

NOTE: SINCE THESE RECOMM HAVE BEEN ADOPTED, THE NATIONAL STANDARD COMMISSION HAS

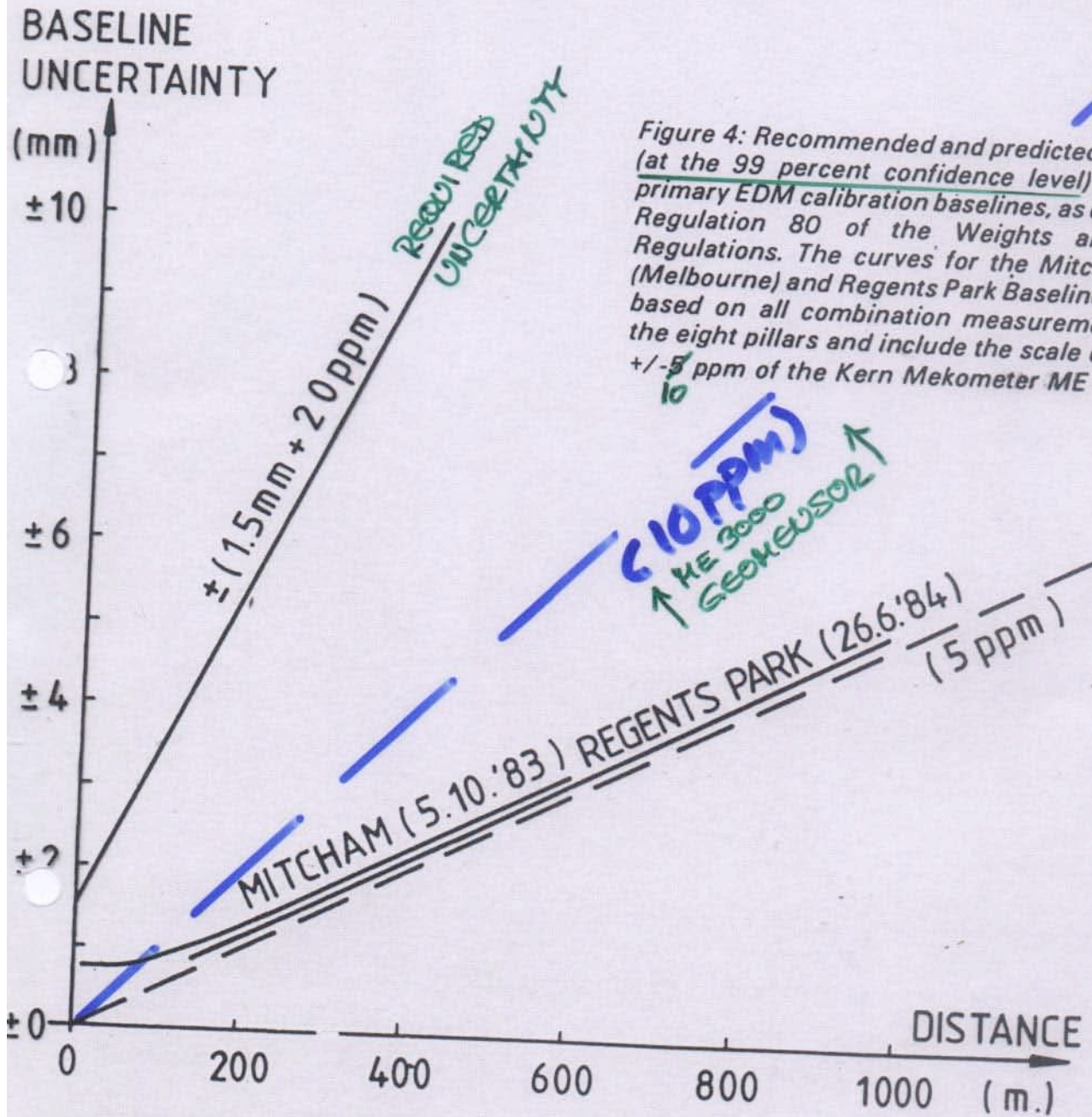


Figure 4: Recommended and predicted uncertainties (at the 99 percent confidence level) of Australian primary EDM calibration baselines, as certified under Regulation 80 of the Weights and Measures Regulations. The curves for the Mitcham Baseline (Melbourne) and Regents Park Baseline (Sydney) are based on all combination measurements between the eight pillars and include the scale uncertainty of ± 5 ppm of the Kern Mekometer ME 3000 used.

