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Department of Environment and Natural Resources

LAMP

FINAL REPORT

ON

SURVEY CONTROL ACTIVITIES

AS PART OF ACTIVITY 13

REPORT D5



Land Administration & Management Project
Prototype Implementation Office II
Quezon City

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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 |
| BOO | Build-Own-Operate |
| CGSD | Coast & Geodetic Survey Department (NAMRIA) |
| CIM | Cadastral Index Mapping |
| CRS | Community Relations and Services |
| DAR | Department of Agrarian Reform |
| DBM | Department of Budget Management |
| DENR | Department of Environment and Natural Resources |
| EDM | Electromagnetic Distance Measuring Equipment |
| FNSP | Field Network Survey Party (DENR) |
| GEP | Geodetic Engineers of the Philippines |
| GPS | Global Positioning System |
| LAM | Land Administration and Management |
| LAMP | Land Administration and Management Project |
| LEI | Land Equity International Pty Ltd |
| LGU | Local Government Unit |
| 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 |
| PRS92 | 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.

To support the title validation activities of the project and for ongoing land administration purposes a CIM is being developed over the pilot area. To ensure that inconsistencies in and between the individual surveys do not result in the creation of very large gaps and/or overlaps, geodetic control was required. The original intention was that the control would be provided by orthophoto maps, however the production of orthophoto maps has been delayed quite significantly.

A program was developed to provide accurate homogeneous geodetic control on the national coordinate reference system (PRS92):

- *To produce orthophoto maps for the five barangays.*
- *On identifiable boundaries within two barangays to enable the CIM production to progress, in the absence of the orthophoto maps.*
- *On monumented control points at approximately one kilometre spacing to control future surveys.*

Geodetic control was to be provided utilizing the GPS resources of CGSD/NAMRIA. The experience has demonstrated that CGSD is not well equipped to support this type of operation. PIO2 staff were not involved in day to day GPS operations, they do not have any GPS equipment, nor have they received training in GPS, other than a basic overview.

The International Survey Control Adviser has worked with PIO2 CIM/survey staff to provide PIO2 with suitable procedures for extension of geodetic control in support of the pilot project and to enable replication of the procedures in support of a long term LAM program.

For a long term project there would be a requirement for a GPS capability which would require extensive GPS training. Effective GPS training is a matter of long term experience and particularly so where the trainees do not have a good background knowledge of geodesy. Several options have been investigated and considered to develop a sustainable GPS capability for the project and the surveying community in general as any long term LAM program will be reliant upon both the public and private sectors.

Key recommendations relating to training are:

- ***Postgraduate scholarships at an Australian university in geodesy/GPS should be pursued.***

- ***Work experience with one or two Australian survey organizations involved in large scale densification should be pursued.***
- ***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.***
- ***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.***
- ***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.***
- ***Extensive on-the-job training should be provided for survey staff in GPS data processing and adjustments, under TA assistance.***

An instruction on the placement and maintenance of survey marks has been developed for PIO1 in Leyte. This instruction will not meet the long term needs in terms of a full mark maintenance program and does not address the urban situation. 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 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 facility for surveyors to test and calibrate EDM equipment is in Manila. It is not readily accessible to surveyors throughout the country and it is not up to the recognized world standard for an EDM calibration base. It is recommended that:

- ***Suitable and accessible EDM bases, to recognized world standards, should be established throughout the country.***

Equipment issues have been considered and a number of recommendations have been made. The most important relates to the procurement processes as it is vital that those executing the project are provided with the most appropriate equipment for the project. Experience indicates that the existing process fails to meet this requirement. It is recommended that:

- ***The PIOs, with the assistance of the TA, should have a major input into all equipment purchases to ensure that equipment meets the project requirements and specifications.***

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.***

Experience on the pilot project has highlighted the problems in not initiating the control survey activities a sufficient time before the control data is required. It is recommended that:

- **Control survey activities should commence one year before the control data is required.**

In PIO2, the project had assistance from CGSD with GPS observations for extension of the geodetic network. Based on this experience and that in PIO1, and given the potential enormity of any geodetic control program to support an expanded LAMP, it is recommended that:

- **DENR AO 98-12 should be revised to allow the project to exercise control over third order densification in compliance with CGSD specifications and guidelines.**
- **CGSD should be responsible for restoring, strengthening and maintaining the Primary Geodetic Network and for Second Order Densification under LAMP support and funding.**
- **PIOs should establish dedicated geodetic sections with responsibility for densification under CGSD specifications and guidelines.**
- **Private sector survey companies that can demonstrate an appropriate level of GPS and geodetic expertise should be contracted to undertake some of the densification activities under careful monitoring by the relevant PIO geodetic sections.**

The establishment of a network of monumented control points will soon be completed in the pilot barangays. Future surveys must be connected to these marks to accurately control surveys, prevent the creation of gaps and overlaps, and enable surveys to be plotted on the CIM. Therefore:

- **Guidelines must 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.**

The Geodetic Engineers of The Philippines (GEP) is the professional organisation representing geodetic engineers in the country, and has particular interests in a number of matters related to LAMP, in particular surveying and mapping.

- **It is recommended that the GEP should be consulted in relation to survey and mapping matters arising from LAMP. In particular their opinions should be sought on the following matters that have been discussed in this report, namely: proposals to improve surveying education; geodetic database issues; mark maintenance; the spacing of survey marks; survey techniques; and changes to survey rules and regulations.**

1. INTRODUCTION

This is the final report on survey control activities as part of the Philippine Australia - Land Administration & Management Project (LAMP) Technical Assistance (TA) for Activity 13, within Prototype 2 (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.

