

City of Quesnel
410 Kinchant Street
Quesnel, BC V2J 7J5

Dear Mr. Jack Marsh, Director of Public Works

**RE: NOVEMBER SLOPE INCLINOMETER INSTALLATION READINGS
WEST QUESNEL STABILITY STUDY**

1.0 INTRODUCTION

This purpose of this letter is to provide the City of Quesnel (CoQ) with an update on slope inclinometer (SI) monitoring in West Quesnel.

Since installation and initial survey of the seven SI installations in the late fall of 2000, AMEC has conducted 10 subsequent readings of each SI (except SI-4 and SI 5 where 11 sets of readings have been conducted). The latest set of readings was conducted on November 19, 2002. At that time three more of the installations (SI-3, SI-4, and SI-7) were determined to be blocked or sheared at depths corresponding with the previously detected slip surface locations. SI-6 had been previously determined to be blocked in a similar manner during May 2002. At present the only remaining fully functional installations are SI-1, SI-2, and SI-5. SI-7 had two slip surfaces detected in it, and was found to be blocked at the lower one. It is therefore still possible to monitor relative movement above and below the upper failure surface in SI-7.

The remainder of this letter further describes slope inclinometer measurements to date.

2.0 SI READING SCHEDULE

Table 1 summarizes the SI reading schedule to date:

Table 1: SI Monitoring Schedule

| SI | SI-1 | SI-2 | SI-3 | SI-4 | SI-5 | SI-6 | SI-7 |
|---------------------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Location | Avery Lane | Avery Lane | Abbott Drive | Voyager School | Abbott Drive | Dixon Street | Pierce Crescent |
| Depth SI Read to (feet/m) | 142 ft 43 m | 244 ft 74 m | 334 ft 102 m | 504 ft 154 m | 474 ft 144 m | 502 ft 153 m | 410 ft 125 m |
| Spiral Reading | 11 Jun. 2001 | 11 Jun. 2001 | 12 Jun. 2001 | 11 Jun. 2001 | 12 Jun. 2001 | 11 Jun. 2001 | 12 Jun. 2001 |
| Initial Reading Date | 21 Nov. 2000 | 21 Nov. 2000 | 21 Nov. 2000 | 3 Nov. 2000 | 28 Oct. 2000 | 22 Nov. 2000 | 22 Nov. 2000 |
| Reading 1 | 7 Dec. 2000 | 7 Dec. 2000 | 6 Dec. 2000 | 24 Nov. 2000 | 24 Nov. 2000 | 6 Dec. 2000 | 7 Dec. 2000 |
| Reading 2 | 12 Jan. 2001 | 11 Jan. 2001 | 12 Jan. 2001 | 6 Dec. 2000 | 6 Dec. 2000 | 11 Jan. 2001 | 12 Jan. 2001 |
| Reading 3 | 5 Mar. 2001 | 5 Mar. 2001 | 6 Mar. 2001 | 11 Jan. 2001 | 12 Jan. 2001 | 5 Mar. 2001 | 6 Mar. 2001 |
| Reading 4 | 2 Apr. 2001 | 2 Apr. 2001 | 3 Apr. 2001 | 5 Mar. 2001 | 6 Mar. 2001 | 2 Apr. 2001 | 3 Apr. 2001 |
| Reading 5 | 28 Apr. 2001 | 28 Apr. 2001 | 28 Apr. 2001 | 2 Apr. 2001 | 3 Apr. 2001 | 28 Apr. 2001 | 29 Apr. 2001 |
| Reading 6 | 18 Jun. 2001 | 13 Jun. 2001 | 14 Jun. 2001 | 28 Apr. 2001 | 29 Apr. 2001 | 13 Jun. 2001 | 14 Jun. 2001 |
| Reading 7 | 4 Oct. 2001 | 4 Oct. 2001 | 4 Oct. 2001 | 14 Jun. 2001 | 14 Jun. 2001 | 26 Sep. 2001 | 4 Oct. 2001 |
| Reading 8 | 20 Nov. 2001 | 19 Nov. 2001 | 19 Nov. 2001 | 4 Oct. 2001 | 4 Oct. 2001 | 19 Nov. 2001 | 20 Nov. 2001 |

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Table 1: SI Monitoring Schedule

| SI | SI-1 | SI-2 | SI-3 | SI-4 | SI-5 | SI-6 | SI-7 |
|------------|--------------|--------------|--------------|----------------|--------------|--------------|-----------------|
| Location | Avery Lane | Avery Lane | Abbott Drive | Voyager School | Abbott Drive | Dixon Street | Pierce Crescent |
| Reading 9 | 6 May 2002 | 6 May 2002 | 6 May 2002 | 19 Nov. 2001 | 19 Nov. 2001 | blocked | 6 May 2002 |
| Reading 10 | 19 Nov. 2002 | 19 Nov. 2002 | blocked | 6 May 2002 | 6 May 2002 | blocked | 19 Nov 2002* |
| Reading 11 | | | | blocked | 19 Nov 2002 | | |

* The SI casing was blocked at lower slip surface, still passable at upper slip surface.

3.0 SI READING RESULTS

Attached in Appendix A are the results of the SI readings to date. The SI readings are presented in incremental and cumulative plots with a 75 mm and 100 mm horizontal displacement scale versus depth. The incremental plots show the individual changes in inclination of the casing at each reading elevation. The cumulative plots are constructed by adding together the incremental changes starting from the bottom of the installation and show the overall apparent movement of the SI casing at each elevation relative to the bottom of the casing.

Two channels of readings are presented: A and B. The A channel is oriented to be "down slope" whereas the B channel is "across slope". The actual orientation of each of the casings is shown on previously supplied mapping. Positive movements on the cumulative plots are down slope on Channel A and across the slope to the right when looking downhill for Channel B.

Table 2 presents AMEC's observations based on the data gathered to date.

Table 2: Slope Inclinomometer Casing Displacement - Dec. 2000 to Nov. 2002

| Installation No. | Location | Casing Displacement (mm) | | Interpretation | Notes |
|------------------|-------------------|--------------------------|-----------------------|---------------------------------|---|
| | | (A) Max. Down Slope | (B) Max. Across Slope | | |
| SI 1 | Avery Lane | 24 | 19 | sliding at 26 and 40 m depths | |
| SI 2 | Avery Lane | 74 | 8 | sliding at 42 and 60 m depths | |
| SI 3 | Abbott & Bettcher | 62* | 10* | sliding at 39 m | Casing sheared at 39 m between May 2002 and Nov 2002 |
| SI 4 | Voyageur School | 60* | 8* | sliding at 51 m | Casing sheared at 51 m between May 2002 and Nov 2002 |
| SI 5 | Abbott Drive | 94 | 26 | sliding at 37 m | Casing compression, 37 to 92 m |
| SI 6 | Dixon Street | 60* | 3* | sliding at 28 m | Casing sheared at 51 m between Nov 2001 and May 2002 |
| SI 7 | Lewis & Pierce | 77* | 25* | sliding at 27 m and 68 m depths | Casing sheared at 68 m between May 2002 and Nov 2002, will continue reading casing above 68 m depth to monitor slip surface at 27 m depth |

* Displacements are reported until last reading prior to the SI being sheared

Included in Appendix B are horizontal displacement versus time (velocity) plots. Velocity plots are given in the downhill A channel direction (positive displacements indicate movement toward the east, and negative toward the west) and in the cross slope B channel direction (positive displacements indicate movement toward the south and negative displacements toward the north).

The following notes should be read while reviewing the SI data presented in Appendix A:

- A second set of plots for SI-5 has been included with the readings previous to 3 April 2001 omitted to eliminate the wave like profile observed in the raw data. This plot may present a clearer representation of how much of the SI deformation may be attributable to lateral ground movement, as opposed to vertical compression of the casing.
- A second set of plots has been included for SI-7 for the portion of the borehole above 68 m which can be still monitored.

4.0 FUTURE WORK

Given the nature of the movements observed to date, AMEC recommends continued monitoring of the operable SI installations, with the next set of readings being conducted in the early spring of 2003. Given that the majority of SI's have been sheared in the Uplands Area, AMEC suggests that an additional SI installation be installed either at Voyageur School or in the central portion of the study area. Note that any new SI should be installed to a depth of at least 10 m past the previously recorded lowest slip surface, rather than the full depth of the original installation. This installation would replace one of the 6 new installations recommended in AMEC's final report of 25 October, 2002.

5.0 CLOSURE

Thank you for the opportunity to provide assistance in this matter. Should you have any questions or comments please contact Mr. Nick Polysou at 1-250-564-3243.

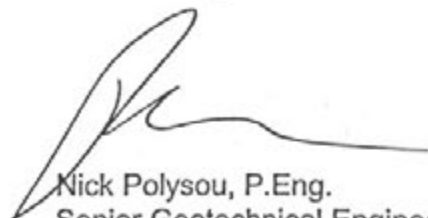
Respectfully submitted,

AMEC Earth & Environmental Limited

Reviewed by:



Shiloh Jorgensen, E.I.T.
Geotechnical Engineer



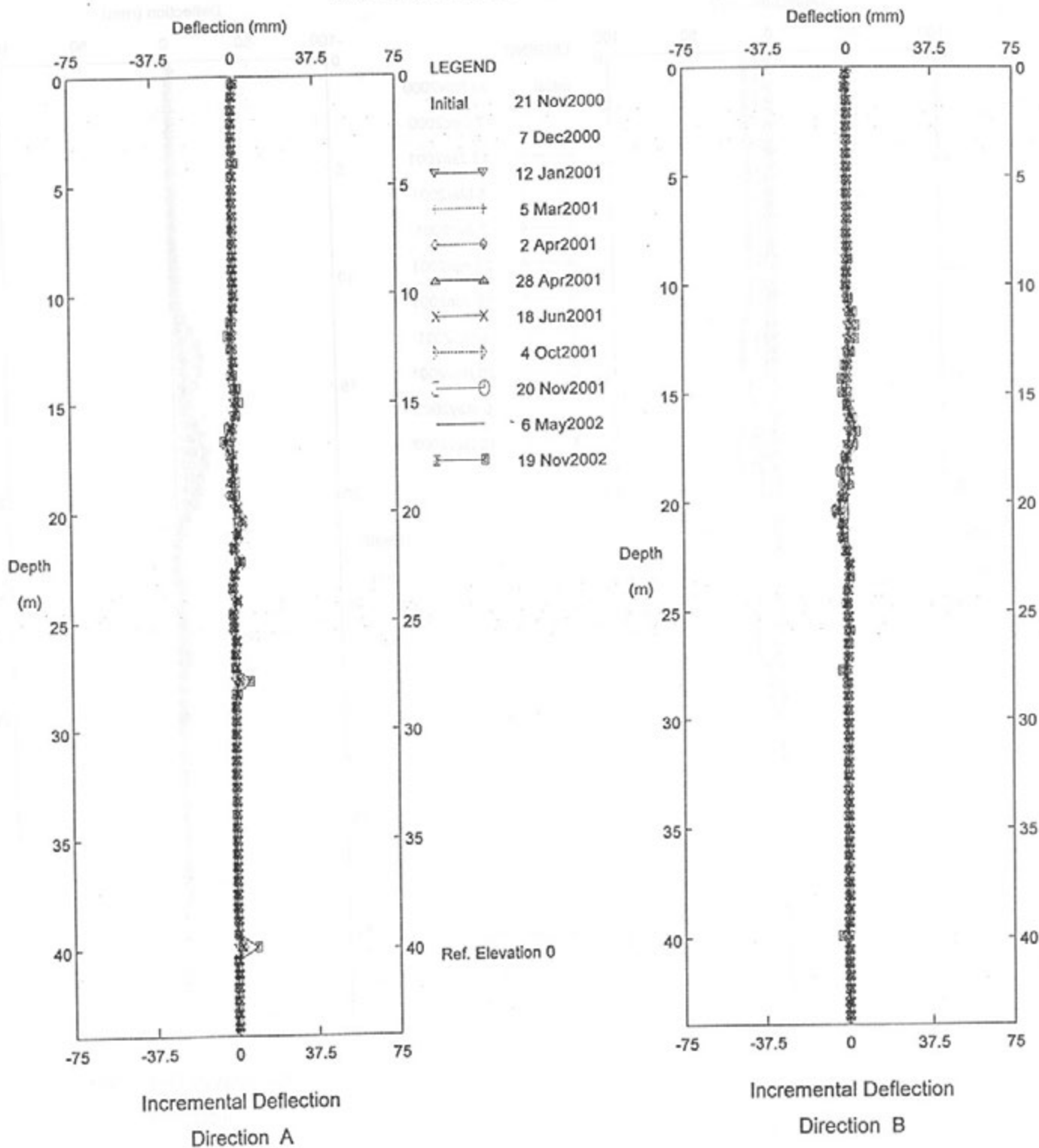
Nick Polysou, P.Eng.
Senior Geotechnical Engineer
Regional Manager, Central BC.



Doug Dewar, M.Sc., P.Eng.
Geotechnical Engineer

APPENDIX A

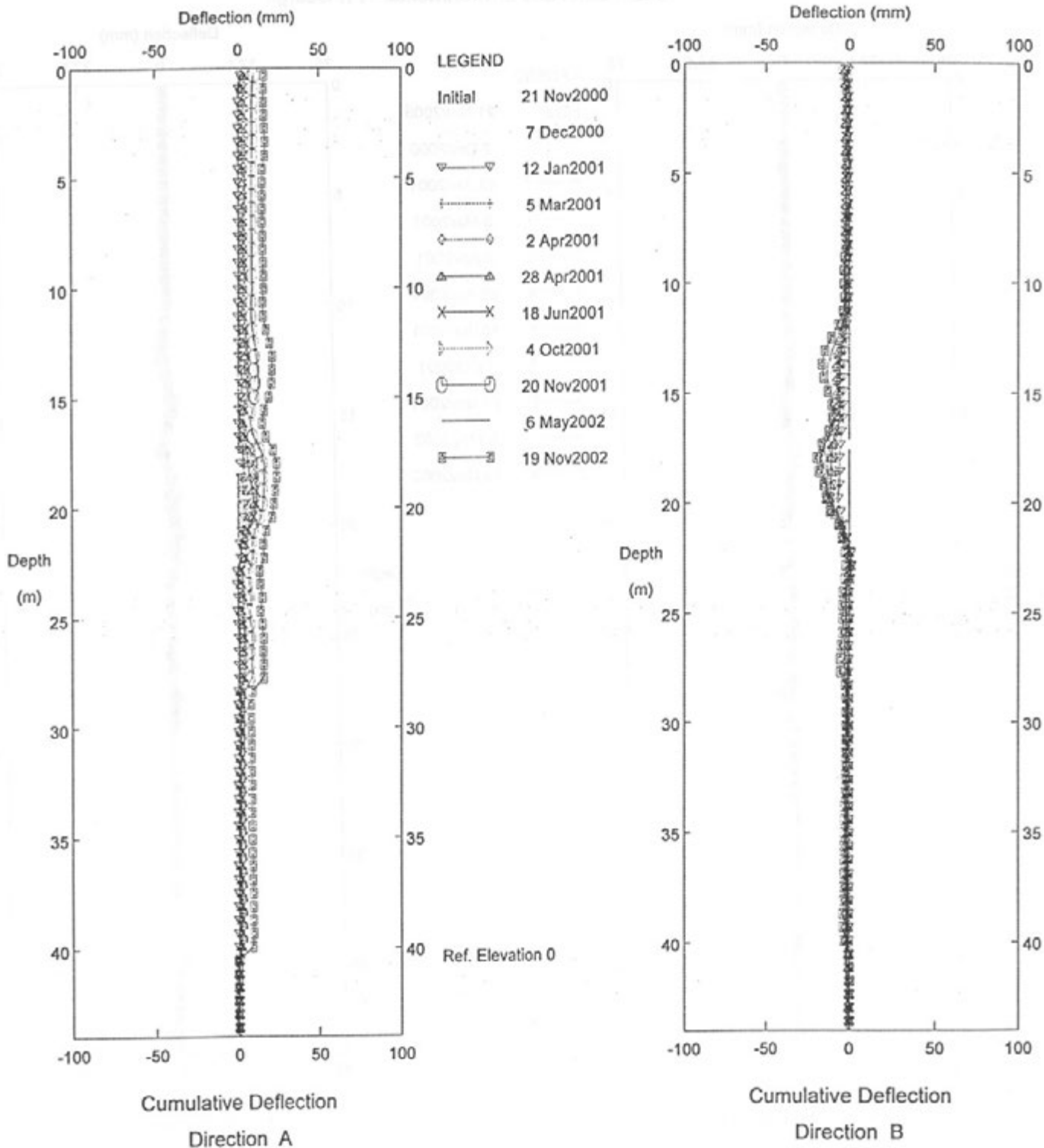
SI READING RESULTS



KX03904 W. Quesnel Stability Study, Inclinator SI-1 Corr.

Lower Avery Lane

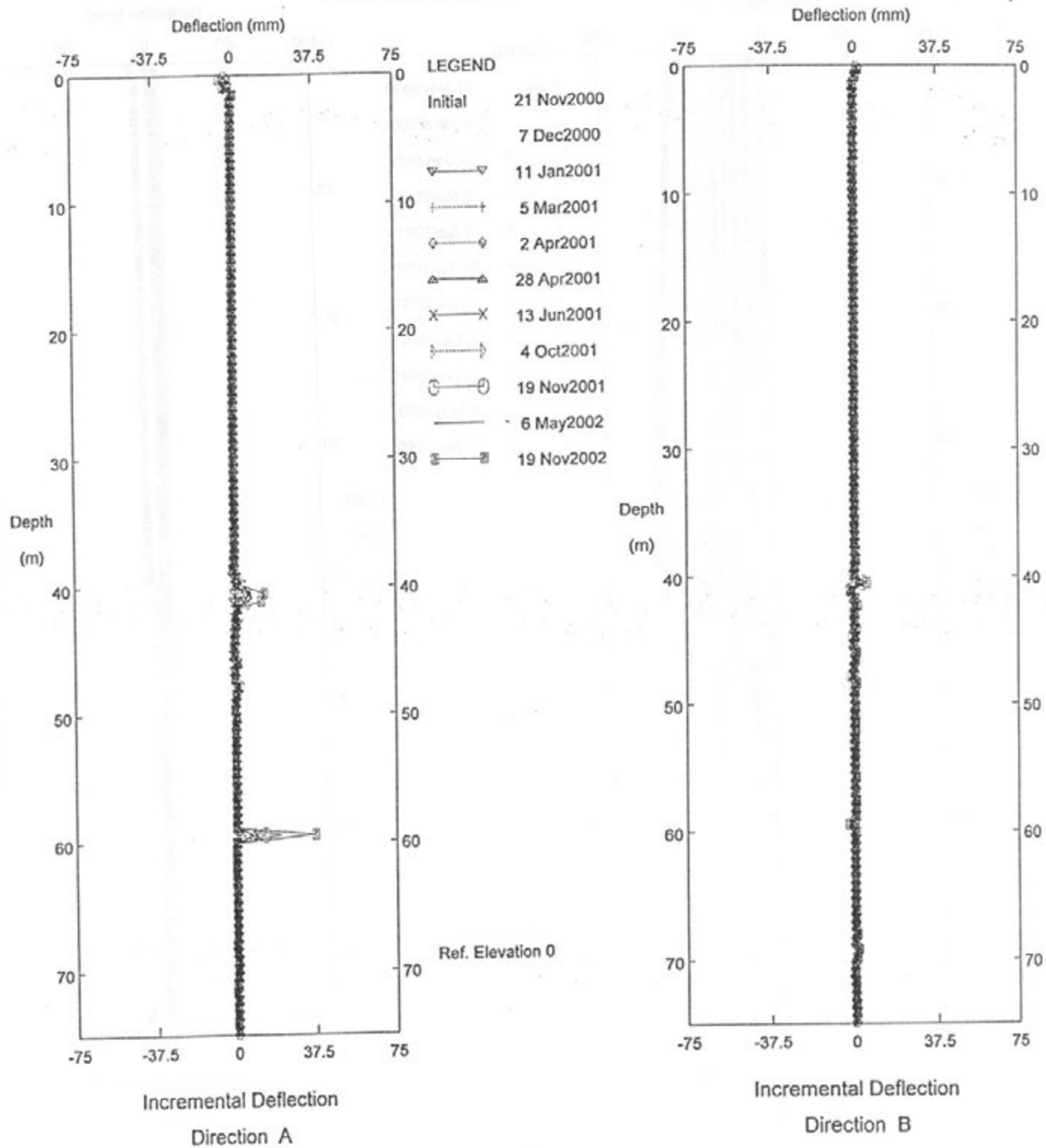
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Lower Avery Lane