SWITCHED FROM 99% C.I. TO 95% CONFIDENCE LEVELS FOR ALL UNCERTAINTIES
 SO MULTIPLY $(\frac{1.960}{1.960})$

TO GET UNCER.
 TRINITY AT
 95% LEVEL
 OF CONFIDENCE:
 $\times \frac{1.960}{2.576}$

Figure 6: Uncertainty of instrument corrections as specified by National Standards Commission and as predicted for some typical EDM calibration baselines. The predictions are based on Mekometer measurements (in all combinations) of a precision of $\pm(0.3\text{mm} + 0.5\text{ppm})$ and on measurements with a distance meter to be tested, assuming a precision of $\pm(1.5\text{mm} + 1.0\text{ppm})$. The curves 1,2,3 and 4 refer to uncertainties (at 99 percent level of confidence) of the instrument correction as derived from fictitious measurements on the Newcastle (NSW, 4 pillars), Mitcham (VIC, 8 pillars), Regents Park (NSW, 8 pillars) and Eagle Farm (QLD, 7 pillars), baselines respectively. The 4 baselines are further described in the text. The uncertainty of the Mekometer's scale was again taken as $\pm 5.0\text{ppm}$ at the 99 percent level. It is the largest contribution to curves 3 and 4 at longer distances. The instrument correction comprises one constant, one linear and two periodic terms in all four cases.

