.

Together with the land parcel mapping adviser to review the possible cadastral survey methods and describe their respective advantages and disadvantages based on overseas experience.

It is essential that a major training course be provided to counterparts.

The International survey control adviser will be responsible for completing the following work no later than 30 November 2002 (reference is the PDD and the work to be completed is described as Deliverables 21 and 22 in the AusAid – AMC contract):

1. The overall survey control task in deliverable 21 is to identify and evaluate alternate approaches and methods in control surveying to support accelerated land titling as envisioned for the next phase of LAMP. To do this the various procedures and advantages and disadvantages for each type of survey control option will be described and unit costs estimated. These methods will be compared in a suitability chart against each major type of cadastral survey (see 2 below). Similarly the control survey methods' suitability for CIM and photomap production will be analysed.
2. The alternate cadastral survey options will be identified and evaluated from overseas experience. The main options will be described in terms of the broad procedures that would be used and the implications of each on time and cost and skills needed and productivity and ease of operational deployment. This will be performed in conjunction with the land parcel mapping adviser.
3. The training program will be continued.
4. If the proposed additional one month is approved by AusAID, direct assistance shall be provided to PIO1 on additional training and support to implement the free patent test in the first Barangays of the Project.
5. The main outputs in prototype 1 are a report on the alternate survey control methods identified and their evaluation and comparison. Also required is a training evaluation and a realistic assessment of the existing capacity in PIO1 to undertake the planning, execution and computation of control surveys.
6. The overall task in prototype 2 is to assist in the identification of alternate survey methods to better support the making of the various maps required for the office and field validation processes. These maps are CIMs from the compilation of map information from various sources (DENR, Assessors, LRA) and control for aerotriangulation for orthophoto mapping. A workshop will be used to summarise the conclusions and lessons.
7. The main output in prototype 2 is a report on the alternate methods identified, the evaluation and comparison and workshops completed.

End

Appendix 2 Survey Methods for Cadastral Surveys

Survey methods identified for cadastral surveys:

- Traversing
  - Transit and chain
  - Theodolite and EDME
  - Semi Total station
  - Total station
  - Stadia
- GPS
  - Point positioning
  - Differential phase
  - Differential code
- Alternate (requiring dense control but simple differential GPS would meet the requirements)
  - optical square and chain offset
  - chaining by two distance connections
- Orthophoto & Imagery
  - hard copy, ie photo/imagery interpretation (office & field)
  - digital copy, ie photo/imagery interpretation (office & field)

Traversing

There are five methods of traversing by the use of an angle measuring instrument and using a distance measuring device, these are discussed in the following table.

METHOD	DISADVANTAGES	ADVANTAGES	RECOMMENDATIONS
Transit and Chain	• Outdated technology • Cumbersome to use • Not overly accurate • Commonly out of alignment	• Commonly found in the Philippines • Cheap to purchase	Convince the surveying profession to upgrade the profession to use modern technology that is more accurate and to discourage their use within the project, **NOT RECOMMENDED.**
Stadia	• Inaccurate over long lines • Outdated technology • Usually requires either slide rule or tables to reduce results • Cumbersome and time consuming	• Little equipment required	Discourage the use within the project due to the method being cumbersome and time consuming. **NOT RECOMMENDED**
Theodolite and EDME	• Outdated technology • Requires either an attachment to the top of the theodolite or is a separate unit • Requires more team members due to extra equipment to carry	• More advanced than a transit and chain • Accuracy is better than a transit and chain • EDME measures longer distances hence traverse lines can be longer • Quicker than the last two methods • Requires periodical servicing and calibration	If calibrated and used correctly is the cheapest form of modern technology. Suggested that the use of this type of equipment be accepted only if the following types are not available.
Semi-Total Station	• Outdated technology • Manual recording methods	• Relatively fast operation • Measuring device is part of the theodolite • Less computations to obtain results due to either measuring horizontal distances or working directly in coordinates • Reasonably priced	This type of equipment is considered better than all those above but does not have the recording capabilities of the total station.
Total Station	• Cost is higher than other types of equipment (note: the cost would be the equivalent to theodolites and semi total stations when first released) • Highly trained personnel • Requires computers	• All observations are electronically recorded • Interface with computer and software for computation of results and graphical presentation • Extremely accurate if used correctly • Very fast if used correctly	Preferred option when doing cadastral surveys by traversing. **RECOMMENDED**