The Scope of Work, within the Inception Report describes Activity 13 as *“Land Title validation methodologies first used, reviewed and updated”*. The main output for the activity is *“Procedures and methodologies tested initially and reviewed at a workshop with recommendations for change.”*

Within the “Output Terms of Reference” there is no specific reference to control surveys. However control survey issues were deemed to be relevant to the following:

“Assistance with the development and testing of new procedures, including interaction with the Build, Own, Operate (BOO) Project, that will streamline and expedite the processes;

“Technical assistance with the determination of processes to improve the comprehensiveness and integrity of land titles and key associated records;”

Within PIO2, the Cadastral Index Map (CIM) is to be used in validating existing titles, to control duplicate land titles and for other administrative purposes. To compile an accurate and reliable CIM the lot data must be homogeneous within a uniform spatial system.

An accurate and homogeneous geodetic network is essential to support the mapping and survey requirements of Activity 13 and LAMP in general. Such a network will ensure that the position, extent and orientation of surveys and mapping are controlled, thereby preventing the creation of gaps or overlaps.

Within Quezon City no systematic cadastral survey was performed and in all probability the isolated surveys are not homogeneous making the integration of survey and mapping data across the five project barangays very difficult. Surveys in the eastern part of the prototype (Payatas Estate) are supposedly connected to BLLM1 in Montalban, Rizal which was about 8km away. A field search by project staff has confirmed that BLLM1 does not exist, yet surveys continue to show connection to it! In the south west (Piedad Estate), the surveys are probably not connected to control. It is suspected that these surveys are not homogeneous. Anecdotal evidence from a geodetic engineer involved in surveys in the area suggests that this is the case.

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

- Plotting of the existing isolated surveys on the CIM within the barangays of Batasan Hills and Holy Spirit;
- Production of orthophoto mapping;
- Control of all future cadastral surveys.

The activities of the International Survey Control Adviser were directed at assisting the survey staff of PIO2 in setting up the appropriate procedures and methods for the establishment of geodetic control on the pilot project such that they would be suitable for replication on any future long term LAM program.

This report concentrates on survey control activities by Andrew Dyson, International Survey Control Adviser, in support of Activity 13. A summary of the tasks and outputs follows.

1.1 Overall Tasks

The overall tasks related to survey control are defined in the adviser's Terms of Reference (TOR) which is included as Appendix 1 to this report. The TOR are as follows:

- To assist in the planning, development, documenting and training on procedures and methods for survey control to facilitate the creation of the CIM of existing land parcels from the existing survey and map data in offices of participating agencies, especially the LGU, LRA and DENR / NCR, and from orthophotos. Evaluate and report on the quality and completeness of existing survey control networks in QC pilot area and how further expansion ought to be conducted.
- Any new equipment or software should be specified for procurement or hire.
- Detailed training plan to be documented.
- Quality assurance must be built into the processes.
- To assist the PMO and PIO2 in interactions on survey control issues in discussions with the BOO project in LRA.

1.2 Main Outputs

The main outputs are defined in the adviser's TOR as follows:

- A report on the test of the survey control approach and procedures obtained from a workshop review.
- Documented procedures.
- A report on training completed and training evaluation.
- A report on the recommended improvements and the lessons learned.

1.3 Inputs

The Scope of Work for Activity 13 specified that the adviser would provide two months of input. The adviser has been in Manila for 7 weeks during this activity, of which a proportion of the time has been dedicated to PIO1 activities.

2. ACHIEVEMENTS AGAINST DEFINED OUTPUTS

The achievements against the specified outputs are discussed below.

2.1 Survey Control Approach

It was decided during 2001 that Coast & Geodetic Surveys Department (CGSD/NAMRIA) would undertake the geodetic control activities with some assistance from PIO2 staff, in particular with the

coordination of boundary points. PIO2 was not to be equipped or trained for geodetic control surveys as their staff were to be mainly concerned with the CIM production.

Geodetic control on PRS92, the national coordinate reference system, was required for three distinct purposes in the pilot barangays. The approach for each of these purposes is discussed below:

2.1.1 Control Requirements to Support CIM activities

The strategy developed in May 2001 to shift the CIM onto the Philippine Reference System 1992 (PRS92) coordinate system, was to utilise the orthophoto maps as the base control and to use a “manual adjustment” technique to manipulate the cadastral data onto this base. It was realised that the success of this approach would depend upon the quality of the individual surveys. It was suggested that in areas where difficulties are encountered, it may be necessary to coordinate identifiable boundary features.

By September 2001, PIO2 staff had completed the preliminary CIM for Barangay Batasan Hills but are unable to shift the CIM onto the PRS92 coordinate system because the Orthophoto Maps are not available. The contractor had not commenced the aerial photography of Quezon City and it was considered very unlikely that the orthophoto mapping to be available before mid 2002.

In response to this situation, Mr Lewis Haley, CIM/Land Records Management Adviser, (Bridging TA) used the resources of Certeza Surveying & Aerophoto Systems Inc to test one of the preliminary CIMs for spatial accuracy. The test revealed a variation of about 10 metres between the Luzon Datum coordinates of the cadastral surveys and the PRS92 coordinate system. In comparison there is a 2-3 metre difference for the nearest two old geodetic stations, one at the University of The Philippines, Quezon City, and the other in Binondo.

Accordingly it has been decided, in consultation with PIO2 personnel and Mr Haley, that some boundaries within the barangays of Batasan Hills and Holy Spirit (the next barangay for CIM compilation) would be coordinated as a matter of urgency.

