



Regulatory Quality Assurance

Processes for Submission of Cadastral Survey Datasets

Summary of Pilot Cadastral Audit Project

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Surveyor-General
General Manager Regulatory

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1. Background

1.1 Introduction

Land Information New Zealand (LINZ) receives cadastral survey datasets (CSD's) lodged by licensed cadastral surveyors (LCS's) in accordance with the Cadastral Survey Act 2002 and the Surveyor-General's Rules for Cadastral Survey 2002/2. The surveyors are licensed by the Cadastral Survey Licensing Board (CSLB) and may be members of the New Zealand Institute of Surveyors (NZIS), the Institute of Cadastral Surveying (ICS) or not affiliated to any cadastral surveying related professional body. The NZIS has a division of the organisation which consists of principals of survey firms known as the Consulting Surveyors of New Zealand (CSNZ).

Regulatory Quality Assurance (Reg QA) is part of the Regulatory Group which provides assurance to the Surveyor-General, that surveyors and LINZ Customer Services Group possess effective controls and processes to verify compliance with the Act and Rules (i.e. legislation, standards, rules etc).

During the first half of 2006, Reg QA prepared a pilot Audit Programme that was developed with the agreement of the Surveyor-General, CSNZ, piloted Survey firms, and the Manager of Regulatory Quality Assurance. An overview of the pilot was presented to CSNZ members at the Hamilton conference on 18 March 2006.

Following discussion between LINZ and CSNZ it was agreed to run the pilot until the end of the financial year 2005/06 and then review its effectiveness. This report summarises the results of the pilot and contains an outcome.

Prior to the release of this report, CSNZ reviewed the report at a meeting between LINZ and CSNZ. It was jointly agreed to release the pilot report to all LCS's as a precursor to the new audit methodology being implemented. A further report explaining the new audit methodology will be circulated to all LCS's by the end of 2006. During the pilot a number of observations were made that the industry may wish to consider and we have provided a couple of tools that may be beneficial in addressing some areas of concern.

1.2 Survey Firms Selected

The pilot project involved the audit of cadastral surveying processes used by eleven firms which supply CSD's to LINZ.

Ten of the firms were selected from the membership of NZIS, and one firm from the membership of ICS. The selection process is outlined as follows:

Firms were selected based on size using three criteria:

- **Small** - Firms with a single licensed cadastral surveyor normally undertaking most of the field and office work single handedly and has therefore little scope for peer review.
- **Medium** – Firms which have one or two licensed cadastral surveyors who often have technicians or graduates undertaking the field and office work under the supervision of a licensed cadastral surveyor.
- **Large** – Multi-Office and Multi-Disciplinary firms which have many LCS's with most of the field and office work being undertaken by technicians or graduates under the supervision of LCS's.

The selection of the firms was based on the number of CSD's submitted to LINZ during the period 1/11/04 to 31/10/05, balanced by the requisition rate, and the geographical spread of the offices which ranged from Dunedin to Warkworth.

The selected firms were invited to participate in the pilot programme. Of the original eleven selected, one declined and another was then chosen based on the same criteria as a substitute. Once firms had been selected and agreed to being part of the pilot, LINZ contacted the firm's key representatives with terms of reference for the audit. The terms of reference included the scope, proposed timetable and locations of the review.

2. Piloted Audit Methodology

2.1 Description

Traditionally, Land Information New Zealand (LINZ) has undertaken routine inspections and audits of the field component of CSD's as a means to measure compliance by surveyors with the Cadastral Survey Act 2002 and the Surveyor-General's Rules for Cadastral Survey 2002/2.

The pilot follows best practice audit methodology in that the greatest efficient level of assurance can be obtained by assessing survey firms. This is done by focussing on survey firms' processes, risks and controls as opposed to random field audits. It is expected that positive changes in the processes and controls used by firms will result, thus increasing the quality of cadastral surveys and CSD's in the future.