GPS

METHOD	DISADVANTAGES	ADVANTAGES	RECOMMENDATIONS
Point Positioning	• Very low accuracy even with Selective Availability (SA) switched off. • SA could be reactivated at any time. • Need to make a number of observations	• Quick & efficient • Low cost of receivers • Easily used • All weather capability. • No need for intervisibility between points	• Not recommended for titling purposes due to the very low accuracy and unreliability of the method
Differential Code	• Low accuracy. • Less accurate than current survey standards in DENR AO98-12. • Unsuitable under heavy tree cover (subject to results of Macalpiay pilot test) • Data requires post-processing	• Does not require dense or particularly close geodetic control. • Short occupation times. • Relatively quick. • Efficient. • Relatively easy to use. • No need for intervisibility between points • All weather capability • Processing simpler than for Differential Phase techniques, but still requires training. • Can use medium cost GPS receivers	• If lower accuracy boundary definition is accepted, it is a possible viable alternative to the use of photomaps and the two low accuracy survey methods, particularly in open areas. (Still subject to results of pilot test to determine the acceptable level of tree cover)
Differential Phase (Relative Positioning)	• Slow in areas with some obstructions, the more obstructions, then the slower the survey. • Not possible in areas with many obstructions – heavy tree cover. • Requires geodetic network to be densified to second order standards at about 5-10 km spacing • Most methods require post processing. • Requires skilled field operators. • Requires highly skilled personnel for data processing. • Post processing can be difficult & tedious when poor data is recorded. • Extensive training required. • Expensive equipment.	• High accuracy. • Very suitable in open areas where it is quite quick. • All weather capability. • No need for intervisibility between points.	• Recommended as an alternative to Total Stations in areas with minimal tree cover (subject to test results in areas with greater tree cover), in such areas it would be more efficient, as tree cover increases it becomes less efficient and eventually not possible. • Requires lower density of geodetic control than total station traversing.

Alternate methods requiring dense control

The methods below require extensive survey control to make these viable. All methods assume that there is a controlled straight line and measurements are made along the line as well as the alternate method described.

METHOD	DISADVANTAGES	ADVANTAGES	RECOMMENDATIONS
Optical square and chain offsets	• Low accuracy • Manual method	• Simple • Quick • Cheap • Skill level low	• Recommended for use in low accuracy surveys
Two distance connections	• Low accuracy • Manual method	• Simple • Quick • Cheap • Skill level low	• Recommended for use in low accuracy surveys

Orthophoto Maps and Imagery

METHOD	DISADVANTAGES	ADVANTAGES	RECOMMENDATIONS
Overall Imagery and Orthophoto	• Overall high cost • Requires cloud free period to obtain good data • Procurement time is lengthy • Requires extensive GPS control for rectification • Requires interpretation skills • Not useful in timbered areas for small parcel identification	• All parcel detail is visible, ie buildings, fences and other occupation that is not obscured by vegetation • Relatively easy method of survey and CIM production and can be built in the field and or office depending on urban or rural situation	
Hardcopy Imagery	• See overall section • Satellite imagery resolution not sufficient for urban areas	• See overall section • Cadastral surveys and CIM can be built in the field for rural areas	Satellite imagery yet to be tested
Orthophoto	• See overall section	• See overall section • Surveys and CIM can be built in the field for rural areas • In urban areas little field verification is required	Test has only been done on two orthophoto maps that have been procured outside of NAMRIA (note the resolution was not of a good quality). This method has been used successfully in both Thailand and Laos, and would be ideal for both urban and rural areas within the Philippines especially in urban areas where there has not been an official cadastral survey.
Digital Imagery	• See overall section • Very large image files • Requires computers • Requires more highly skilled personnel	• See overall section • Surveys and CIM can be built in the field • GIS/digital model can be easily produced • Individual lot survey plans can be digitally produced	Requires testing in rural areas. In use in developed countries for large property identification, ie Australia
Orthophoto	• See overall section • Very large image files • Requires computers • Requires more highly skilled personnel	• See overall section • Surveys and CIM can be built in the field • GIS/digital model can be easily produced • Individual lot survey plans can be digitally produced	Requires testing in both urban and rural areas

The recommended practices for cadastral surveys are:

- Traversing
    - Theodolite and EDME
    - Semi Total station
    - Total station
- GPS
    - Differential phase
    - Differential code
- Alternate (requiring dense control)
    - optical square and chain offset
    - chaining by two distance connections
- Orthophoto & Imagery
    - hard copy, ie interpretation(still to be tested);
    - digital copy, ie interpretation (still to be tested).