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



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. Three reconnaissance teams were to be employed, each comprised of one person from PIO2 and one from CGSD. The PIO2 personnel to locate the preferred boundary locations and the CGSD personnel to advise if the locations are 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 would be used as the reference stations for fast static observations.

In September 2001, a work plan was developed for implementation of the boundary control under which it was to be completed by early November 2001.

By January 2002, little had been achieved. PIO2 had not provided the staff to assist CGSD in selection of boundary points and the CGSD teams had experienced difficulties in accessing the areas. Some progress had been made on selection of the second order points.

A new work plan was developed under which the second order control and boundary control was to be completed by 19th February 2002.

The Survey Control Adviser provided fast static operating instructions and field sheets, and also on-the-job training in fast static GPS observations.

There were numerous delays and eventually the coordinates and descriptions for the CIM boundary control data were submitted to the project on 9th April 2002.

The adviser assisted CGSD with adjustment of the second order control and provided some advice and guidance on adjustment of the boundary control data.

2.1.2 Control Requirements for production of Orthophoto Maps

The Technical Specifications for the mapping 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 +/-0.05m (horizontal) and +/-0.15m (vertical).

To meet the control requirements in the Technical Specifications, it was originally estimated that between 15 and 20 photo control points would be required in and around the five pilot barangays. The preferred approach was to use the three second order control points as reference points and use fast static GPS techniques to coordinate the photo control points to third order specifications.

At a meeting with NAMRIA survey and mapping representatives in January 2002 they advised that 30 to 40 control points would be required because of the irregular shape of the area. A work plan was subsequently developed for the photo control and cadastral control (see 2.1.3 below) activities. They were to commence after completion of the boundary control operations in mid February and be completed by 22nd March 2002.

CGSD was to be responsible for the entire field operation.

Control activities were suspended at the end of March because of funding problems and there was a considerable delay in recommencing operations. There were a few points to be reobserved and in

addition, CGSD was proposing extensive levelling for height control. Eventually this issue was resolved and 13 additional GPS control points were to be established.

GPS operations resumed early in June, but as of 29th June the adviser has not been notified when the control will be completed.

2.1.3 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 PRS92 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.

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

As indicated above a work plan was developed in January 2002 in which the photo control and cadastral control activities were to commence after completion of the boundary control operations in mid February and were to be completed by 22nd March 2002.

Alternative monumentation techniques were developed in consultations between PIO2 staff, CGSD staff, the Land Parcel Mapping Adviser and the Survey Control Adviser. These methods were for marks in substantial concrete structures such as sidewalks, kerbs and rooves.

CGSD was to be responsible for the field operations, but PIO2 was responsible for CRS activities to ensure that the CGSD teams could access the required locations without hindrance.

Control activities were suspended at the end of March because of funding problems and there was a considerable delay in recommencing operations. There were a few points to be reobserved and 20-24 control points remained to be established and coordinated within three barangays. CGSD had advised that informal settlers were preventing entry to some areas.

GPS operations resumed early in June, but as of 29th June the adviser has not been notified when the control will be completed.

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 azimuth 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. It would be appropriate to consult with the Geodetic Engineers of The Philippines in developing these guidelines.

2.2 Documented procedures

Procedures have been developed for each of the geodetic control activities used in PIO2. The procedures have been documented in a manual, prepared by the Control Survey Adviser, to assist PIO2 staff in control survey activities. The manual is titled:

- *Manual for Densification of the Geodetic Network to Support Land Records Management & Cadastral Surveying*

PIO2 has not purchased GPS equipment and all GPS operations in Quezon City were undertaken by CGSD. Operational GPS manuals have been prepared by the adviser as part of his input into PIO1 control activities in Leyte. The content of these manuals is relevant to other GPS operations although the receiver operation and data processing components are written specifically for the Leica GPS equipment and software. These manuals are:

- *GPS Guidelines & Receiver Operation Manual*
- *GPS Processing & Adjustment Manual*

A brief summary of the content of each of these manuals follows:

2.2.1 Manual for Densification of the Geodetic Network

The *Manual for Densification of the Geodetic Network* is based on the techniques and procedures developed and used in PIO2. It was developed and revised in consultation with PIO2 survey staff and CGSD staff. The procedures have been tested in the field and were further reviewed at the PIO2 Survey Control Workshop on 28th May 2002. Following the feedback from the review they were again revised. As work instructions they should be subject to regular review and revision.

The manual covers the following activities:

- Search of data;
- Reconnaissance;
- Monumentation; and
- Traversing.

2.2.2 GPS Guidelines & Receiver Operation Manual

The *GPS Guidelines & Receiver Operation Manual* has been prepared as a comprehensive operation manual for users of the Leica SR520 GPS receivers.

The manual is made up of four components:

General Instructions

The general instructions are applicable to any GPS survey, and except for a few references are receiver independent. They include instructions on preparation, equipment setup, observation guidelines, and care of equipment.

Leica SR520 Receiver Operating Instructions

These instructions are specific to the Leica SR520 GPS Receivers and give a detailed step by step operating procedure for the various types of GPS surveys that will be utilised on PIO1 control surveys. They include instructions on monitoring the progress of the survey. Instructions are provided on configuring the SR520 receivers and details of each configuration set that has been developed for PIO1 are documented. Although the operating instructions and configurations have been developed for PIO1 they are also applicable to similar survey activities in PIO2 or anywhere in the country.

GPS Planning Guidelines

The GPS planning guidelines are intended to assist senior staff in the planning of GPS surveys with suggested techniques. Recommended minimum observation times are provided together with the minimum requirements for connection to existing control and the number of independent observations to achieve the required level of accuracy.