Objectives of the pilot include assessing:

- the level of assurance such an approach provides
- how efficient the methodology is
- the level of benefit provided to survey firms

2.2 Field Audit

The process undertaken was as follows:

Two CSD's were selected randomly from those submitted for each firm and were audited in the field. The field audits were executed in accordance with the Cadastral Survey Audit Manual (SG Manual 1) and included evaluating the field evidence, testing survey dimensions and testing the adequacy of location and connection to existing survey reference or boundary marks (i.e. the definition).

The template used for field audit has been modified for possible use by survey firms and is attached in **Appendix 2**.

2.3 Preparation for Office Visits

Prior to the office visit being conducted, a questionnaire was sent to each firm to gain an understanding of the firm's size, staffing and quality control processes (refer **Appendix 3**).

An analysis of each survey firm's requisitions, including multiple office analysis for the larger firms, for the period 1 November 2004 – 31 October 2005 was conducted. This included identification of requisitions by individual LCS's and exploration of trends in the types of requisitions. This analysis was provided to the firms before or during the office visit and was discussed as part of the audit process.

2.4 Office Visit

The approach for the office visit included the following:

- A review of the survey firms' documented QA processes, if any, used by the LCS in the execution of cadastral surveys and the submission of CSD's to LINZ;
- Identification of quality controls used by the survey firm for the submission of CSD's and to determine if these controls are adequate to provide assurance to the Surveyor-General; and
- A sample of two files were reviewed to determine if the quality controls identified have been performed correctly.

It is to be noted that while survey firms will normally develop company QA processes the ultimate responsibility for the accuracy of a cadastral survey and CSD lies with the surveyor who certifies the CSD.