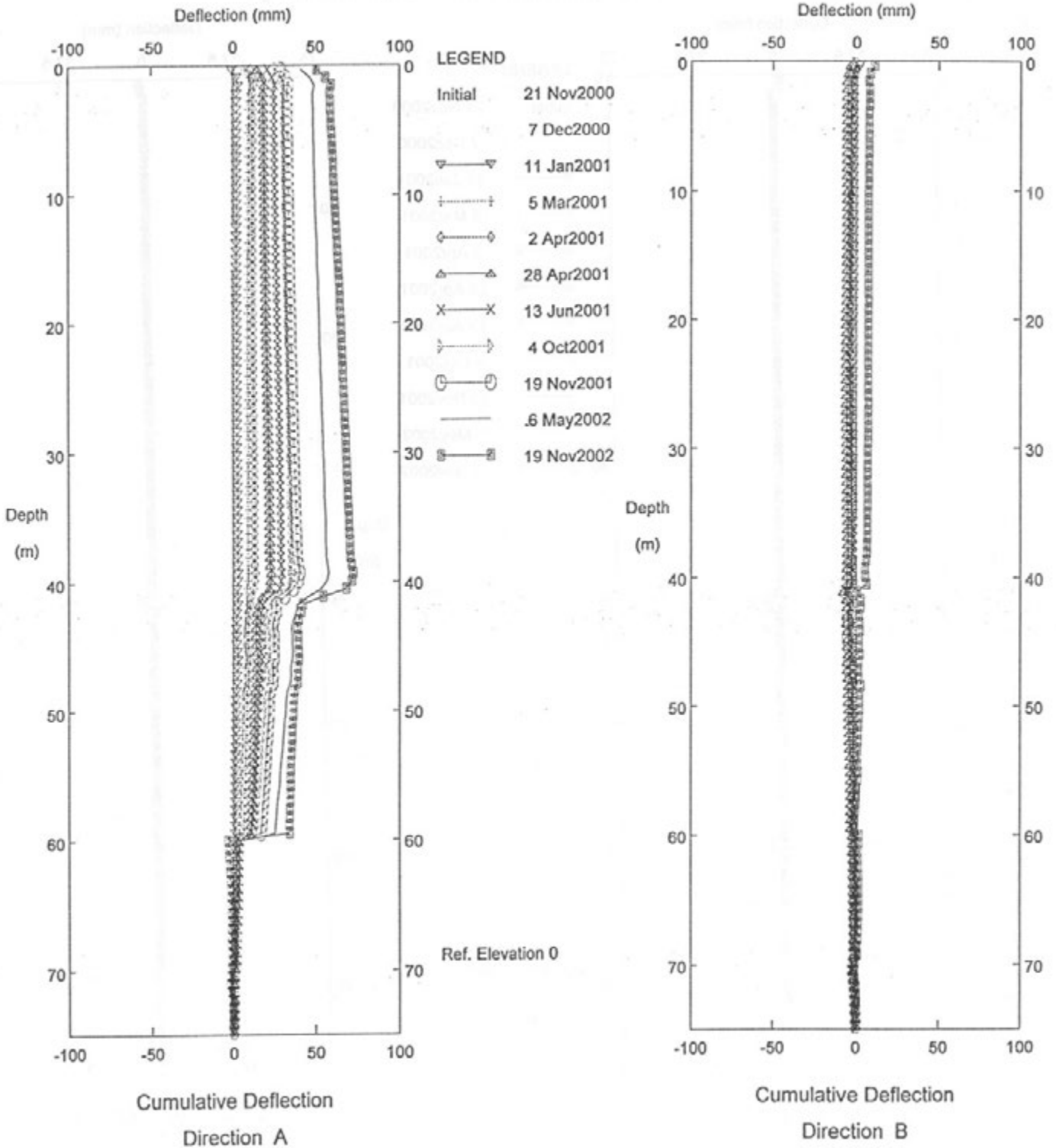
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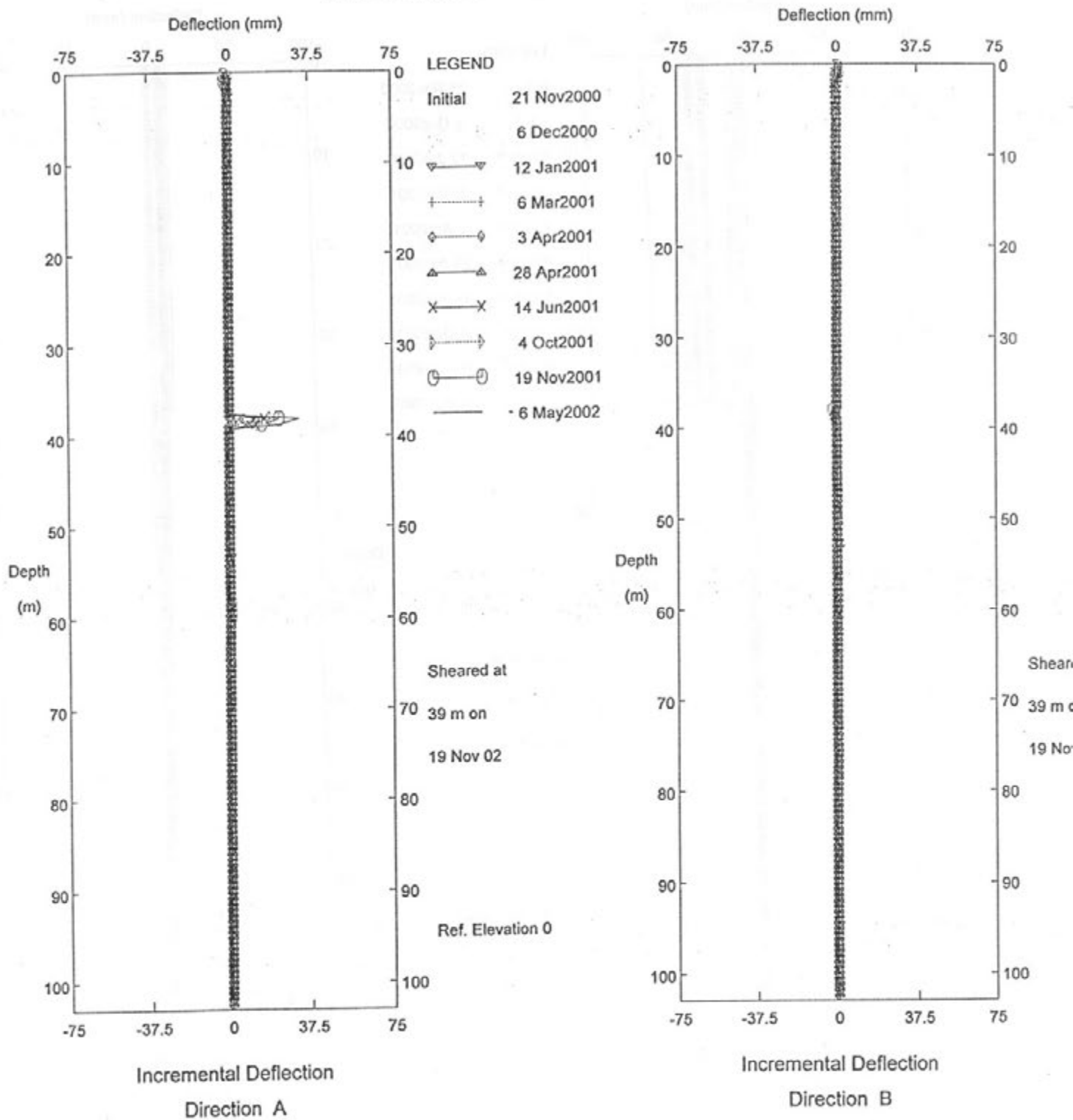
Upper Avery Lane

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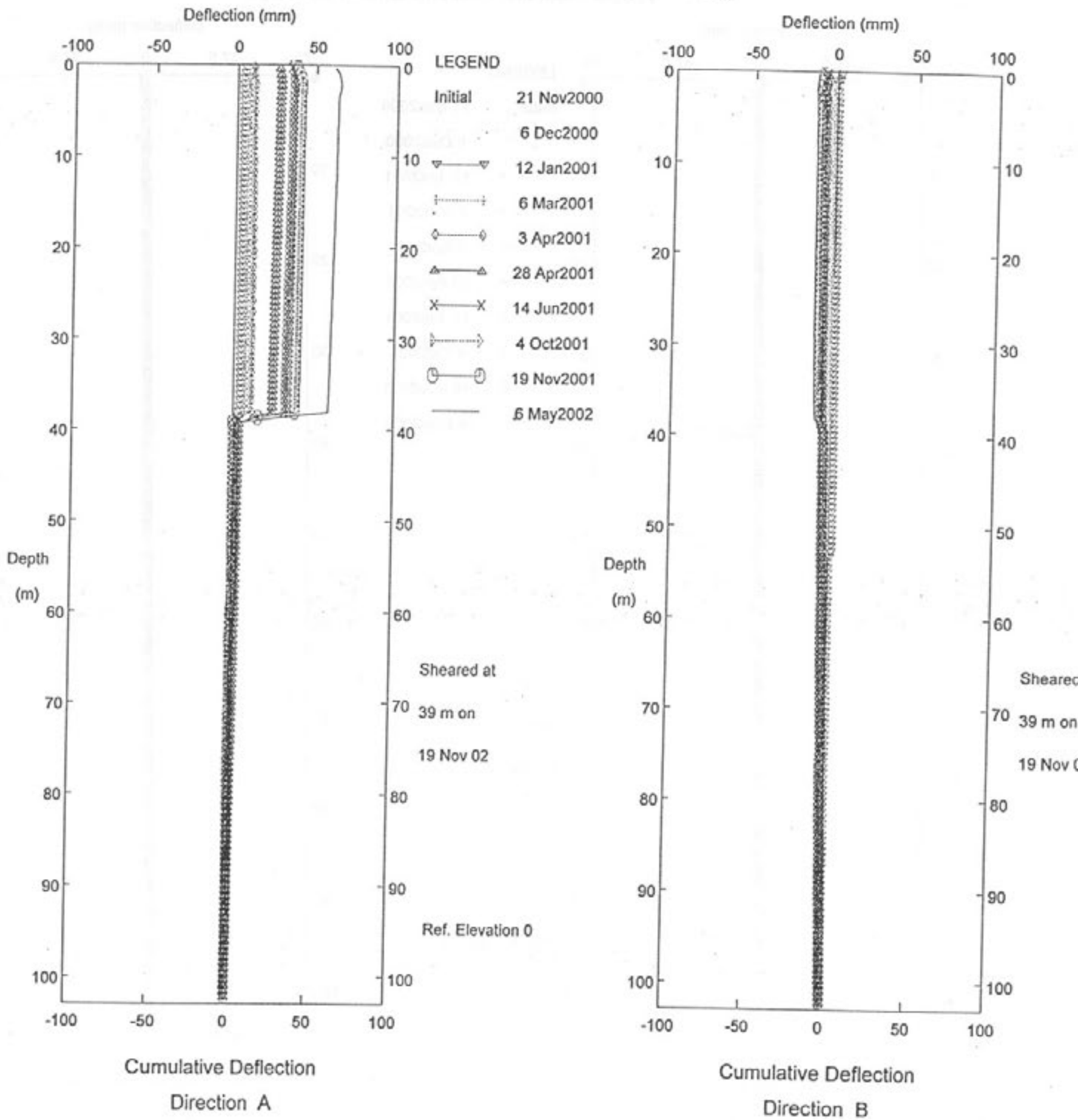
Upper Avery Lane