GPS Field Sheets

GPS Field Sheets have been developed specifically for the Leica receivers for use on LAMP GPS surveys. One field sheet for reference and static control, the other for rapid static roving. They are included at the end of the manual.

2.2.3 GPS Processing & Adjustment Manual

The *GPS Processing & Adjustment Manual* has been prepared as a comprehensive operational manual for the processing of data from the Leica SR520 GPS Receivers using the Leica SKI-Pro Software and the adjustment of this data using the Microsearch GeoLab adjustment software

The manual is made up of eight major parts:

SKI-Pro Overview

The user is given an overview of the software, the components that are available, the use of the software protection key (dongle) and a guide to navigation through the program.

Getting Started with SKI-Pro

This section guides the user through project management, setting up a project, and importing and backing up observed data.

Baseline Processing

The user is taken through the steps to set up the data for processing and running the baseline processor.

Analysis of Processing Results

The user is provided with a guide to the analysis and assessment of the results, reprocessing of unsatisfactory baselines and export of data for adjustment.

Network Adjustment

Provides a brief overview of adjustments and the GeoLab software.

Adjustments Using GeoLab & the GPS Environment

The section explains suggested options for GPS adjustments and guides the user through the steps to set up and adjust GPS data.

Analysis of Adjustment Results

The important features of the output are explained and tips on analysis of adjustment results are provided to assist in assessment of the particular adjustment and the data quality. The steps in running a constrained adjustment are detailed. Guidelines for file management are provided.

Transformations & Extracting Coordinates

In the final section, the user is shown the steps for extracting coordinates from the adjustment, and the transformation to PRS92 and Philippine Transverse Mercator (PTM) coordinates.

2.3 Training

As CGSD would undertake the geodetic control activities in Quezon City, PIO2 was not to be equipped or trained for geodetic control surveys. The staff were to be mainly concerned with CIM production, apart from assisting in the selection of suitable boundary features for CIM control in two barangays. Nevertheless, PIO2 staff indicated that they wanted training on GPS and Total Station equipment.

In the initial training plan developed by the Land Parcel Mapping Adviser and the Survey Control Adviser in response to discussions with PIO2 staff an attempt was made to include the PIO2 and PMO staff in the proposed PIO1 GPS and Total Station training. However it soon became apparent that the limited number of Total Stations, GPS receivers and the associated software would make it impossible to include PIO2 and PMO staff and deliver effective training. It was considered to be essential for all the participants to get extensive “hands on” experience with the equipment and software. Too many participants in relation to the resources would prevent this. Accordingly a decision was made to restrict the training to PIO1.

It was however decided that it would be appropriate to offer a one day Introductory GPS course to PIO2 and PMO staff.

Accordingly very little training has been provided by the Survey Control Adviser in PIO2. It has been limited to the following:

2.3.1 Rapid Static GPS Operations for CGSD

Appropriate operating procedures were developed for CGSD’s GPS equipment, for rapid static GPS techniques. On the job training was conducted for the CGSD personnel and they were provided with operating instructions at the commencement of the observing campaign in February 2002.



Given the existing experience of CGSD personnel in static GPS observations, they quickly developed their ability to conduct rapid static GPS observations.

2.3.2 Introduction to GPS

A one day course was conducted by the supplier of the Leica GPS equipment for PIO1, assisted by the Survey Control Adviser. The course provided:

- A general overview of GPS for all interested PIO2 staff.
- The opportunity to conduct a small GPS survey using the Leica receivers.
- An overview of GPS processing and mission planning.

The general overview gave the participants a clearer understanding of GPS, and its capabilities and limitations. It gave them an appreciation of the wide level of application of GPS to positioning and surveying problems.

The supplier kindly provided two GPS receivers for the training course.



2.4 Recommended Improvements and the Lessons Learnt

The control survey activities on the project commenced in a limited manner in October 2001, but did not really make much progress until February 2002. They continued until the end of March and recently resumed.

During these activities a number of lessons have been learnt and in many cases changes have been initiated as a result. Appropriate procedures have evolved over time and been incorporated into the operational manuals.

A formal assessment of the control survey activities was made during the Survey Control Workshop.

2.4.1 Survey Control Workshop

The *PIO2 Survey Control Workshop* was organised to enable all PIO2 survey staff and other persons who had contributed to the control activities, to provide input into the content of the manuals and feedback on lessons learnt during the control activities. The workshop was held on 28th May 2002.

PIO2 was represented by Eng. Rosalyn Pereira, Head of the CIM Unit, and therefore also responsible for survey matters. In addition Eng. Ildefonso Padigos, LRA, and formerly Head of the CIM Unit attended. No other PIO2 staff attended. There were four representatives of CGSD, a representative of PMO together with the Land Parcel Mapping and Survey Control Advisers.

The participants provided comments and suggestions on the content of the draft *Manual for Densification of the Geodetic Network*. The comments have been considered and in response some further revisions have been made to the manual.

The Lessons Learnt Session provided an open forum for the participants to share their lessons learnt since October 2001.

A report on the workshop was prepared by Rosalyn Pereira. A copy of the report (may 28 GPS workshop.doc) is included as Appendix 2.

A summary of the lessons learnt comments has been prepared by the Control Survey Adviser (Lessons Learnt PIO2 Survey Control Workshop.doc). A copy of the summary is included as Appendix 3.

2.4.2 Lessons Learnt & Recommendations

The lessons learnt from the control survey activities and the suggestions and recommendations from the workshop have been divided under a number of headings and 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.

2.5 BOO Project in LRA

The adviser's TOR indicated that the adviser should "assist PMO and PIO2 on interactions on survey control issues in discussions with the BOO project in LRA.