Appendix 3 Advantages and Disadvantages of CIM Production by Various Methods

CIM Method	DISADVANTAGES	ADVANTAGES
Manual (building from survey plans)	• Slow depending on materials available for compilation • Not feasible without control • Survey plans are not always at the CIM scale	• Low technology • Minimal training • Basic Materials and equipment needs
AutoCAD / Microstation (Digitising)	• Expensive to purchase • Requires computers • Requires control of some description • AutoCAD works on a plane system • Highly qualified operators	• Capability of producing the entire CIM within the computer environment • Can be imported into a GIS • Easily updated
Scanning and Vectorising	• Expensive to purchase • Requires computers • Vectorising requires skilled operators	• Produces a digital model • Can transform existing data onto a new datum • Added advantage of archiving data
GPS (Processed Data) (ie using the same electronic data that was used in the construction of the cadastral maps)	• Depending on the equipment cost can be high • Highly skilled personnel required if using the data in computerised environment • Requires computers and specialised survey software	• Can be built digitally • Relatively quick to produce • Field data can be digitally manipulated within the software environment and CIM automatically produced
Total Station (ie using the same electronic data that was used in the construction of the cadastral maps)	• High cost of equipment and traversing • Requires computers and specialised survey software • Requires highly trained personnel	• Can be built digitally • Field data can be digitally manipulated within the software environment and CIM automatically produced • Relatively quick and accurate
Orthophoto Map (office interpretation)	• High cost of orthophoto map production and associated control • Not the same scale in urban areas where the parcels are small • Requires light tables • Photo interpretation skills required	• Easy to produce • Usually the same scale as the CIM • On the datum of the project • The added advantage of seeing what is on the ground
MapInfo (Heads Up Digitising)	• Requires a digital image, ie either orthophoto, satellite or scanned survey plans • Requires computers and software • Requires highly trained personnel • Not yet tested	• Capability of producing the entire CIM within the computer environment • Seamless map that can be used as the base for a GIS • Fast, efficient and easily updated • Direct link to the textual database of land records • Ideal for front desk of OSS as a GIS • Not yet tested
Satellite Imagery	• Not suitable for urban areas • High cost of imagery • Not yet tested	• Not yet tested
Others survey methods as depicted in survey methods	• Not a congenial environment for drafting (field)	• Can be done in the field at the same time as the survey • Simple and efficient

Appendix 4 Geodetic Control Methods – Advantages & Disadvantages

Table 1

Cadastral Survey Method	Geodetic Control Requirements	Method of Establishing Geodetic Control	Advantages	Disadvantages
Traversing:	3rd Order control at maximum 1km spacing.	GPS differential phase from 2nd Order control within 5-7km, supplemented by Total station traversing.	Relatively high density of control points as part of the national geodetic infrastructure, creates reasonably accessible network for all future survey and mapping purposes. High accuracy. Provides good control of cadastral surveys. Accuracy of network comparable with accuracies achievable using modern survey equipment.	Large undertaking to establish control. High cost. Needs many highly qualified and trained survey personnel, particularly for the planning, supervision, data processing and adjustment. Expensive GPS equipment Long lead time - control must be established long before it is required, suggest commencing control activities 1 year before data is required. Network must be maintained.

Table 1				
Cadastral Survey Method	**Geodetic Control Requirements**	**Method of Establishing Geodetic Control**	**Advantages**	**Disadvantages**
GPS Differential Phase:	1st, 2nd or 3rd Order control within 5-7km (min 2 pts).	GPS differential phase	Medium density control. Control at more accessible density than available at present More moderate cost of establishing control. More moderate undertaking.	Needs a significant number of highly qualified and trained survey personnel, particularly for the planning, supervision, data processing and adjustment. Expensive GPS equipment Still significant lead time - control must be established long before it is required, suggest commencing control activities 6-12 months before data is required. At this spacing, surveyors will still be reluctant to make adequate connections to the geodetic network to properly control their surveys unless they have GPS capabilities. Organisations compelled to provide own control in piecemeal non-coordinated manner for future projects. Possible that survey and mapping activities will continue to be on local datums and be incompatible Network must be maintained.

Table 2				
Method of CIM Production	**Geodetic Control Requirements**	**Method of Establishing Geodetic Control**	**Advantages**	**Disadvantages**
From survey plans: Connection of survey plans to PRS-92 control, unless plans already on PRS-92 Direct GPS connections to identifiable boundary points with Differential code GPS from existing control within 30km.	1st, 2nd or 3rd Order control within 30km.	GPS differential phase	Low density control. Much lower cost than other options. Least time required for establishing control over a large area.	Very little control for future survey and mapping activities. Control at the same or slightly higher density than at present. Control only really accessible to surveyors with GPS equipment, not conventional survey equipment and techniques. Organisations compelled to provide own control in piecemeal non-coordinated manner for future projects. Possible that survey and mapping activities will continue to be on local datums and be incompatible.