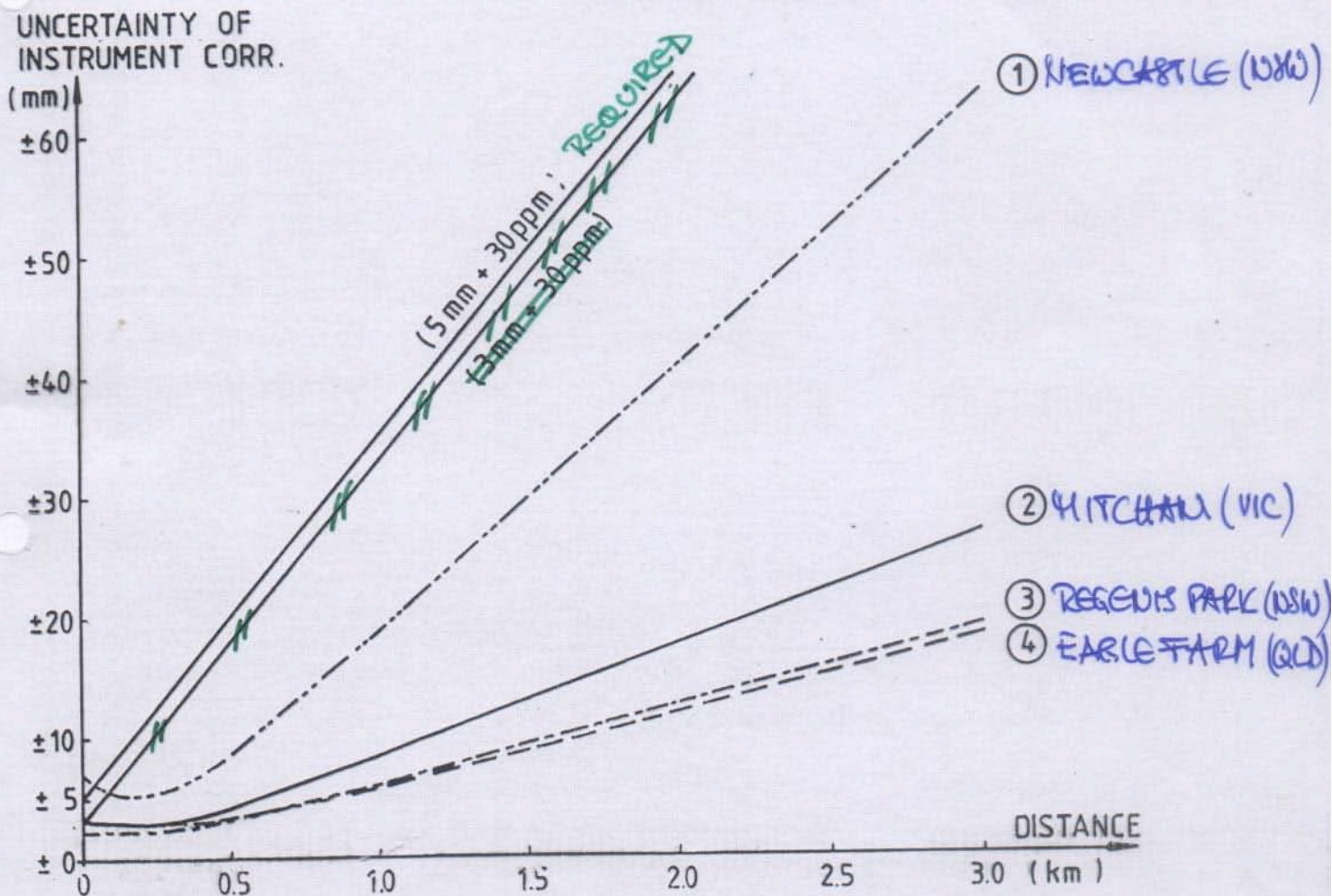
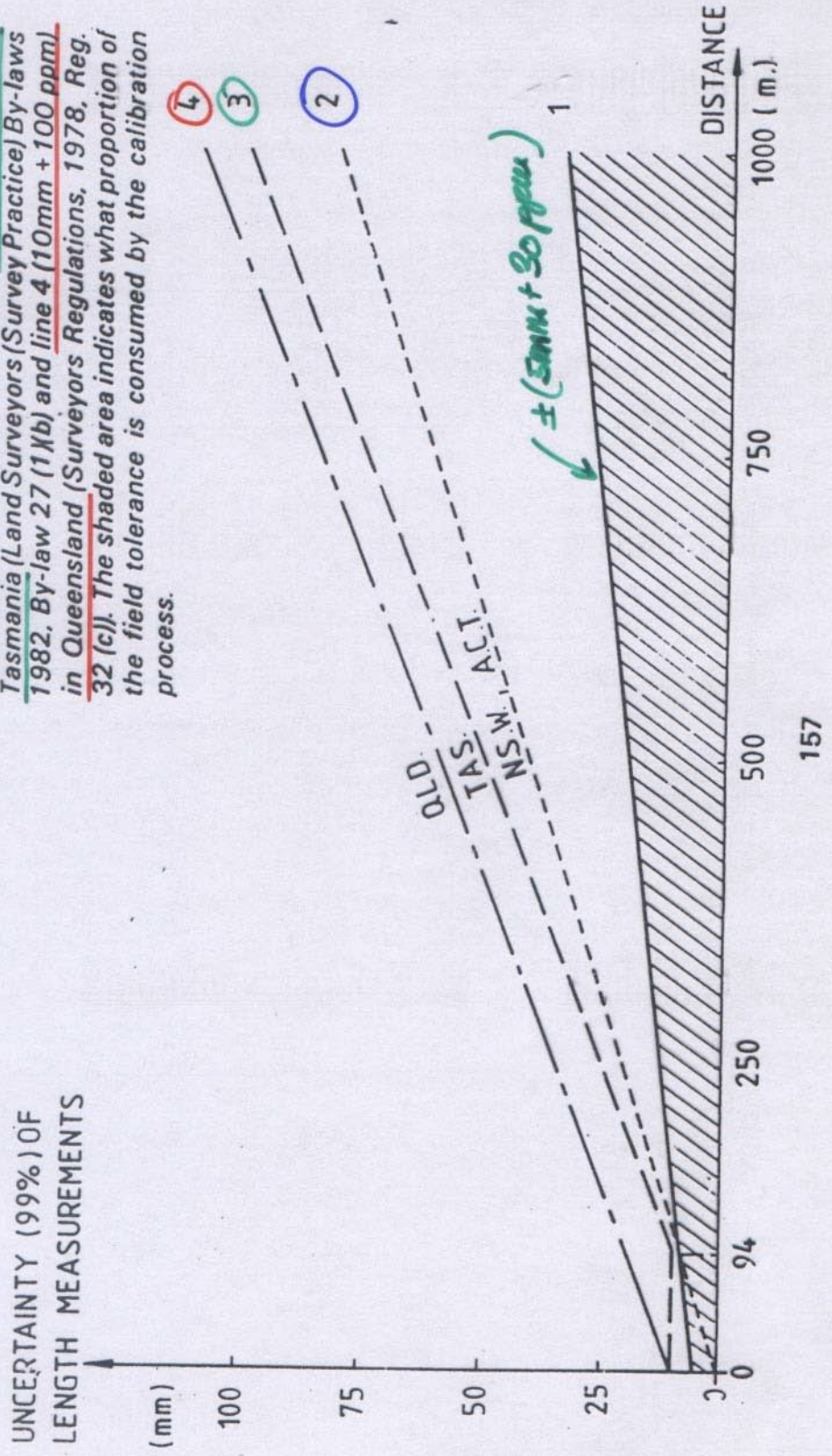


Figure 5: Tolerances of length measurements in cadastral surveys versus the specified uncertainty (against National Standards) of instrument corrections of short-range distance meters. The latter (5 mm + 30 ppm) is represented by line 1. Line 2 applies to the highest cadastral requirement of 1:12000 or 83 ppm in New South Wales (Survey Practice Regulations, 1933, Reg. 44 (a)) and in the Australian Capital Territory (Survey Practice Directions, 1980, Dir. 33 (a)). Line 3 applies in Tasmania (Land Surveyors (Survey Practice) By-laws 1982, By-law 27 (1)(b)) and line 4 (10mm + 100 ppm) in Queensland (Surveyors Regulations, 1978, Reg. 32 (c)). The shaded area indicates what proportion of the field tolerance is consumed by the calibration process.