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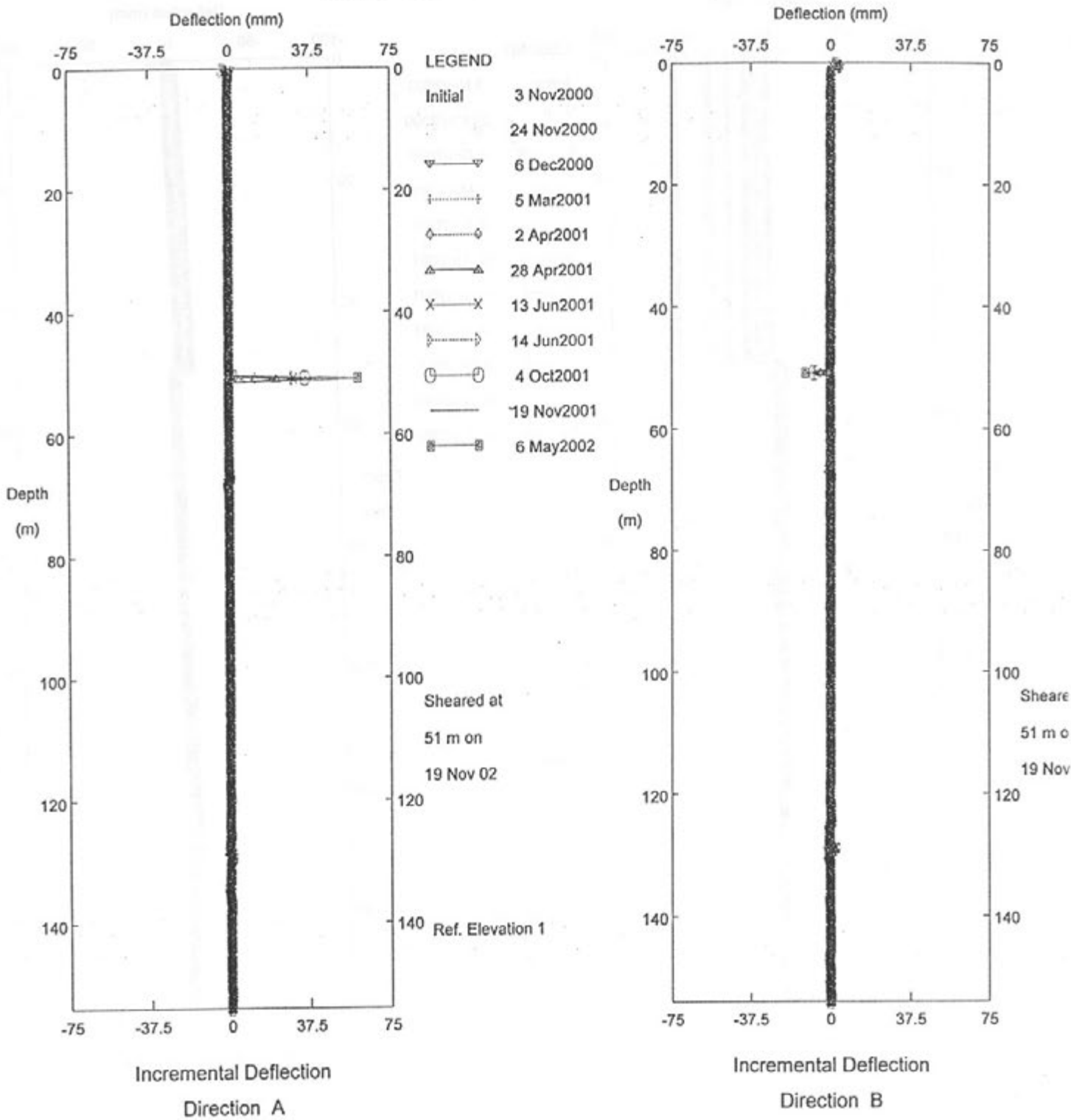
Abbott Drive near Bettcher

Sets marked * include zero shift and/or rotation corrections.



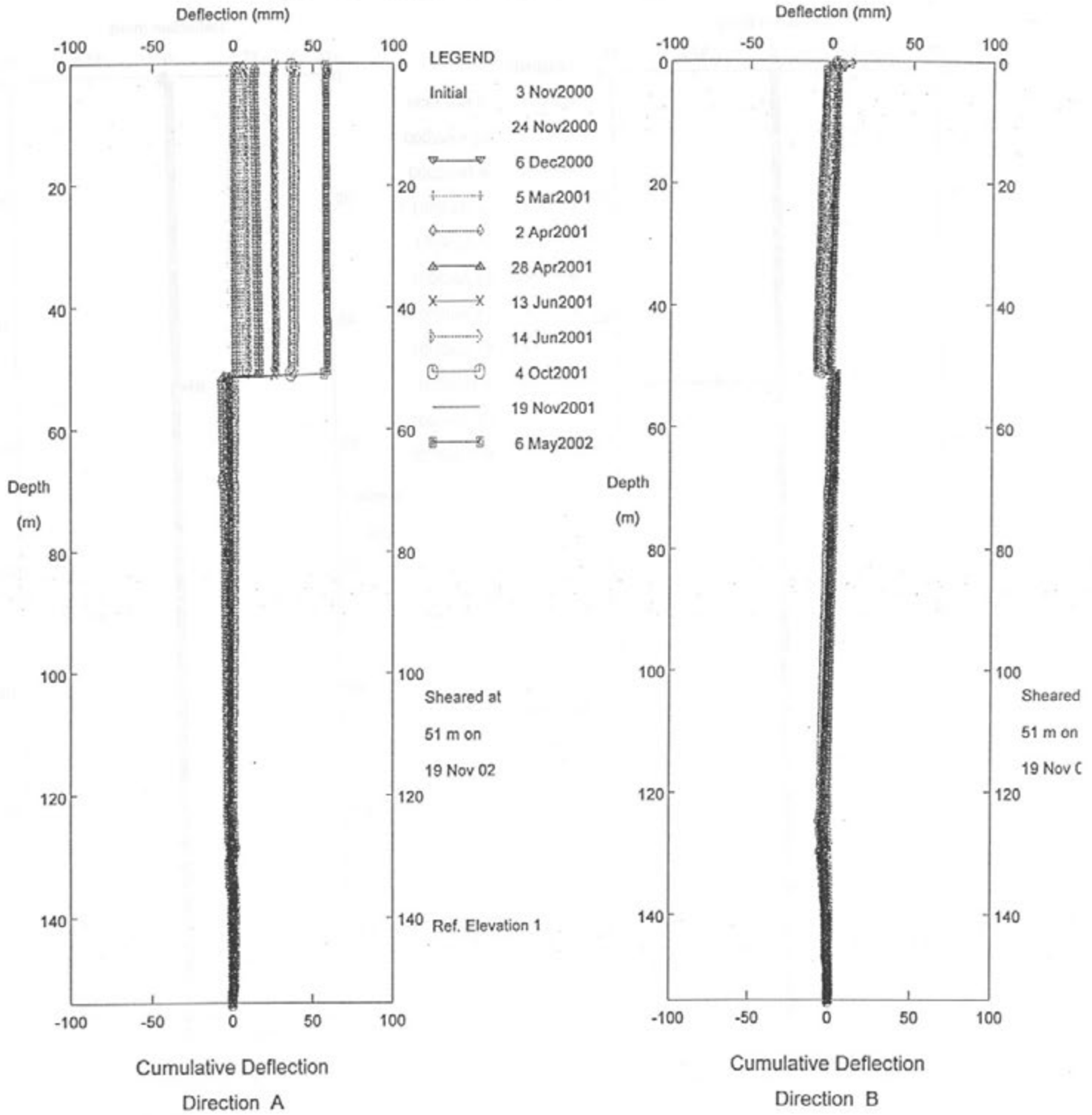
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Abbott Drive near Bettcher



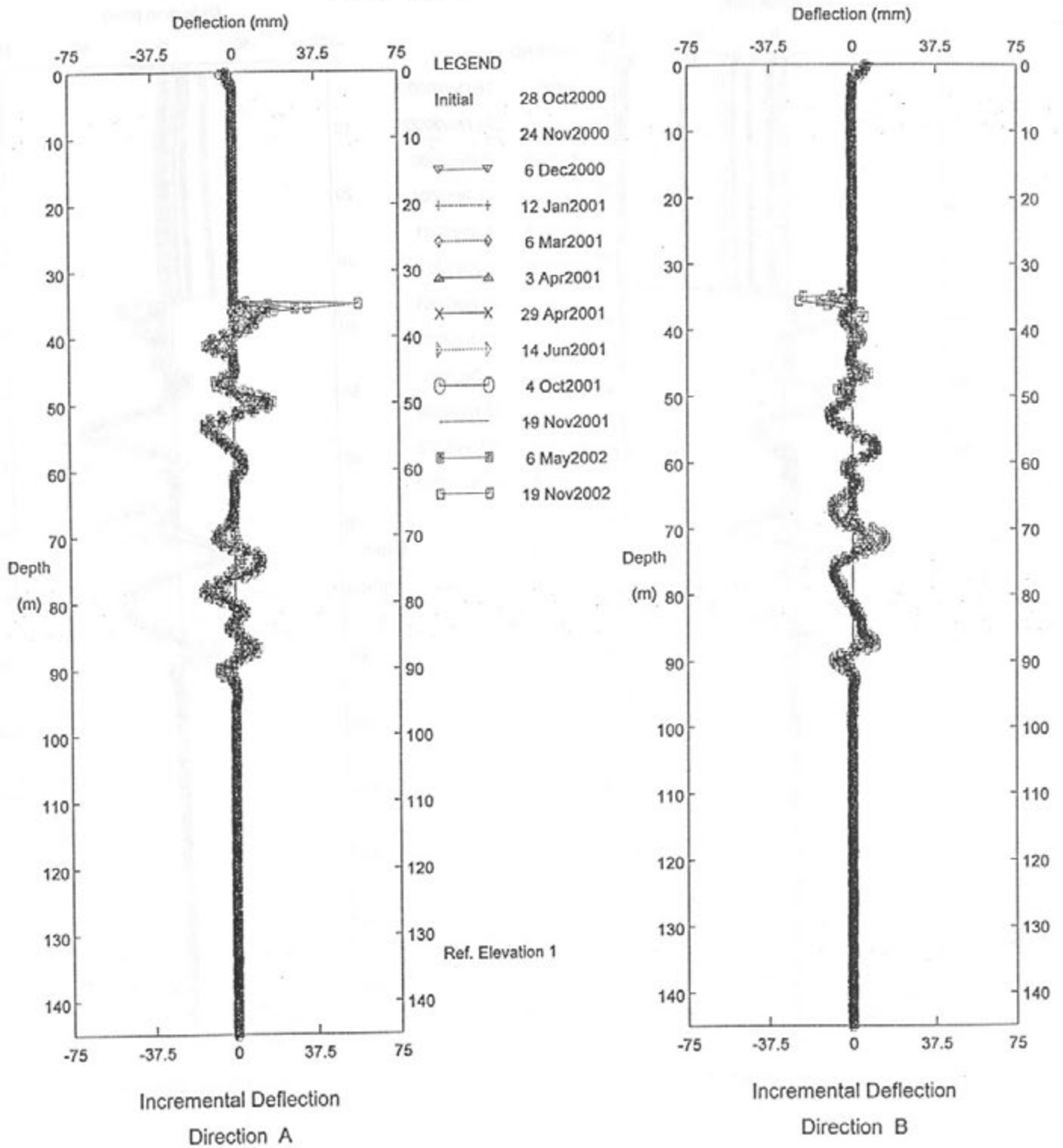
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Voyageur School