The adviser made repeated requests to PIO2 management to arrange meetings with representatives from the BOO project, on each visit to Manila. However no meeting was ever arranged and neither PMO nor PIO2 have sought any advice on survey control matters relating to the BOO project. Accordingly no assistance has been given in this matter.

3. TECHNOLOGY TRANSFER & TRAINING

Within PIO2 there was not intended to be any operational survey capabilities. The decision to utilise CGSD capabilities for control surveys and the restriction of PIO2 staff to CIM preparation and a mere supporting role for the boundary control functions has effectively precluded any technology transfer and training in modern control survey techniques as part of the pilot project.

In the event of expansion of the project into other areas of Quezon City, consideration will have to be given to the need to develop an in-house geodetic survey and GPS capability. This is particularly so given CGSD's inability to deliver GPS services in a timely and efficient manner. The lessons learnt in PIO1 in regard to training and technology transfer should be considered. (see the corresponding report for PIO1)

4. ISSUES & RECOMMENDATIONS

Issues raised so far in this report that are not considered to have been covered satisfactorily in the operational manuals will be considered here and recommendations made. These may relate to ongoing activities in PIO2 or to the long term LAMP program. In addition any issues that have arisen from the PIO1 activities that are also seen as relevant to PIO2 will be raised.

4.1 Ongoing Control Activities

Recommendations related to ongoing control activities within PIO2 follow.

4.1.1 Completion of GPS Observations

- *The completion of all GPS control activities by CGSD and provision of the relevant information should be followed up.*

4.1.2 TA Support for Ongoing Control Activities

It became apparent during the project that CGSD's adjustment capabilities are limited because of a lack of experience and formal training. Two of their personnel attended the one week adjustment training course held during June at PIO1. They have gained a good basic understanding of adjusting GPS data with the GeoLab software and the analysis and assessment of the adjustment output to determine the suitability and quality of the data. However, they acknowledge their inexperience and need for formal geodesy training and on-the-job training in adjustments.

- *The need for TA input into the final adjustment of GPS data by CGSD should be considered.*

4.1.3 Mark Maintenance

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 Quezon City and in fact it should be relevant to the whole country.

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.

- *Consideration should be given to a full study to develop a comprehensive mark maintenance program for the whole of the country.*
- *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.*

4.1.4 Geodetic Database

The issues regarding accessibility of an updated CGSD Geodetic Database have been explored in the PIO1 report and the same issues are relevant to PIO2.

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

4.1.5 EDM Base & Equipment Calibration

The issues regarding an EDM base and equipment calibration have been explored in the PIO1 report and the same issues are relevant to PIO2.

- *The establishment of a suitable and accessible EDM base, to recognized world standards, within Metro Manila should be investigated.*
- *A tribrach tester should be purchased and installed at an appropriate location and should be accessible to the general surveying community.*

4.1.6 BOO Project in LRA

- *The need for adviser input into survey control issues related to the BOO project, during the remainder of the adviser's assignment must be determined.*

4.2 Long Term LAMP

Within PIO2, there were limited survey control activities, limited input from the Survey Control Adviser, and even more limited involvement of PIO2 personnel. Therefore it is appropriate to draw from the experiences in PIO1 in making many of the recommendations for a long term LAMP program.

Accordingly many of the PIO1 recommendations have been incorporated into the following:

4.2.1 CRS

- *In urban areas, and in particular in areas of informal settlers and very high population density, CRS activities must be given a very high priority.*
- *CRS specialists should be responsible for CRS activities but representatives of the survey control teams must also be present at public meetings.*
- *Every effort should be made to secure written approval from homeowners for the survey activities at the public meetings.*

4.2.2 Equipment

- *For efficient and effective GPS operations a minimum of three fully equipped dual frequency P-code GPS receivers are required by each unit. The receivers must have a user friendly interface to enable full operator control, input of data and provide a full display of receiver and satellite status. Qualified assistance should be obtained in preparing any specifications for purchase.*
- *Radio communications are essential for efficient GPS operations in a long term program and suitable radios should be provided for GPS teams.*
- *Field personnel should be equipped with personal protective clothing and safety equipment.*
- *Appropriate protective boxes and bags should be acquired for all items of survey equipment.*
- *Procedures should be initiated to ensure that all survey equipment is well maintained and cared for.*
- *Steps should be taken to provide proper storage facilities for the survey equipment.*
- *A survey officer should be appointed as equipment officer with the appropriate responsibilities.*
- *Maintenance agreements for major equipment items must be maintained.*
- *There should be a budget allocation for ongoing equipment maintenance.*
- *The PIOs, with the assistance of the TA, should have a major input into all equipment purchases to ensure that equipment meets the project requirements and specifications.*

4.2.3 Software Maintenance

- *Software upgrade agreements must be maintained.*
- *Anti-virus software should be installed on all computers and kept up to date.*
- *Funding should be provided for software upgrades and maintenance agreements.*

4.2.4 Vehicles

- *4WD vehicles should be allocated for survey activities.*
- *Each field team should be allocated a vehicle.*
- *Appropriate vehicles should be allocated for particular tasks.*

4.2.5 Operational Funding

- *Funding should be provided for ongoing survey control activities including consumable items.*

4.2.6 Mark Maintenance

- *If not initiated during the pilot project, then a full study to develop a comprehensive mark maintenance program should be undertaken for the main LAM 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.*

4.2.7 Geodetic Database

- *If not addressed during the pilot project, the issue of accessibility to the CGSD Geodetic Database to update data and to obtain control information should be investigated and addressed.*