Appendix 1: Sample of a Test Report

This report is fictitious in most parts. The distance measurements and the baseline however are real.

Surveyor-General of Victoria

Test No: 1248

Date: 15 Oct 1983

Statement of Test

ELECTRONIC DISTANCE METER

- (1) The Electronic Distance Meter AGA Geodimeter 112, Serial Number 23620, as mounted on the telescope of the theodolite Wild T2, serial number 234618, together with an AGA Prism (AGA Part No. 571 125 021), as mounted in the centre hole of a tiltable AGA Target (AGA Part No. 571 125 026), was calibrated on the 'Mitcham' Baseline in Melbourne on 10 October 1983 between 11.00 h and 12.00 h. The prism and the tiltable target carry the engraved marks 'M.M.B.W. 427' and 'M.M.B.W. 286', respectively.
- (2) The 'Mitcham' Baseline was last measured and certified under Regulation 80 of the National Standards Regulations on 5 October 1983. A full description of this baseline may be found in the publication 'The Mitcham Baseline', as published by this Department (Publ. No. 347, February 1983). The EDM Instrument as well as the target/reflector are owned by the Melbourne Metropolitan Board of Works, Mitcham Area Office.
- (3) The Measurements were executed in daylight and as specified in 'Recommended Field Procedures for ...' (Published by this Department, Publ. No. 286, March 1983). The reflector/target assembly was always pointed to the telescope of the theodolite using the gun sight in the centre of the target, both, horizontally and vertically. All observations were made on a sunny day with light NW winds. The temperatures varied from +17 degrees Celcius to +21 degrees Celcius, with a mean temperature of +19 degrees Celcius.
- (4) The following first velocity correction was applied to all measurements by computation:

$$K' = \left(\frac{275.0 - 79.6 p}{273.15+t} + \frac{11.20 e}{273.15+t} \right) 10^{-8} D$$

where t in degree Celcius, p and e in millibar. The yearly average partial water vapor pressure of 12.8 mb was used, as specified for the Mitcham Baseline.

- (5) No additive constant was applied to the measurements. Any built-in additive constants are unknown and inaccessible to the user. The observations were executed by Messrs. B. Green, P. Brown and G. Blue of the Melbourne Metropolitan Board of Works.

- (6) For the temperature measurements a Zeal mercury pocket thermometer graduated from 0 degrees Celcius to 60 degrees Celcius at 1 degree Celcius intervals was used. The calibration constant of this thermometer was determined by comparison with the weather station dry bulb thermometer at Mitcham Post Office on 9 October 1983 and yielded + 0.4 degree Celcius with an uncertainty of one part in one hundred +/- 0.5 degrees Celcius. This thermometer carries the engraved mark 'M.M.B.W. 846'. A Thommen pocket barometer 'Everest 6000m' with the serial number 416452 was used for the measurement of atmospheric pressure. Its calibration constant was derived by comparison with the mercury column barometer at the Mitcham Post Office on 9 October 1983 and yielded - 16.4 mb with an uncertainty of one part in one hundred of +/- 0.5 mb. Both calibrations were executed as specified by the 'Recommended Field Procedures for ...' (published by this Department, Publ. No. 286, March 1983).
- (7) The instrument correction I.C. (in millimetre) was determined according to the 'Recommended Analysis Procedures for ...' (Published by this Department, Publ. No. 287, March 1983) as follows:

$$I.C. = - 0.7 - 2.8 (D/1000)$$

where D is the distance in metre. This instrument correction is valid in the distance range from 70 m to 600 m and for an ambient temperature of + 19 degrees Celcius. The second term of the instrument correction refers to a setting of the PPM-Dial to +/- 0 ppm. The uncertainty of one part in one hundred of the above instrument correction I.C. is +/- 2.44 mm, +/- 2.40 mm, +/- 4.00 mm at 70 m, 260 m and 600m, respectively. As a guide only, the uncertainties of the instrument correction are also given for longer distances as +/- 7.8 mm, +/- 12.0 mm and +/- 16.2 mm for distances of 1200m, 1800m, and 2400m, respectively. When considering these values, due allowance should be made for the fact that they are based on extrapolation.

- (8) This instrument/reflector set fulfils the requirements of Recommendation No. 8 of the NSC's working party on the 'Calibration of EDM Equipment'. The periodic error was tested over a wavelength of 10m at distances ranging from 70 m to 600 m; it was found to be insignificant. The measured mean distances were found to have a precision of +/- (0.6 mm + 0.4 ppm).
- (9) The original measurements and computations may be found in file 'Test 1248' of this Department. The instrument should be reverified on or before the fifth October 1984.

CERTIFIED ON THE FIFTEENTH DAY OF OCTOBER 1983 FOR THE SURVEYOR-GENERAL OF VICTORIA
A.B.C. Miller