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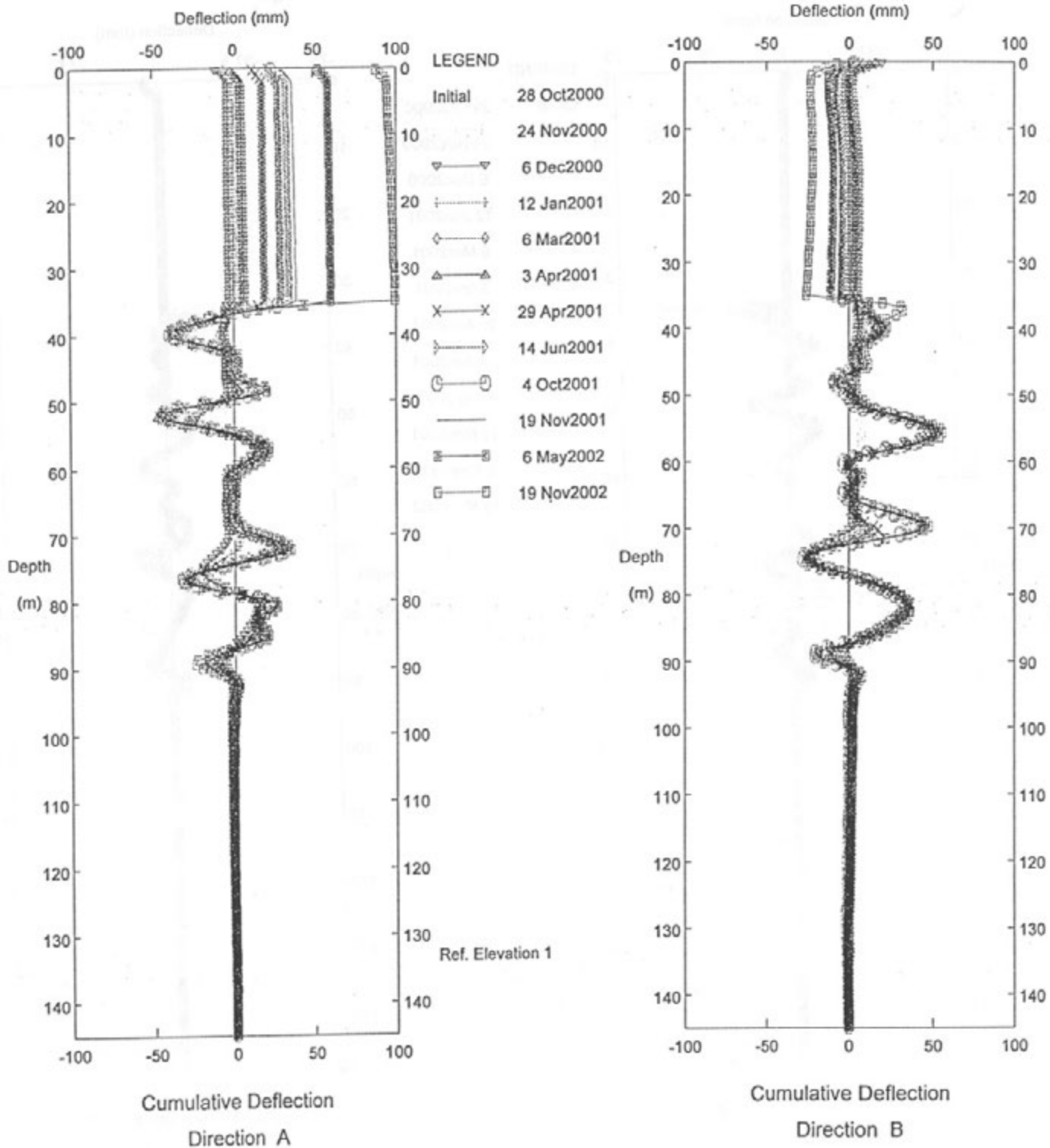
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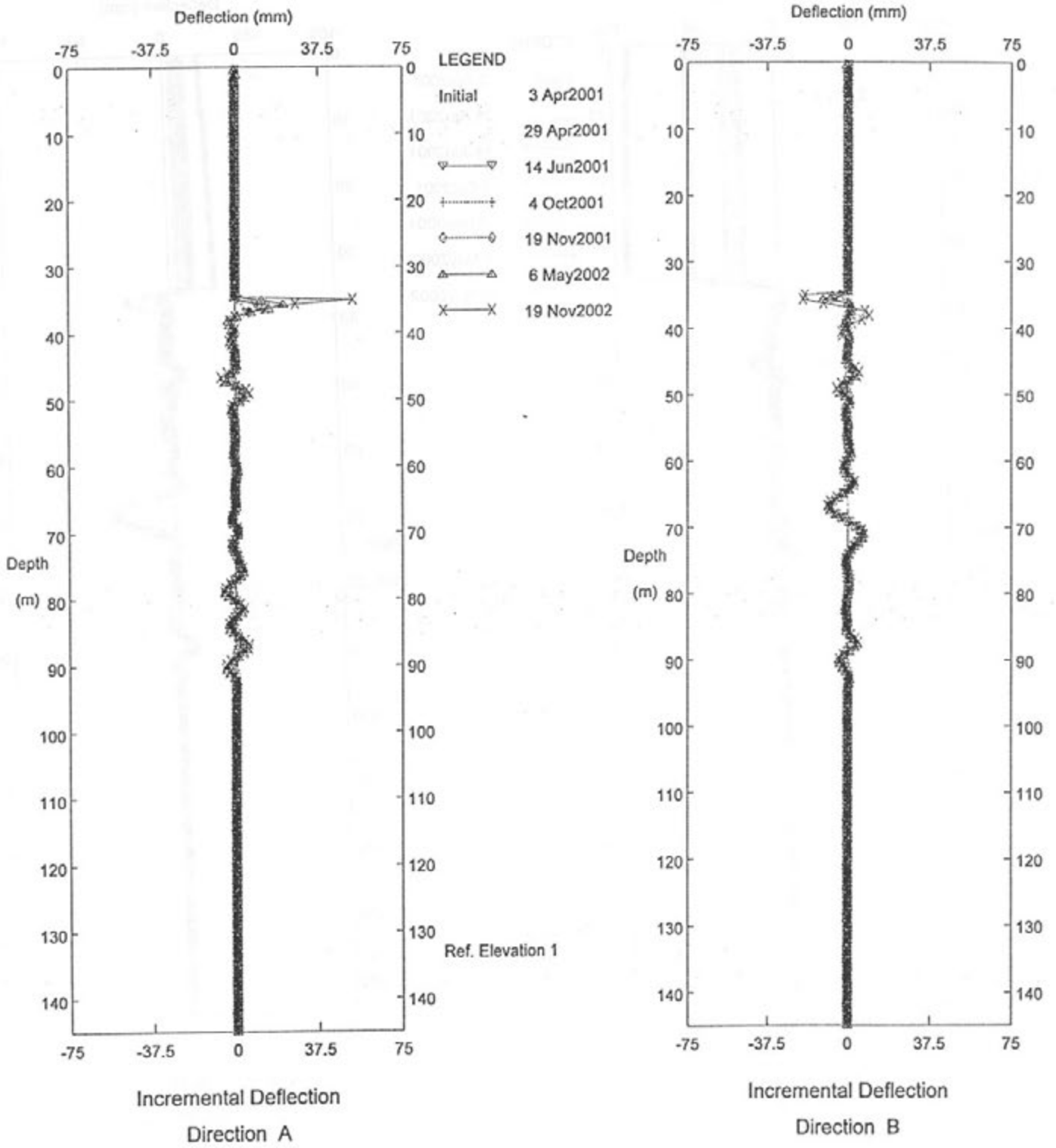


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Abbott Drive

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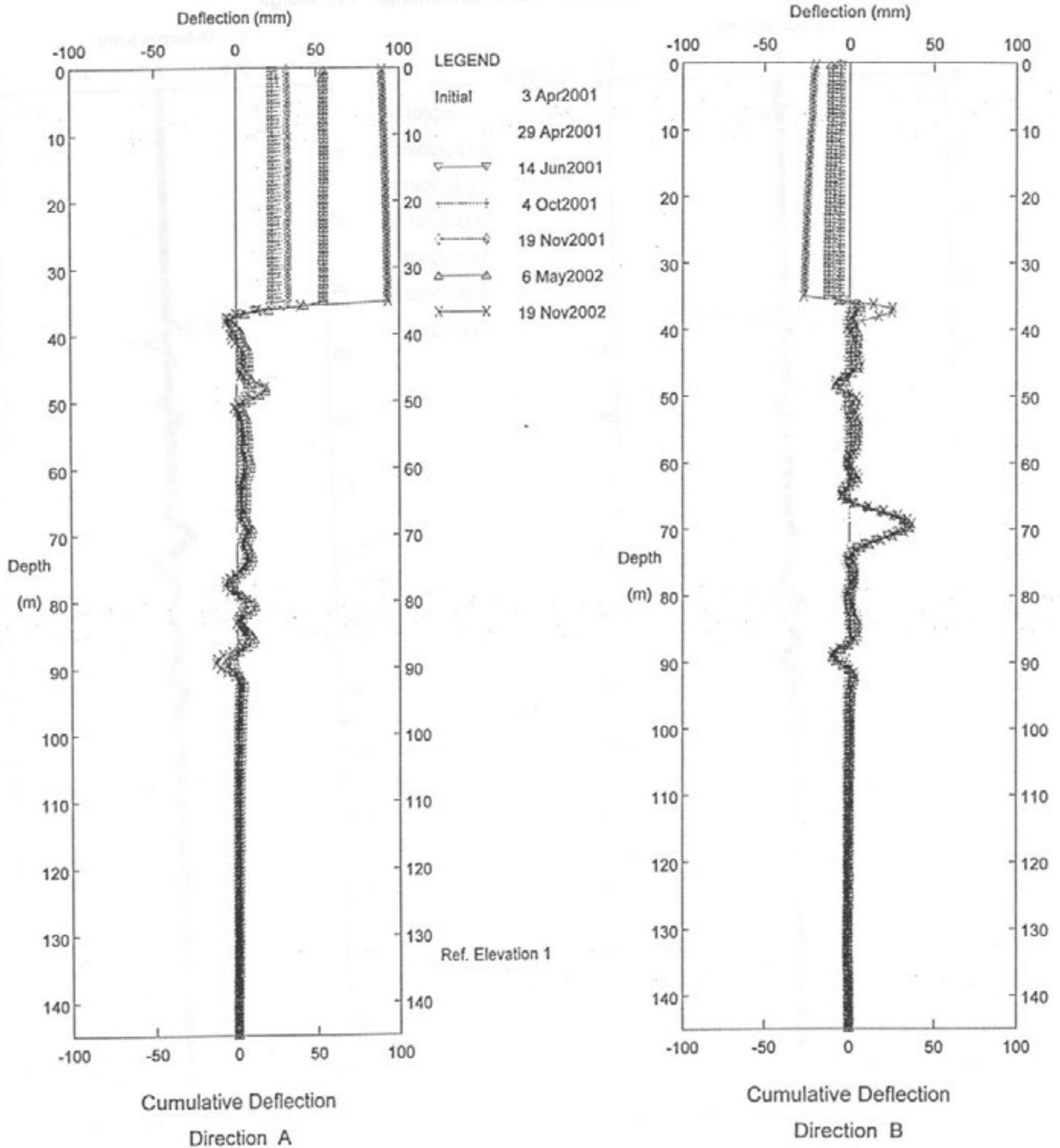