4.2.8 EDM Base & Equipment Calibration

- *Suitable and accessible EDM bases, to recognized world standards, should be established throughout the country.*
- *A tribrach tester should be purchased and installed at each future PIO and should be accessible to the general surveying community.*

4.2.9 Training

- *Training in equipment care and maintenance should be provided for equipment officers.*
- *Postgraduate scholarships at an Australian university in geodesy/GPS should be pursued.*
- *Work experience with one or two Australian survey organizations involved in large scale densification should be pursued.*

- *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.*
- *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.*
- *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.*
- *Extensive on-the-job training should be provided for survey staff in GPS data processing and adjustments, under TA assistance.*

4.2.10 Timing of Control Activities

- *Control survey activities should commence one year before the control data is required.*

4.2.11 Who should do control

- *DENR AO 98-12 should be revised to allow the project to exercise control over third order densification in compliance with CGSD specifications and guidelines.*
- *CGSD should be responsible for restoring, strengthening and maintaining the Primary Geodetic Network and for Second Order densification under LAMP support and funding.*
- *PIOs should establish dedicated geodetic sections with responsibility for Third Order densification under CGSD specifications and guidelines.*
- *Private sector survey companies that can demonstrate an appropriate level of GPS and geodetic expertise should be contracted to undertake some of the densification activities under careful monitoring from the relevant PIO geodetic sections.*

4.2.12 Guidelines for Geodetic Engineers working in the Pilot Barangays

- *Guidelines must 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.*

4.2.13 Consultation with the Geodetic Engineers of The Philippines

As the professional organisation representing geodetic engineers in the country, the Geodetic Engineers of The Philippines (GEP) should be consulted on a number of matters related to LAMP and in particular in matters related to surveying and mapping. GEP members and their operations will be affected by any changes in these fields. It would therefore be appropriate that they should be advised about matters relating to this report and the corresponding report for PIO1 and their views sought.

- *It is recommended that the GEP should be consulted in relation to survey and mapping matters arising from LAMP. In particular their opinions should be sought on the following matters that have been discussed in this report, namely: proposals to improve surveying education; geodetic database issues; mark maintenance; the spacing of survey marks; survey techniques; and changes to survey rules and regulations.*

Appendix 1 Terms of Reference for Survey Control Adviser

TERMS OF REFERENCE

INTERNATIONAL SURVEY CONTROL ADVISER

First Part of Long Term Assignment (2001/2002)

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 to the TA team leader. 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 first 6 months of the assignment. A new TOR will be prepared for the later stages of the assignment.

The overall objective of the assignment is to develop and document a set of initial procedures 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. Secondly, plan and assist to ensure that sufficient survey control is placed to support the new cadastral surveys and transformation of old surveys to the new coordinate system. Third, review the field record of information defining boundaries and propose improvements. It is essential that extensive training be provided to counterparts and the private sector as appropriate, so that during the second stage of the assignment a large part of the work can be fully completed by the counterparts.

The International survey control adviser will be responsible for completing the following work no later than 30 June 2002 (reference is the PDD and the work to be completed is described as Deliverables 11 and 13 in the AusAid – AMC contract):

1. The overall task in prototype 1 is to assist in the planning, development, training, testing and documenting of procedures and methods for survey control and boundary definition to support land titling, in particular the judicial land titling test in early 2002 and any further administrative titling tests. Any new equipment or software should be specified for procurement or hire. Detailed training plan is to be documented. Quality assurance must be built into the processes.
2. The main outputs in prototype 1 are a report on the recommended improvements and the lessons learned, documented procedures and report on training completed and training evaluation.

3. Further, an instruction on the placement and maintenance of survey control marks to ensure maximum longevity and suitable access, is to be prepared.
4. The overall task in prototype 2 is to assist in the planning, development, documenting and training on procedures and methods for survey control to facilitate the creation of the CIM of existing land parcels from the existing survey and map data in offices of participating agencies, especially the LGU, LRA and DENR / NCR, and from orthophotos. Evaluate and report on the quality and completeness of existing survey control networks in QC pilot area and how further expansion ought to be conducted. Any new equipment or software should be specified for procurement or hire. Detailed training plan is to be documented. Quality assurance must be built into the processes.
5. The main output in prototype 2 is a report on the test of the survey control approach and procedures obtained from a work shop review. The report will also contain recommended improvements and lessons learned. In addition there will be documented procedures and project training plan and evaluation of the first 6 months.
6. Assist the PMO and PIO2 in interactions on survey control issues in discussions with the BOO project in LRA.

End

Appendix 2 Report on PIO2 Survey Control Workshop

LAND ADMINISTRATION AND MANAGEMENT PROJECT
PROTOTYPE IMPLEMENTATION OFFICE 2
QUEZON CITY
May 28, 2002

Executive Summary

The GPS workshop discusses about the instruction and procedure manual for the densification of the Philippine geodetic network. The purpose is to support land records management and cadastral surveying.

Activity Title

Process Document for the GPS Workshop

Rationale

T.A. Andrew instructed the group to read the provided manual for the GPS densification and to focus on the lessons learned in land titling. The delay of the orthophoto maps will be included in the lessons learned. The purpose of a geodetic survey is for use for future reference and PIO2 being a pilot project, it may be useful to

- Control for CIM
- Control to identify coordinates of barangays features
- Control for monuments
- Control for future survey works to be connected to

Mr. Brandes, NAMRIA representative, explained that the responsibility in the densification of GPS stations was done in DENR and other government agencies i.e. the Department of Agriculture [foreign assisted] as part of their project. He explained the existence of an executive order stating the extension of deadline of the project and thus stating the involvement of other agencies.