Table 2				
Method of CIM Production	**Geodetic Control Requirements**	**Method of Establishing Geodetic Control**	**Advantages**	**Disadvantages**
GPS survey of boundaries (Differential code):	1st, 2nd or 3rd Order control within 30km.	GPS differential phase	Low density control. Much lower cost than other options. Least time required for establishing control over a large area.	Very little control for future survey and mapping activities. Control at the same or slightly higher density than at present. Control only really accessible to surveyors with GPS equipment, not conventional survey equipment and techniques. Organisations compelled to provide own control in piecemeal non-coordinated manner for future projects. Possible that survey and mapping activities will continue to be on local datums and be incompatible.

Table 2				
Method of CIM Production	**Geodetic Control Requirements**	**Method of Establishing Geodetic Control**	**Advantages**	**Disadvantages**
GPS survey of boundaries (Differential Phase):	1st, 2nd or 3rd Order control within 5-7km (min 2 pts).	GPS differential phase	Medium density control. Control at more accessible density than available at present More moderate cost of establishing control. More moderate undertaking.	Needs a significant number of highly qualified and trained survey personnel, particularly for the planning, supervision, data processing and adjustment. Expensive GPS equipment Still significant lead time - control must be established long before it is required, suggest commencing control activities 6-12 months before data is required. At this spacing, surveyors will still be reluctant to make adequate connections to the geodetic network to properly control their surveys unless they have GPS capabilities. Organisations compelled to provide own control in piecemeal non-coordinated manner for future projects. Possible that survey and mapping activities will continue to be on local datums and be incompatible Network must be maintained.

Table 2				
Method of CIM Production	**Geodetic Control Requirements**	**Method of Establishing Geodetic Control**	**Advantages**	**Disadvantages**
Total Station survey of boundaries:	3rd Order control at maximum 1km spacing.	GPS differential phase from 2nd Order control (5-7km spacing), supplemented by Total station traversing	Relatively high density of control points as part of the national geodetic infrastructure, creates reasonably accessible network for all future survey and mapping purposes. High accuracy. Provides good control of cadastral surveys. Accuracy of network comparable with accuracies achievable using modern survey equipment.	Large undertaking to establish control. High cost. Needs many highly qualified and trained survey personnel, particularly for the planning, supervision, data processing and adjustment. Expensive GPS equipment Long lead time - control must be established long before it is required, suggest commencing control activities 1 year before data is required. Network must be maintained.
Orthophoto & Imagery:	Control only required for base map production. (see table 3)	See table 3		

Table 3				
Base Map Production	**Geodetic Control Requirements**	**Method of Establishing Geodetic Control**	**Advantages**	**Disadvantages**
Orthophoto Maps: & Satellite imagery:	GPS differential phase observations to identifiable Photo or imagery control points	GPS differential phase from 2nd Order control (5-7km spacing), supplemented by Total station traversing	Monumentation not required for photo/imagery control points, as on identifiable features. Faster than providing monumented control. In the event that the selected photo/imagery points are considered to be suitable for permanent monumentation, they may be monumented for possible future use. Medium density control. Control at more accessible density than available at present More moderate cost of establishing control**.** More moderate undertaking.	Most photo/imagery control points established for one off use and will be of little future benefit. Needs a significant number of highly qualified and trained survey personnel, particularly for the planning, supervision, data processing and adjustment. Expensive GPS equipment Still significant lead time - control must be established long before it is required, suggest commencing control activities 6-12 months before data is required. At this spacing, surveyors will still be reluctant to make adequate connections to the geodetic network to properly control their surveys unless they have GPS capabilities. Organisations compelled to provide own control in piecemeal non-coordinated manner for future projects. Possible that survey and mapping activities will continue to be on local datums and be incompatible

Appendix 5 Partnership Building Workshop - Output

Workshop 2: **Agreements, Apprehensions and Recommendations on Options and Alternative Approaches**

Group 3: Former Directors/CENROs or Contractors
Presenter: Engr. Randy Vicente, *President, GEP Regional Div. NCR*

Option	Strategic Direction	Action/Recommendation
1. Densification (Hasten)	1. Previously established shall be formed part of the NGCN 2. Funding support for NDP 3. Amend DAO 22 4. Points established by private sectors be included in NGCN	1. Inventory of previously established points 2. Draft the NDP thru the IATF 3. Review the DENR AO 22 4. Issue a policy requiring private GEs to submit data on CPs
2. Permanency of Points	1. All 3rd order or higher accuracy established by government agencies should be marked permanently for easy recovery 2. Markers be in accordance to national standards 3. Setting of national standard monumenting/procedures/location	1. Revise existing guidelines 2. Re-issue existing guidelines 3. Convene an IATF to draft the standards
3. Proper Maintenance of Geodetic Control Points	1. NAMRIA to be responsible in maintaining the control points 2. To penalize offenders / whoever disturbs/demolishes the points 3. NAMRIA to re-establish demolished/disturbed points 4. To enforce AO on monument recovery	1. Strengthen NAMRIA units concerned with funding back up 2. To issue policy RE: disturbance/demolition 3. Include in the NDP with adequate funding support 4. Re-issue/amend certain provisions
4. Interconnection of Control Points	1. To enforce the policy on interconnection of points established by other agencies	1. Re-issue/amend policy 2. Inventory of all BLLMs 3. Issue order creating the IATF (LMB, NAMRIA, LRA,