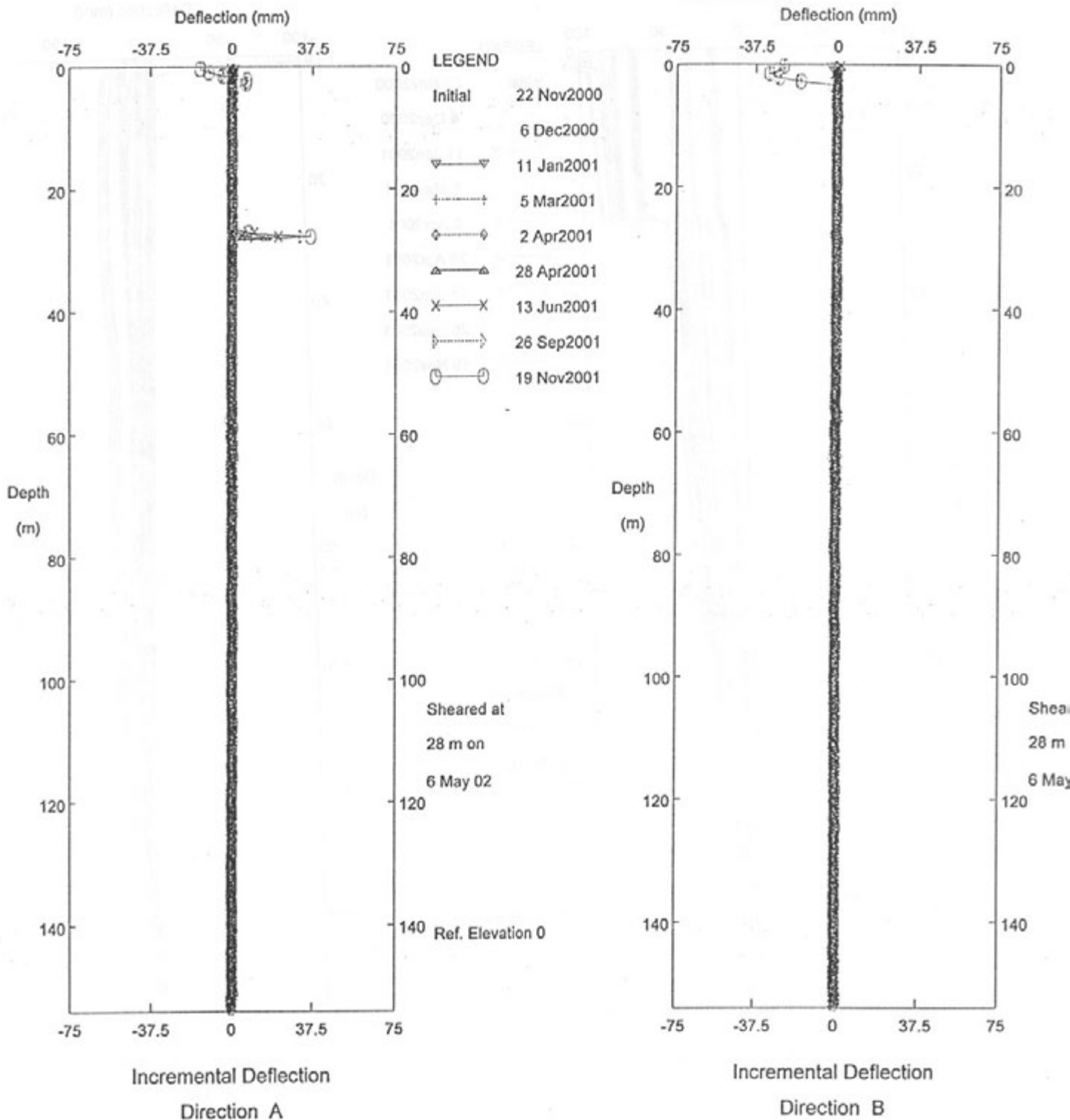


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Abbott Drive

AMEC Earth and Environmental - Pr. George

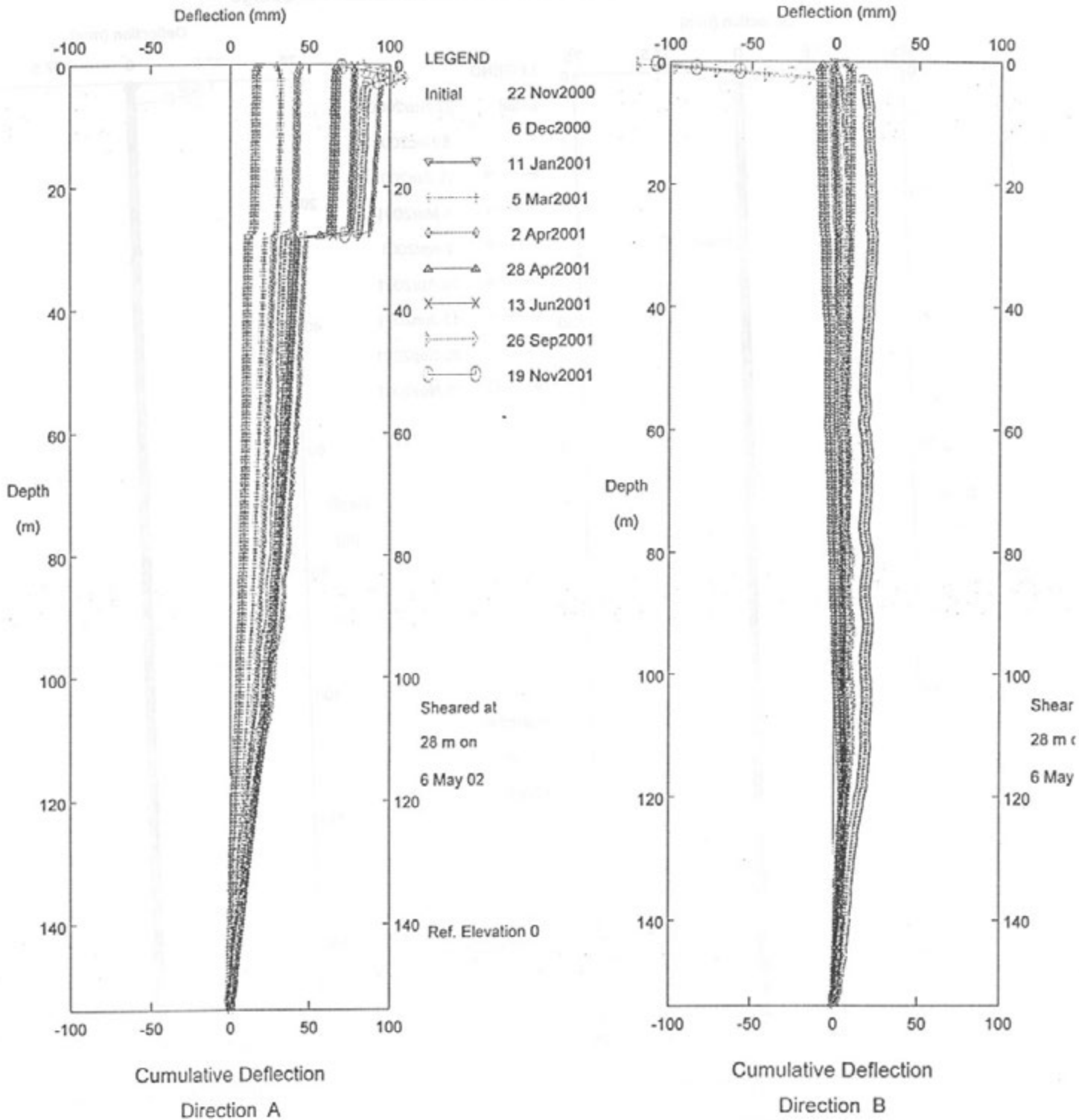




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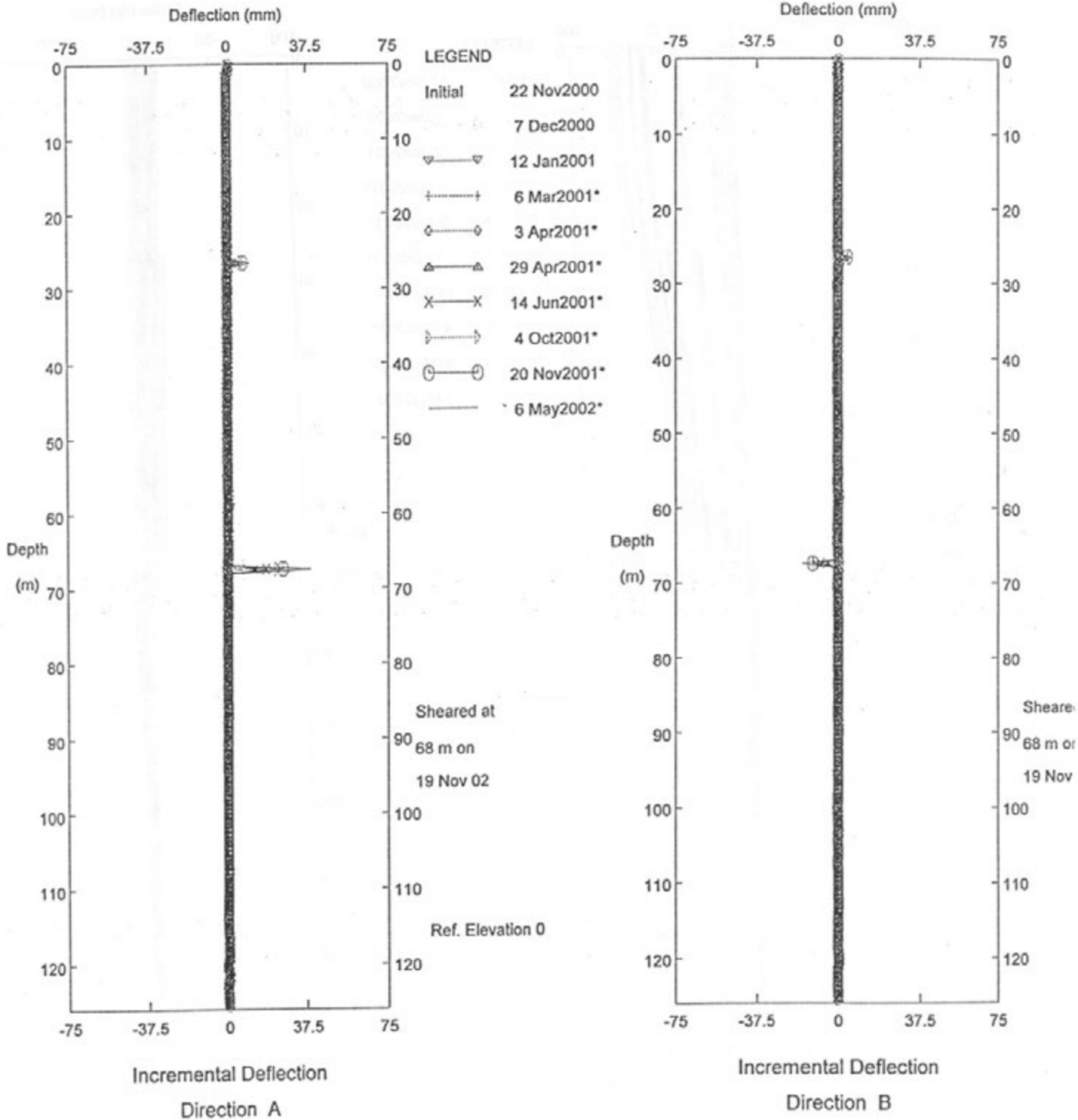
End of Dixon Street

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End of Dixon Street