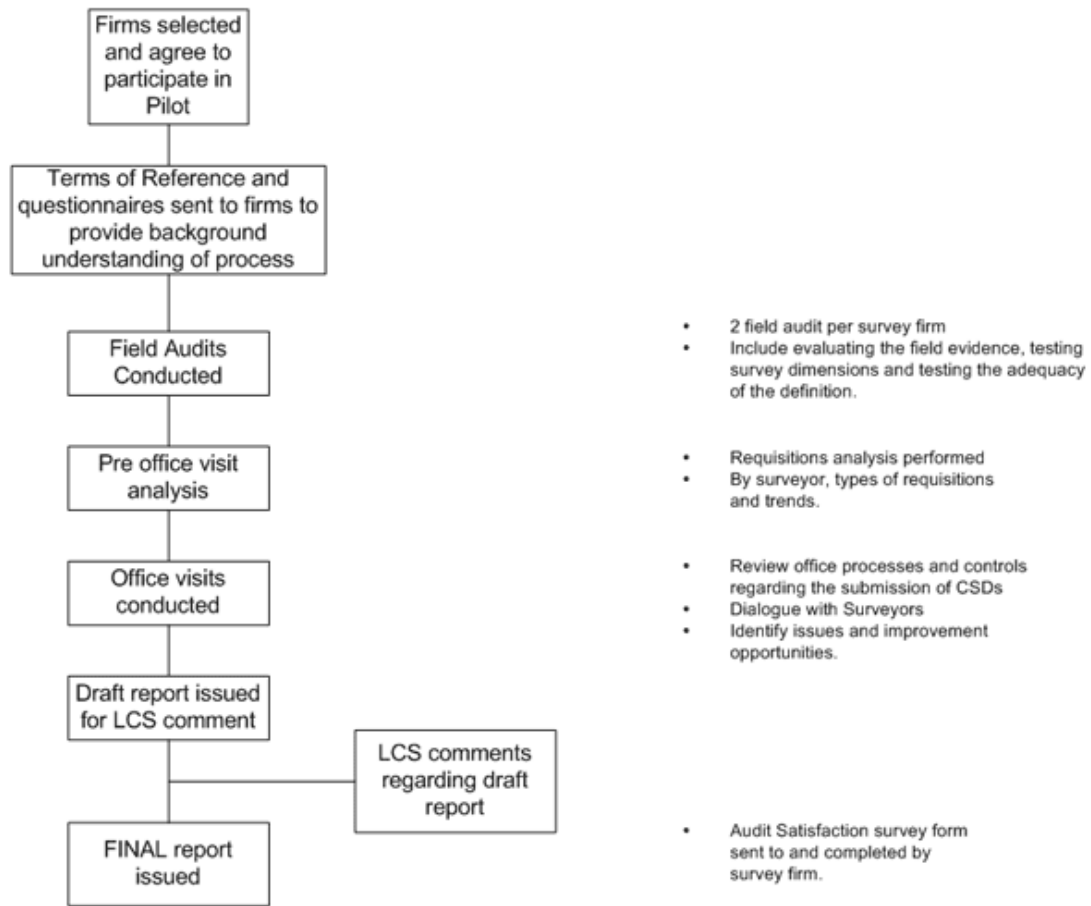
2.5 Audit Reports

Discussions were held throughout the audit with the LCS's as any issues or process improvements were identified. These were also summarised in a close out meeting where the findings and recommendations were discussed with the Surveyor prior to the audit report being drafted.

A draft report which identified risks together with process improvement ideas was sent to each firm for comment prior to finalisation. The final report was issued to the Director/s and Surveyor-General, and copied to the General Manager, Regulatory.

Refer **Appendix 1** for Summary of Observations, Key Controls Identified, Key Findings and Recommendations.

The diagram below outlines the process followed for the pilot audits:



3. Survey firm feedback

On receipt of the final audit report the surveyors were asked to complete a satisfaction survey form which is attached in **Appendix 4**. Responses have been received thus far from 10 survey firms. Feedback to date indicates that the pilot has been well received and all but one rating has been a 4 or above (1 = Strongly Disagree, 5= Strongly Agree). This has included the final comment where "overall the audit provided added value to my operation".

4. Other Issues

During the pilot it was recognised that the quality of systems and controls within survey firms varied considerably. While LINZ is able to provide insight into each firm on a case by case basis, it may be beneficial to develop guidelines on "good survey processes and controls" that will identify elements of a strong office QA process. Such guidelines could eventually form the basis by which Regulatory QA staff performs audits but establishment will need the support and endorsement of the professional bodies. Such an approach has occurred in the rating valuation sector and in the valuation of utilities where industry established a joint working party to agree on a standard approach and then issued industry guidelines.

In the meantime tools and information need to be available to enhance the capability of survey firms to support a robust quality assurance process. This includes providing survey firms with ways to detect errors or omissions in work performed by them or within their survey firm and with tools to analyse previously identified errors to ensure these are not repeated. Examples include:

- Provision of requisition statistics to all firms which submit a minimum of 6 CSD's per six months. (If the number of submissions is less than six, difficulty would be encountered in the identification of any significant trends). Survey firms would be expected to perform a formal analysis to identify causes of requisitions and perform actions, such as changes in processes, to resolve them. This process of learning from previous errors and amending processes and actions should assist survey firms in lowering requisition rates.
- A quality assurance checklist which will assist surveyors in ensuring that the relevant attributes of a complete and accurate data set have been reviewed and are correct before the dataset is submitted to LINZ. An example of the current field audit template which has been amended to demonstrate what the checklist may cover is attached in **Appendix 2**.

It is envisioned that this process will be developed into Quarter three of the 2006/07 year. When the work has been completed, it is the intention that all surveyors will receive a letter stating the approach for the 2007/08 year and the processes that will be involved for office visits.

During this time Reg QA plans to undertake targeted audits. These audits will also involve the same process as the pilot programme and include field audits and audits of office process.

5. Summary

In summarising the results we have considered each of the pilot's key objectives.

Level of Assurance

It is considered that the level of assurance obtained by assessing the quality/adequacy of systems and controls within survey firms, associated with CSDs and the standard of field survey work, is much greater than by a random sample of field audits. This approach is modelled on best practice and provides an insight to the quality of all surveys undertaken by a firm. It is verified by a small audit sample, which if indicating non compliance, may lead to more scrutiny.