Option	Strategic Direction	Action/Recommendation
	2. All BLLMs be relocated/re-established to form part of the network 3. To create an inter-agency task force	NCIP, DPWH, DAR, PNOC, NPC, NIA, GEP, and other entities)
5. Appropriate Methodology/S.O.P.	1. Revise/amend the methods/procedures and incorporate/integrate/include in the MLSP 2. NAMRIA as the sole authority for the evaluation/verification of data observed using GPS 3. GE to endorse survey returns	1. Amend MLSP 2. Re-issue/amend existing polic(ies) 3. Issue order incorporating GE endorsement as part of the survey returns
6. National Geodetic Control Network Database	1. NAMRIA to maintain the database 2. To update the database on a regular basis 3. Be made accessible thru electronic means	1. Formulate joint MOA with other agencies and provide additional funding 2. Collect relevant information from other agencies and stakeholders 3. Include in the website of NAMRIA including e-payment system

Appendix 6 Partnership Building Workshop – Edited Output

Workshop 2: **Agreements, Apprehensions and Recommendations on Options and Alternative Approaches – Edited by Control Survey Adviser**

Group 3: Former Directors/CENROs or Contractors
Presenter: Engr. Randy Vicente, *President, GEP Regional Div. NCR*

Option	Strategic Direction	Action/Recommendation
1. Densification (Hasten)	1. Previously established control points not already incorporated shall be part of the National Geodetic Control Network (NGCN) 2. Funding support for a National Densification Program (NDP) 3. Amend DAO 22 4. Points established by private sector to be included in NGCN	1. Compile inventory of previously established points, validate and classify. 2. Draft the NDP thru the Inter Agency Task Force (IATF) 3. Review the DENR AO 22 4. Issue a policy requiring private GEs to submit data on Control Points
2. Permanency of Points	1. All 3rd order or higher accuracy control points established by government agencies and qualified private survey companies should be marked permanently for easy recovery 2. Markers should be in accordance with national standards 3. Setting of national standards for monumenting/procedures/location information.	1. Revise existing guidelines 2. Re-issue existing guidelines 3. Convene an IATF to draft the standards
3. Proper Maintenance of Geodetic Control Points	1. NAMRIA to be responsible for maintaining control points of the NGCN 2. To penalize offenders who disturb/demolish control points 3. NAMRIA to re-establish	1. Strengthen NAMRIA unit concerned, with funding back up 2. To issue policy RE: disturbance/demolition 3. Include re-establishment in the NDP and provide adequate funding support. 4. Re-issue/amend certain provisions

Option	Strategic Direction	Action/Recommendation
	demolished/disturbed points 4. To enforce AO reporting requirements on monument recovery.	
4. Interconnection of Control Points	1. To enforce the policy on interconnection of points established by other agencies 2. All BLLMs be relocated/re-established and coordinated to form part of the network. 3. To create an Inter-Agency Task Force (IATF)	1. Re-issue/amend policy 2. Compile inventory of all BLLMs 3. Issue order creating the IATF (LMB, NAMRIA, LRA, NCIP, DPWH, DAR, PNOC, NPC, NIA, GEP, and other entities)
5. Appropriate Methodology/S.O.P.	1. Revise/amend the methods/procedures and incorporate/integrate/include in the Manual of Land Surveys (DENR AO 98) or MLSP 2. NAMRIA as the sole authority for the evaluation/verification of data observed using GPS 3. GEs to endorse survey returns	1. Amend (DENR AO 98) MLSP 2. Re-issue/amend existing polic(ies) 3. Issue order incorporating GE endorsement as part of the survey returns
6. National Geodetic Control Network Database(NGCND)	1. NAMRIA to maintain the database 2. To update the database on a regular basis 3. To be made accessible to all GEs and Regions thru electronic means	1. Formulate joint MOA with other agencies and provide additional funding to maintain the NGCND 2. Collect relevant information from other agencies and stakeholders 3. Include in the website of NAMRIA including e-payment system

Appendix 7 Survey Control Workshop - Proposal

LAND ADMINISTRATION AND MANAGEMENT PROJECT (LAMP)

Prototype Implementation Office 2 – Quezon City

Rm. 201 2nd Flr. LRA Bldg., East Ave., Quezon City
Tel no. 920-1026 local 291

SURVEY CONTROL WORKSHOP

NOV 25, 2002

Background and Rationale

The Land Administration and Management Project (LAMP) was designed to:

- Formulate land administration and management policy and regulatory changes; and
- Test alternative approaches that will improve the protection of rights to land, and improve the effectiveness, transparency and efficiency of land administration.