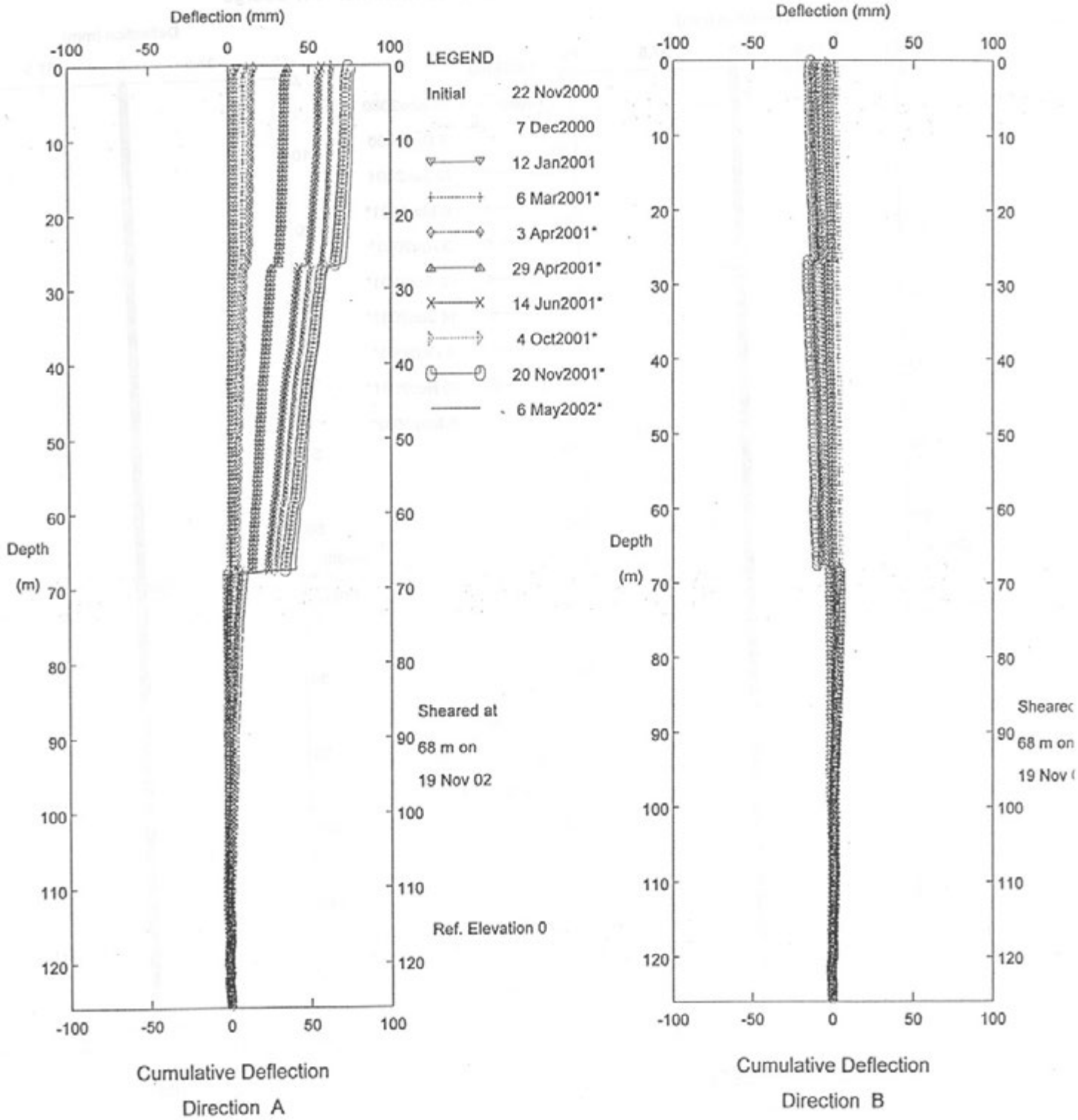


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Pierce Crescent & Lewis Drive

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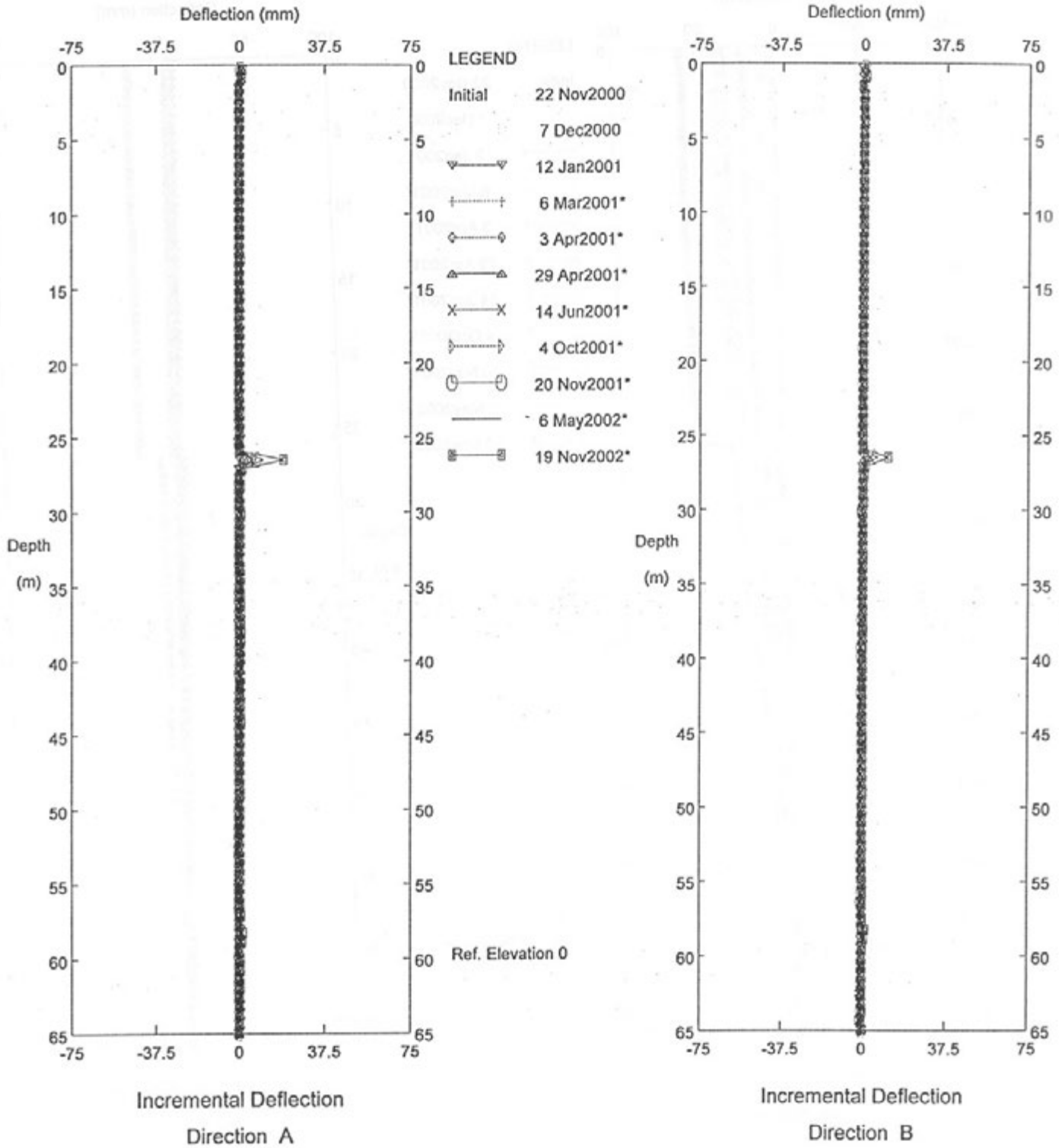
AMEC Earth and Environmental - Pr. George



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Pierce Crescent & Lewis Drive