Efficiency of Process

While adopting a systems and control based audit methodology means more time is spent in the survey firm looking at practice there is less time in the field. A far wider view of the quality of work can be obtained resulting in a greater level of future assurance for comparatively less or the same effort.

Benefits for Survey firms

The feedback obtained from those firms in the pilot was overwhelmingly positive. By investigating a firm's quality assurance practice, issues can be identified, discussed and if necessary rectified. Improvement to processes is forward focussed so subsequent surveys should not suffer from discovered errors as improved controls will rectify them. The recommendations will generate more robust QA processes thereby increasing the overall quality of cadastral surveys and CSD's. Time and cost savings for the firm should follow as the number of requisitions decreases.

Outcome

Reg QA recommended to the Surveyor-General that the methodology used in the pilot be the basis of the quality assurance audits undertaken on behalf of the Surveyor-General.

Appendix 1

Summary of Observations

The results of assessing QA practices and conducting field audits are summarised as follows:

1. Seven survey firms demonstrated adequate process controls and had no issues arising from field audit.
2. In two field audits of work performed by different firms, one critical pegging error was identified in each.
3. Eight survey firms could not adequately demonstrate compliance with Rule 6 - Calibration of Equipment.
4. Two survey firms did not demonstrate adequate controls relating to office QA processes.
5. One survey firm misinterpreted Rule 36 – Witness Marks

Office QA Processes	Field Work	Firm Size			Total
		Small	Medium	Large	
✓	✓	2	3	2	7
✓	✗	0	1	1	2
✗	✓	0	1	1	2
✗	✗	0	0	0	0

✓ – Reasonable Assurance obtained

✗ – Reasonable Assurance not obtained

The key controls identified at survey firms and the key findings and recommendations arising from the audit work performed are summarised below.

Key Controls Identified

- ***Experience of staff completing fieldwork***
 Field staff in general are very capable and many possess more than ten years of experience. In the large firms where less experienced graduate staff are often employed, there is generally a buddy or mentoring system in place which assists in ensuring the quality of the work produced.
- ***Use of QA Checklists***
 Six of the eleven firms have checklists to ensure that all relevant attributes of a complete and accurate data set have been reviewed and are correct before the dataset is submitted to LINZ. In three cases suggestions were made to improve the checklists and these findings are discussed further in the following page.
- ***Documents reviewed as part of Quality Assurance***
 In the majority of firms, traverse sheets, field notes and calculation sheets were reviewed by the LCS as part of the quality assurance processes performed at each office, and these were retained on file.
- ***Documented processes***
 Three of the four larger firms have ISO 9001 accreditation and as such have comprehensive quality manuals and documented processes. While it is acknowledged

that a documented process may not necessarily produce a better result than one that is not, there is an inherent advantage in having a checklist which will provide guidance and consistency.

Key Findings and Recommendations

Inconsistent Office and QA processes

Checklists

- There were nine recommendations to firms related to the use of checklists as part of the quality assurance process. The use of a checklist assists in ensuring that all relevant attributes of a complete and accurate data set have been reviewed and are correct before the dataset is submitted to LINZ. The verification that the checklists are complete and have been reviewed assists in ensuring that an effective process has been followed and that the dataset submitted is accurate and complete.
- Five of the firms audited did not use a checklist at all. These were predominantly medium size firms where Licensed Cadastral Surveyors placed reliance on their experienced staff members to ensure completeness and accuracy of the CSD.
- There were also two recommendations where checklists required updating for electronic submission. While there is no change in the field requirements for a digital CSD, there are additional administrative requirements that are necessary for the submission. The inclusion of these in a checklist will assist in ensuring these have been considered or completed before submission.