A geodetic network is the basic spatial framework for the control and integration of surveys, mapping and all land related information. To adequately fulfill these functions it must be of sufficient quality to ensure accuracy, and be spaced such that surveyors can readily connect their surveys.

Although supposedly connected to the national geodetic network, cadastral surveys in the Philippines have in fact been connected to a variety of coordinate systems. Within Quezon City no systematic cadastral survey was performed. Surveys in different parts of the five pilot barangays within the Prototype 2 for LAMP-PIO2 have been connected to control points (BLLM) in other municipalities, or are probably not connected to any control. It was therefore assumed that the isolated surveys were unlikely to be homogenous making the integration of survey and mapping data across the five barangays very difficult.

Based on the studies made on the current control establishment procedure and that of the GPS establishment activities in the prototype areas, a draft proposal for future establishments of controls in urban areas has been made.

Objectives

1. To share the experiences of the LAM project in control establishment activities with the concerned agencies.
2. To review, comment on the draft proposal by the different agencies and private practitioners as well as institutions.
3. To solicit inputs from the participants based on their experiences and current practices.
4. To start building the awareness and consensus among agencies on survey control establishment.

Expected Outputs

1. Documentation of some possible issues that may be raised by the agencies.
2. Input from the different agencies and private practitioners as well as institutions, that may further enhance the proposed future strategies in control establishment.

Participants

The workshop will be participated in by technical staff from agencies such as LMB, LMS, NAMRIA, LRA, DAR as well as representatives from private practitioners, GEP, academic institutions and other distinguished surveying companies.

AGENCIES	# PARTICIPANTS	AGENCIES	# PARTICIPANTS
DENR-NCR	6	THETAN	3
LRA	4	PMO	2
LMB	4	PIO2	10
GEP	3	TA	3
FEATI	3	NAMRIA/F. BONI	3
UP	3	CGSD/NAMRIA	3
ESRI	3	DAR	3
CERTEZA	3	Secretariat	2
FF CRUZ	3	**TOTAL**	**61**

Workshop Program

8:00	Registration
8:45	Opening Remarks
9:00	Overview of LAMP
9:15	Overview of PIO2
9:30	Discussion
10:30	Overview of CIM (its value in records management)
11:00	Discussion
11:30	Need for Geodetic Control for CIM production
12:00	Lunch Break
1:00	Geodetic Control Approach and Procedures Developed for PIO2
1:30	Discussion
2:30	CGSD Activities in Support of PIO2 Control Requirements
3:30	Other Issues (Training, Mark Maintenance, EDM Bases, CGSD Geodetic Database, Guidelines for GEs working in the pilot barangays)
4:30	Lessons Learned; Future Directions, Conclusions
5:00	Closing Remarks

Appendix 8 Survey Control Workshop - Feedback

LAMP PIO2 Survey Control Workshop

25th November 2002

Geodetic Control Issues Raised by Participants

Quezon City

No political boundary surveys in QC.

Strong support for survey of all political boundaries, seen as very important.

Mark Spacing

If land use is to determine the mark spacing, how would urban or rural areas be determined?

It may be appropriate to consider a greater density of marks in some areas such as the pilot barangays with very dense settlement.

Several participants expressed strong support for pairs of marks (ie azimuth marks, a requirement under AO98-12).

Training & Education

National GE Board meeting considered the matter of the Licence/Board Exam not being in compliance with the GE courses.

To sponsor a conference of Heads of Schools with GEP. Would like assistance from the project in this area.

Coordination of existing control points

All existing control points (BLLMs, MBMs etc) should be coordinated.

Prepared by: Andrew Dyson, Survey Control Adviser, in consultation with Eng. Rosalyn Pereira, Head CIM Unit.

Appendix 9 Survey Control Workshop – Minutes of Proceedings

MINUTES ON THE WORKSHOP ON THE SURVEY CONTROL

INTRODUCTION:

The workshop aims to share the experiences of the LAM Project in control activities and to solicit inputs from the participants based on their experiences and current practices. It will also start building awareness and concensus among agencies, private practitioners, GEP and academic institutions on future strategies and directions on survey control establishments in the Philippines. The workshop was held last Nov. 25, 2002 at the Rembrant Hotel which started at about 9:30 in the morning.