In connection to the previous activity of NAMRIA as to establish control points for PIO2, Mr. Brandes also clarified that Engr. Danny of PMO has been misinformed since he was expecting that all five barangays of the pilot project would involve GPS densification and boundary surveyed. But as per latest instruction, only 2 of the five barangays are completed.

Mr. Brandes also confirmed with the accuracies for both the vertical and horizontal control requirements for the orthophoto maps since it is confusing for their team with the specifications because it is usually based on a relative position.

One concern was that as he [Brandes] observes that in CIM with 1 m accuracy but having a baseline of 20 km and 1 m is more than the third order. T.A. Jan explained that each point indicated in the orthophoto should be in a meter but that doesn't contribute to the horizontal and vertical accuracy and not bigger as compared to the requirements.

Then he [Brandes] clarified a figure of 37 and 24 instead of 15 and 20 photo control points were required. The purpose of extending outside the pilot barangays is because of the irregular shape of the surface and the 37 control points were GPS navigated instead thru aerial.

Engr. Jun Padigos asked if are there any special instruction for the photo control surveys. T.A. Jan explained that there should be photo taken and points selected. T.A. Andrew mentioned that designation and selection of points can be chosen in an area you want then conduct a field visit to continuously check the photomaps to meet targets.

From the procedural manual, it is stated that BLLM2 never existed and Mr. Brandes made clear that there have been no cadastral survey in Quezon City and the BLLM2 is either joined from montalban or Marikina and part of Kalookan. So succeeding surveys were conducted to the adjacent surveys.

Engr. Padigos brings in the case of the Payatas were it was classified as public land and there were monuments in the Piedad Estate with no control points and adopted the use of magnetic survey. A common practice was as if it was established in a known survey when submitting the documents for approval.

After the discussion, Engr. Pereira has been assigned to rephrase the first paragraph for section 2.2 of the manual by getting a common consensus to the geodetic engineers of PIO2.

Action Taken:

The common practice of conducting surveys for the prototype area alone is to tie points with the adjoining parcel and compute for the bearing and distance of the tie line from the tie point of BLLM1 Montalban, Rizal to the first point of the technical description of the land. The existence of the monuments of both BLLM1 and BLLM2 is unknown.

There was another issue raised by Engr. Padigos that the 1 km interval of each control point is too far to tie future surveys when using transit and tape. And proceeding is the discussion of minimizing the usage of this particular instrument and result in much better instruments.

Engr. Pereira explained that the use of the transit and type is viable as still stated in the official gazette of the geodetic engineers. There were clarifications from T.A. Jan that the official gazette will need further revision to adapt to future surveys as a reference for the geodetic engineers.

Engr. Brandes confirmed with T.A. Andrew if are there drafted instructions with the usage of the 1 km interval because NAMRIA wants to adapt with the practice. And in addition, T.A. Andrew also explained that there is no need for establishing marks for the boundary and sub-surface marks for the monuments are not necessary.

Proceeding further with the discussion of the manual, Engr. Lopez of NAMRIA shared his bad experience with the Reconnaissance Information Sheet (RIS) since the description of the points might not represent its actual position on the ground. If there could be some other way to explicitly describe the location of the point accurately and informative as possible to avoid such experience and makes the output more productive and conducive for the surveying team.

Lessons Learned

1. Confusion between NAMRIA and PIO2 to conduct Community Relations Service – it is a standard procedure of NAMRIA but not as extensive as PIO2 requires. Before NAMRIA conducts the actual survey, there should be an existing permission signed by the homeowner's association to avoid delay and this should be done by the project CRS.
2. Documentation of the procedure is needed and it should be the responsibility of CRS. CIM have no field operation and no concrete procedure since it is only understood as a part of the CRS strategy and only a number of endorsed files exist as a basis for transparency of the activity. It has also been raised the importance of the presence of NAMRIA during general assemblies for them to be introduced to the homeowners as a way of accepting their team when the survey operation is conducted. It is also emphasized the importance of project CRS to disseminate the general awareness of what the GPS team is.
3. Point selection – it can be a combination of the 2 offices are both parties can agree on the points to be selected.
4. Problem with funds.
5. PIO2 concern – there is no service vehicle provided for the operation, no food and transport allowance. It has been suggested to create a separate division for the GPS densification.
6. NAMRIA concern – there should be enough training for the personnel to have more experience on the field. During the actual survey their team still need to wait for other PIO2 staff that don't arrive early on the site thus causing the delay of conducting the survey. If only NAMRIA can work independently or should it be possible for them to start even without the presence yet of the PIO2 staff.

Prepared by:

Rosalyn A. Pereira
Engineer II
LAMP-PIO2

Noted by:

Andrew Dyson
Survey Control Adviser
PA-LAMP

Appendix 3 Summary of Lessons Learnt

PIO2 SURVEY CONTROL WORKSHOP

Tuesday 28th May 2002

Lessons Learnt

Summary of comments and suggestions made during the Lessons Learnt Session of the Survey Control Workshop in relation to Survey Control Activities in PIO2 from February 2001 to June 2002. This summary was prepared by the Survey Control Adviser.

CRS Activities

Jun Padigos commented that there was some debate between PIO2 and CGSD as to who should be responsible for CRS activities.

Jun Brandes added it was a standard CGSD procedure to do CRS but not as extensively as done by PIO2.

Jun Padigos suggested that there was a need to identify who will be responsible for CRS.

Jan van der Kevie suggested that as part of the CRS public meetings that the participants should be asked to sign letters approving the proposed activities.

It was suggested that CGSD representatives should attend the barangay public meetings.