Field Issues identified

- Issues requiring remedial action in accordance with s52 of the Cadastral Survey Act 2002 were identified with two field audits. Both of the errors could have been identified from the field note entries and corrected before submission of the CSD if more robust quality assurance processes, and attention to the quality assurance had been in place at the offices involved.
- The first issue related to a peg placed at a fence angle and being observed correctly but badly recorded. A review of the field notes identified that the observation and measurement entries could not easily be determined due to the illegibility of the notes, which was compounded by incorrect arithmetic in the 'included angle' check.
- The second issue related to the placement of a peg that did not meet the criteria of Rule 26 tolerances of the Surveyor-General's Rules for Cadastral Survey 2002/2. In summary the position of the peg in the field did not match the mathematical position of the peg submitted in the CSD, because the distance used for setting out differed from that calculated. The CSD data, however, was correct.
- Two instances concerning witness marks were observed. In one survey, iron tubes designated as witness marks had not been driven deeply enough to ensure permanence while in another survey due to some confusion, the witness marks did not meet the requirements of Rule 36 (2)(c) – (Convenient Location for Use).

QA evidence

There were three recommendations arising from inadequate evidence that appropriate QA procedures had been performed.

Disposal of quality assurance documents presents a risk to surveyors that evidence of a thorough QA process is lost in the event that a post approval challenge for a survey emerges. The retention of key documents provides evidence that office processes have been consistently followed.

Requisition Analysis

Nine of the firms surveyed did not formally review requisitions or identify trends and issues with the requisitions received. The majority of surveyors informally reviewed and discussed requisitions when received, however a regular and formal analysis (i.e. quarterly/monthly trend analysis) of requisitions received is not performed. Regular formal analysis of requisitions provides assurance that issues, trends and patterns are identified and highlighted, and that appropriate actions are put in place to identify and resolve the cause of the requisition.

Reg QA acknowledges that requisitions are issued for an individual CSD and this does not assist surveyors in performing a formal analysis. During the course of these reviews an analysis of requisitions was provided to surveyors for the period 1 November 2004 – 31 October 2005. The requisition reasons together with the percentage of requisitions against lodged CSD's were discussed with surveyors during the office visits.

Other issues to be noted

NZGD1949 & NZGD2000 comparison

Discussions with Surveyors throughout the audit process indicated that in some areas there is an assumption that NZGD1949 bearings and NZGD2000 bearings are equivalent as advised in the Cadastral Survey Guidelines 3.4.1(6) & 3.7.2.1. Discrepancies between NZGD1949 and NZGD2000 bearings are more widespread than originally thought and therefore equivalence should not be presumed.

Calibration record

Rule 6 of the Surveyor-General's Rules for Cadastral Survey 2002/2 requires that all measuring equipment used in undertaking a survey must be and remain correctly calibrated and that if the Surveyor-General so requests, evidence of the calibration of any instrument used in the survey to which a CSD is related must be able to be produced.

Eight of the firms either did not have a process to verify that their equipment was calibrated, or did not retain evidence that this requirement could be met.

Appendix 2

Amended Field Audit Checklist

Technician/Graduate:	Survey Number:
Licensed Surveyor:	Survey Purpose:
Survey Type:	Survey Class:
Location:	Job Ref:

No.	Audit Item	Comments	Technician check	Surveyor check
	SURVEY ORIENTATION			
	Horizontal			
1	Is the origin of bearings adequate to ensure that orientation and scale is correct over the whole survey? (Rule 7)		/ /	/ /
2	Is the origin of bearing in terms of NZGD 2000, NZGD49 or Old Cadastral as appropriate? (refer SG ruling 2004/1).		/ /	/ /
	Vertical			
3	Is the origin of heights appropriate? (Rule 25, SG Ruling 2005/?).		/ /	/ /
	SURVEY DEFINITION			
	Horizontal Boundaries			
4	Have all of the underlying parcels been accounted for by the new parcels? (Rule 19).		/ /	/ /
5	Is the definition of existing boundaries correct taking into account all evidence available both from the cadastral record and on the ground (within survey tolerances)? (Rule 26).		/ /	/ /
6	Is the status of all old marks correct i.e. reliable/unreliable / disturbed/ undisturbed? (Rule 42).		/ /	/ /
7	Are marks placed or tied to by the survey within regulation accuracy tolerances? (Rule 26).		/ /	/ /
8	Are the adoptions appropriate? (Rule 9).		/ /	/ /
9	Has a bearing adjustment been applied to adopted work where appropriate? (Rule 23).		/ /	/ /
10	Is there sufficient information within the CSD to enable all boundaries to be redefined with confidence? (Rule 14, 15 & 42).		/ /	/ /
11	Is the class of survey appropriate? (Rule 2)		/ /	/ /
	Natural Boundaries			