OBJECTIVES:

The workshop was organized with the following objectives:

- To share the experiences of the LAM project in control establishment activities with the concerned agencies.
- To review, comment on the draft proposal by the different agencies and private practitioners as well as institutions.
- To solicit inputs from the participants based on their experiences and current practices.
- To start building the awareness and consensus among agencies on survey control establishment.

The different agencies who participated in the said workshop are as follows:
(Please see attached).

- The program started with the opening remarks by Engr. Edmund T. Mateo, Prototype Manager of LAMP PIO2 and he also presented the Workshop Overview of LAMP.

- Another presentation on Overview of PIO2 was delivered by Mr. Noel D. Obra,Chief, Planning and Coordination, LAMP-PIO2.

- Followed by the discussion on Overview of CIM (it's value in records management) was discussed by Engr. Rosalyn A. Pereira, Unit Head, Cadastral Index Map, LAMP-PIO2.

- Need for Geodetic Control for CIM production was discussed by Engr. Alex O. Venzon, Geodetic Engineer, LAMP-PIO2.

- On the other hand, Geodetic Control Approach and Procedures Developed for PIO2 was thoroughly discussed by our Technical Adviser Mr. Andrew Dyson.

- Presentation on other issues (Training, Mark Maintenance, EDM Bases, CGSD Geodetic Database, Guidelines for GE's working in the pilot barangays) was also explained by Mr. Andrew Dyson as our Technical Adviser, LAMP.

- CGSD Activities in Support of PIO2 Control Requirements was presented by Engr. Rudolfo Brandes Jr., OIC, GPS Surveys Section, GCSD, NAMRIA.

- A discussion from Lessons Learned; Future Directions, Conclusion was delivered by Engr. Rosalyn A. Pereira, Unit Head, Cadastral Index Map, LAMP-PIO2.

- After the discussion, the following issues and concerns were raised during the workshop.

- Mr. Kevie raised his concern, what if education is a limitation on having good quality Geodetic Engineers. While it is true that TA Andrew's experience while he was working with the project gave him serious problems in trying to resolve the control requirement of the prototype. He admitted that geodetic knowledge in the country is not very satisfactory and he suggested to have world trained Geodetic Engineers.

- Mr. Ariel Reyes of LMB expounded that in choosing whether it be a main or subsidiary survey, the practitioners chooses the main control so that the Political Boundary surveys can be connected from. Base on the AO-98-12, it is a requirement to connect to one control point on each quadrant which is not conformal from the suggestion of the densification of control points by 1 km spacing. He further suggested that it would be better to use the political boundary control points in order to establish the densification of control points. Mr. Kevie also mentioned that Quezon City is not actually in need of political boundaries since there are already existing Barangay boundaries where these were derived from the lot boundaries. In addition, Jan van der Kevie answered that in 5 barangays here in Quezon City, we don't need to survey political or either municipal boundaries because political boundary came from lot boundaries and were all calculated.

- Engr. Privadi J. G. Daliri, Dean of FEATI University explained that Political Boundary mean two things, it either refers to Internal Revenue allotment where local officials are concerned of, or it has purposes for determining the area of governance. He suggested that Project Boundary is a preferred term than Political Boundary to avoid confusion. Mr. Dyson clarified that Political Boundary is used because it depicts the control network and not on the Cadastral Political aspect.

- Engr. Randolf Vicente is especially concerned on the instruction manual that is distributed to the participants prior the workshop. He inquired if the Manual for the Densification be implemented in the country or that it is only for the project instruction. He also asked what the objective of the workshop is, if not to give comment on the said manual. Mr. Dyson clarified that the manual is presented for background information and have specific comments that is primarily used for the project. The manual is procedural and it has issues on control spacing, mark maintenance, etc. that is generally looking forward on the implementation of the project for the long term LAM Program.

- Engr. Juan Fernandez (GEP) inquired if the project will end on September 2003 and did emphasize that the prototype office are still into data gathering. Instead of focusing on this aspect, it would be beneficial if the prototype office should focus on the recommendation on

this workshop to work for the future LAMP. TA Dyson commented that the LAMP-phase 1 is testing procedures and arrive with recommendations for the LAMP-phase 2.

- Professor Lopez of UP raised the issue regarding the report of Engr. Brandes of NAMRIA about the barangay control points, he is curious if PIO2 is referring to the barangay or lot boundaries. Mr. Dyson clarified, that Engr. Brandes is referring to the CIM boundary control points, selected with identifiable features on the cadastral index maps (CIM) and are accessible on the ground like a fence or wall so that we could coordinate the features in relocating lot surveys and for systematic plotting. PIO2 is not establishing any barangay or municipal boundaries instead positioning the survey plans in PRS92 system.