Selection of Boundary Points for CIM Control

In areas of informal settlement, the draft CIM bore no resemblance to the situation on the ground.

It was suggested that the selection of boundary points should be a cooperative exercise between CGSD and PIO2 staff.

Funding Problems

Custodio Armingol commented that CGSD was good at GPS operations but not at paperwork. He suggested that the paperwork should be kept up to date so that expenditure could be liquidated regularly.

Jun Padigos explained that PIO2 staff had difficulty assisting CGSD as they had no vehicles allocated, no transport or food allowances, and no funding for day to day field operations.

Jun Brandes commented that PIO2 staff had relied upon private vehicles to go into the field.

Cooperation between PIO2 & CGSD

Jun Brandes commented that PIO2 staff weren't ready to start work early because of the lack of vehicles and operational funding. This delayed starting work on many occasions.

CGSD Problems

Jun Brandes indicated that CGSD lacked sufficient trained personnel with the necessary expertise to properly support LAMP's requirements.

CGSD was not training enough people for sustainability.

Some other GPS trained personnel are available in CGSD but are assigned to other duties.

PIO2 Problems

Jun Padigos suggested that PMO was unaware of the day to day activities of PIO2 and accordingly did not provide the necessary support. PMO was unaware as to why PIO2 had problems.

Responsibility for Control Surveys in an Expanded LAMP

The preferred option for control surveys in an expanded program was to create a Geodetic/Control Survey Section with full responsibility for control surveys.

Reconnaissance Information Sheets

Arnold Lopez advised that from experience in PIO1, the descriptions on the Reconnaissance Information Sheets are not adequate. He suggested that greater care must be taken to ensure that the descriptions are adequate for the GPS teams to locate the points without assistance.

Prepared by:

Andrew Dyson

Control Survey Adviser

29th June 2002

Appendix 4 Higher Surveying Education Memo



Memorandum

Land Equity International Pty Ltd

1 May 2002

To: Ian Lloyd, Team Leader.

From: Andrew Dyson, Survey Control Adviser

Land Administration & Management Project

Higher Surveying Education

A meeting was held on Tuesday 30th April at the Department of Geodetic Engineering, University of the Philippines, Diliman to explore ideas to set up a cooperative program in cooperation with an Australian University with acknowledged expertise in the field of Geodetic Surveying and GPS education to build the capacity of Philippine universities to sustain an in-country program offering postgraduate education in higher surveying with an emphasis on Geodesy and GPS.

The meeting was attended by Prof Epifanio Lopez, Chair, Department of Geodetic Engineering, UP, Eng. Oliver Ong, PMO; Ditas Campo, Training Coordinator; and Andrew Dyson, International Survey Control Adviser.

The ideas developed by LAMP for the development of in-country expertise to offer a program at the Graduate Diploma level to provide the training necessary to sustain the long term higher survey requirements of the long term Land Administration & Management Program were discussed. Upon successful completion of such a course, students would be awarded an Australian qualification or one which would be recognised world wide as equivalent to an Australian qualification.

Prof Lopez indicated a strong support for the concept and is keen to see the matter developed further. However he indicated that from past experience it could take up to a year to institutionalise the course which includes approval of the curriculum by the Curriculum Coordinating Committee. The process could be fast tracked by making representations to the Chancellor through the Dean.

The existing post graduate course in remote sensing was apparently treated as an exceptional case as a result of such representations and was approved in under a year. During the year when approval was being obtained, they ran a series of pilot training courses with the assistance of the University of New South Wales. Completion of the pilot courses did not result in the award of any formal recognition, however those that did so were able to sit for the formal exams for the same formal subjects without the need to attend lectures.

Prof Lopez advised that the key to ongoing sustainability of such a course would be it attracting sufficient student numbers to satisfy the university that the course should be maintained in the mid to long term. The university offered a Masters level course in Geodesy over ten years ago but had

been unable to maintain the course because of a lack of interest. To sustain the post graduate program, an invitation could be extended to suitably qualified students from the profession, staff of the 17 schools offering geodetic engineering studies, LGUs, other government agencies in addition to relevant staff from the agencies involved in LAMP implementation.

The university has no formally trained geodesists and would be keen to address this acknowledged weakness by developing the necessary expertise. Prof Lopez indicated that they would be happy to cooperate with other local universities offering courses in geodetic engineering such as Feati University. They enjoy good relations with Feati and he saw it as a logical choice.

There are 17 campuses throughout the country offering undergraduate education in geodetic engineering. Although the courses offered are supposed to be of a uniform standard, in reality they are not. The standard of the courses is a reflection of the level of the academic staff and the equipment levels within the various universities. Prof Lopez is trying to organise an Educators Conference for Geodetic Engineers to be attended by representatives of each organisation. The university has the facilities to host such a workshop and would also be a suitable venue to offer the proposed post graduate training. He suggested that he would like the project to provide a representative to attend the conference.

At such a conference the representatives could gather information to examine and compare the standards of their courses and the knowledge level of geodetic engineers. The need to determine the existing knowledge level of prospective students to ensure that the course is set at the appropriate level was agreed.

Prof Lopez advised that the Department of Science & Technology offers scholarships for post-graduate studies and that such a course could come under their earth sciences component.

In discussions on access to equipment he advised that NAMRIA, some private companies and equipment retailers have in the past made equipment available. In addition he suggested that DAR has a substantial number of GPS receivers that might be available. However it was acknowledged that it could be difficult relying upon the availability of equipment from other organisations as their priorities may not coincide with the timing and requirements of the course.

It was agreed that consideration should be given to conducting a feasibility study to further investigate this matter.

Andrew Dyson
Survey Control Adviser