No.	Audit Item	Comments	Technician check	Surveyor check
12	Does the CSD correctly address the natural boundary appropriately: <ul style="list-style-type: none"> • Adoption (and certification) • Erosion (including depiction of area, CT boundary etc), • Accretion (including depiction of area, CT boundary etc). • Avulsion • Removal of limitations • Better fix (Rule 11 & 19, Common Law doctrine)?		/ /	/ /
13	Is the natural boundary adequately fixed? (Rule 11).		/ /	/ /
Limited Titles etc				
14	Is the occupation: <ul style="list-style-type: none"> • position, type and age shown correctly in relation to each boundary? • correctly taken into account? (Common Law principles, LTA)		/ /	/ /
Vertical (Heighted) Boundaries				
15	Is the definition of heightened boundaries correct (within survey tolerances)? (Rule 26).		/ /	/ /
16	Is there sufficient information within the CSD to enable all boundaries to be redefined with confidence noting the witnessing requirements of Rule 12(4)? (Rule 12, 14, 15 & 42).		/ /	/ /
MONUMENTATION				
Witness Marks				
17	Have sufficient witness marks been used? (Rule 12).		/ /	/ /
18	Are all witness mark adequately: <ul style="list-style-type: none"> - monumented? - placed for stability and permanence? (Rule 36).		/ /	/ /
Traverse Marks				
19	Are all traverse marks adequately monumented & stable? (Rule 38).		/ /	/ /
Boundary Angles				
20	Are all boundary angles appropriately monumented including recalculated boundaries? (Rule 31, 32, 34, 35, Ruling 2005/2).		/ /	/ /
21	Is the form of boundaries correct i.e. are boundaries right lined (except natural boundaries and adopted irregular boundary over 4 ha)?(Rule 10).		/ /	/ /
Natural Boundaries				
22	Is the natural boundary adequately described (i.e. MHWM, MHWS, tidal, top of bank etc)? (Rule 11).		/ /	/ /
23	Where the waterway has dried up, has the boundary been reduced to right-lines and monumented appropriately? (Rule 10).		/ /	/ /
OCCUPATION				

No.	Audit Item	Comments	Technician check	Surveyor check
24	Is the occupation position, type and age shown in relation to each boundary for "guaranteed titles"? (Rule 12).		/ /	/ /
25	Is the relationship between any building and a boundary clear where the building is in close proximity of the boundary? (Rule 12).		/ /	/ /
UNIT & CROSS LEASE				
26	Are all units, lease areas or common areas adequately or correctly defined by: <ul style="list-style-type: none"> • structure, physical feature or dimension, offset or monument? • reduced levels? • accurately plotted? (Rule 33).		/ /	/ /
27	Is the relationship between any building and a boundary clear where the building is in close proximity to the boundary? Rule 12).		/ /	/ /
28	Is the relationship between any building and a boundary clear where the building encroaches beyond the subject land? (Rule 12).		/ /	/ /
29	Is the definition of heightened boundaries correct (within survey tolerances)? (Rule 26). (Unit Title CSD only).		/ /	/ /
30	Has an appropriate mark type been used as a site bench mark? (Rule 12). (Unit Title CSD only)		/ /	/ /
31	Are the unit boundaries the same as on the relevant PUD plan (for subsequent, substituted proposed, and redevelopment plans)? (UTA). (Unit Title CSD only).		/ /	/ /
DOCUMENTATION				
The CSD				
32	Is the CSD detail (including plan detail and layout) clear and unambiguous? (Rule 3B, 14, 15 & 42).		/ /	/ /
33	Are all recalculated lines clearly detailed/ annotated? (Rule 15 & 42).		/ /	/ /
34	Is the information retained on file sufficient to support certification of the CSD? (Rule Sch1)		/ /	/ /
35	Is there sufficient information within the CSD to enable all marks or rights (including parcels, easements, covenants etc) to be redefined with confidence? (Rule 14, 15 & 42).		/ /	/ /
Reporting				
36	Does the survey report detail all necessary information? (Rule 42).		/ /	/ /