- Engr. Juan Fernadez clarified that it is better to name the Barangay Boundary a Project boundary since the project can not facilitate in relocating the boundaries of the barangays. Mr. Dyson explained that the CIM control points coordinate the boundary features on the ground that are identifiable on both on the ground and survey maps. Engr. Fernandez pointed out that if the CIM boundary is not delineating Political boundaries then on what particular point from the CIM will describe the barangay. Mr. Dyson explained that the CIM is not a survey map instead an index map. It is a geographical reference linked to a database for easy access on parcel information. The UPI will facilitate the linking of the CIM to the database. The CIM does not replace the cadastral map since it is not a legal identifier. Engr. Pereira expounded that the Prototype 2 is embarking on an effective and efficient land administration by improving the land records system. This is achieved thru a CIM in order to facilitate identification of fake, fraudulent and duplicate records.

- Engr. Randolf Vicente visualized that the project is trying to inject the combination of Land Surveying and Photogrammetry. He suggested having a visual layer of a rectified image and superimposing it with the cadastral lots. Mr. Dyson mentioned that the project intended to use orthophotomaps in producing the CIM but because of the delays on the delivery of the orthophotomaps, the Advisers resorted to establishing ground controls for both barangays (Holy Spirit and Batasan Hills).

- Follow-up explanation from Engr. Vicente says that common GE practitioners are experiencing difficulty on justifying project proposals before the actual survey is done. What he suggests is to attach a copy of land valuation on the CIM (or the like) in order to aid in the tax mapping valuation of the lot. He clarified that GE's are not only into surveying but also into planning and decision making. Mr. Dyson said that the policy valuation is not related to control surveys.

- Mr. Dyson asked the Geodetic engineers to consider the proposed 1 km spacing of monumented control points in urban areas. How it will affect future survey operations and the feasibility of connecting all cadastral surveys to a minimum of 2 and preferably 3 control points, its advantages and disadvantages and any other suggestions regarding the proposed control spacing.

- To clarify the issue, Engr. Randolf Vicente of GEP asked how they should include 1 km spacing of monumented control points in densely-populated urban areas. Mr. Dyson cited that only for the prototype area, it has been considered for 1 km spacing while rural area

will be in 2km spacing. The spacing may vary and all comments and suggestions are welcome pertaining to this matter.

- Engr. Bernabe of F. F. Cruz suggested if control points can be established in pairs. He suggested that it is useful for the GE practitioners. Mr. Dyson stress that one of the very good reasons for establishing single mark spacing is to avoid traversing from different stations. Assuming that GEs connect to 2 or 3 marks which will be used for connections in the survey of a certain parcel, this can be risky if the marks are not closely established that can result to the swinging of the survey. Engr. Bernabe suggested if PIO2 can provide guidelines for future connections on the control points.

- Professor Lopez of UP asked Mr. Dyson what made the project choose 1 km spacing? Mr. Dyson said 1 km is quite near for traversing to another stations and it is not his own decision but it is the project decision. Considering this situation, 1 km spacing is densely controlled than at present but it is better to consider the value, size and topography of lots and road patterns in the area.

- Another suggestion by professor Lopez of UP, 1 km distance is acceptable considering the range of total stations. If we can reduce 1 km to half km spacing for our pilot barangay because of the limited spaces in the area where 1km is relatively long. Jan van der Kevie stated that PIO2 is not doing any cadastral surveys in Quezon City.

- A follow up suggestion by Engr. Juan Fernandez of GEP that in every CIM there should be a pair regardless of the spacing as long as it is intervisible with one another depending on the scale they prefer to use.

- Engr. Ariel Reyes of LMB suggested that when using total stations, initial azimuth is required. Mr. Dyson illustrated a simple example on the board with 2 control points with stations having 1 km spacing and when it is intended to conduct survey on a certain lot. The marks are connected by running a traverse between the points. By assigning an initial azimuth to the first line, closing azimuth is calculated. From the coordinates of the control points, a true azimuth is calculated and applies the differences of the assumed azimuth to obtain the azimuth in PRS 92. Mr. Dyson suggested the computations could be done using Jan van der Kevie's software or by the use of calculator.

After the issues and concerns raised by the participants from different agencies, Closing Remarks was delivered by Mr. Noel Obra, Chief Planning and Coordination, LAMP-PIO2

The workshop was adjourned at exactly 5pm.

Prepared by :	Noted by:
Ms. Violeta Calimlim Cartographer II CIM Unit	Rosalyn A. Pereira