Appendix 3

Name of Survey Firm

QUESTIONNAIRE - CADASTRAL SURVEY DATASET (CSD)

This questionnaire is designed to provide LINZ with an insight into your firm prior to our office visit. Please attempt to answer all questions and return by DATE to the Manager Regulatory QA.

Company Structure

Is your firm ISO 9001 accredited (or hold similar accreditation – if so please state accreditation type)? Yes/No?

Who has overall responsibility for quality control in your firm for all processes? (It is acknowledged that the responsibility for a CSD lies with the signing surveyor.)

Does your firm undertake cadastral surveys from multiple offices? Yes/No?
If yes, please list the office locations.

CSD Preparation Processes and Controls

List field and office personnel that are involved in the preparation and submission of CSD's to LINZ within your office.

What quality control processes do you have in place to ensure the accuracy of CSD's submitted to LINZ (including self-audits, external audits, checklists etc)?

Are they documented?

Is there a peer review system for surveyors who submit CSD's? If so, please explain how it operates?

What reporting do you perform to monitor the effectiveness/efficiency of your firms' CSD processes? (e.g. do you keep a record of the percentage of requisitioned CSD's?)

What processes do you have in place for improving your CSD preparation?

Do you have difficulty achieving approval of CSD's? Yes/No?
If yes, please list the key issues you have.

General

What does your firm see as the key risks to undertaking Cadastral Surveys?

What training and development programmes are provided to your staff to ensure they are appropriately skilled?

Thank you for completing this questionnaire.

Name of Survey Firm

Appendix 4

Audit Customer Satisfaction Survey

Your input is essential in our improving the overall audit process. Please circle the rating for each question below and add any comments particularly for items you were not satisfied with or were extremely satisfied with in the comments section.

Area reviewed:	CSD Submission Processes
Date of audit:	
Auditor[s]:	

<i>Key: 0 = Not Applicable or Don't Know 1 = Strongly Disagree ⇒ 5 = Strongly Agree</i>	
1. Sufficient notice of the date of the audit was given.	0 1 2 3 4 5
2. The audit objectives were clearly explained in the Terms of Reference	0 1 2 3 4 5
3. The audit took an acceptable amount of time (on site, in total).	0 1 2 3 4 5
4. The audit was conducted in an efficient manner and disruption to daily activities was minimised	0 1 2 3 4 5
5. My business concerns and perspective were adequately considered during the audit	0 1 2 3 4 5
6. The audit team demonstrated technical proficiency in audit areas	0 1 2 3 4 5
7. The audit team were courteous, professional and had a constructive and positive approach	0 1 2 3 4 5
8. Audit recommendations were constructive, accurate and actionable	0 1 2 3 4 5
9. The audit report was clearly written, logically organised and accurate	0 1 2 3 4 5
10. The audit report was received promptly	0 1 2 3 4 5
11. Overall the audit provided "added value" to my operation	0 1 2 3 4 5

Comments: *Please tell us how we could have done a better job on this audit. [What did you not like, what would you change, what was good?]*

_____ Signed _____ Name (Printed)

_____ Position / / Date

When completed please return to Noel Miranda, Manager Regulatory QA