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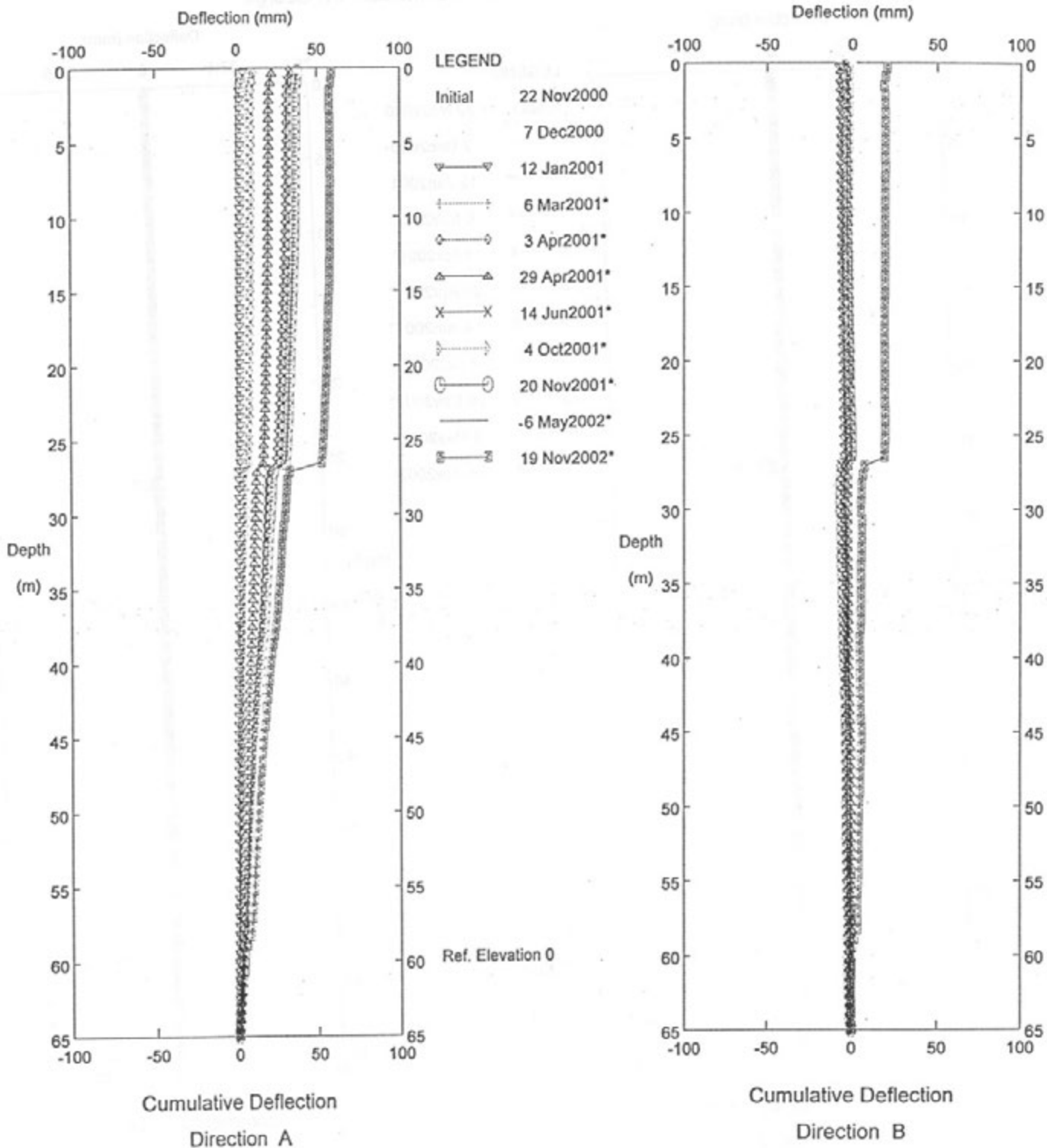


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Pierce Crescent & Lewis Drive

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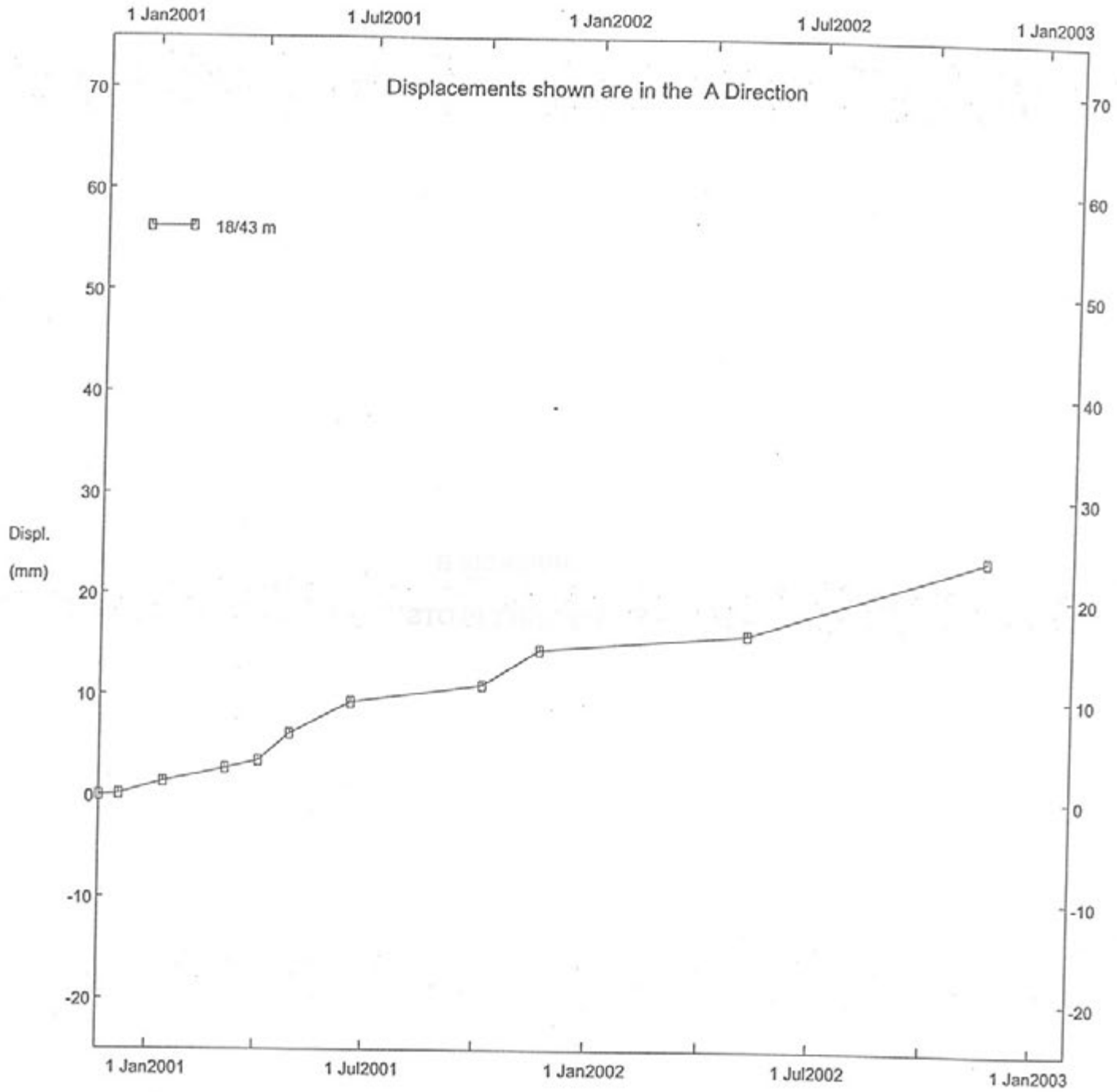


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Pierce Crescent & Lewis Drive

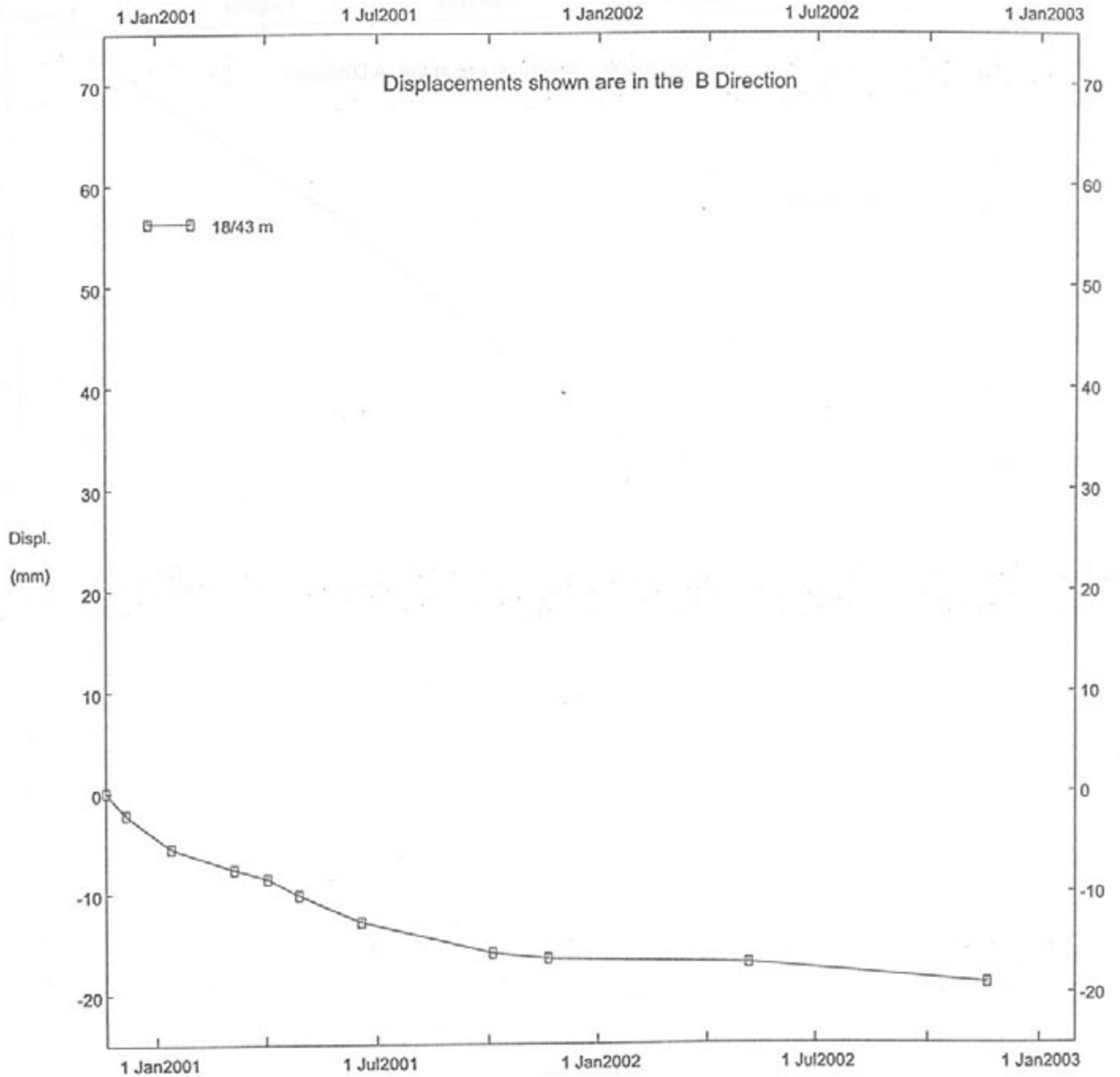
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APPENDIX B
VELOCITY PLOTS



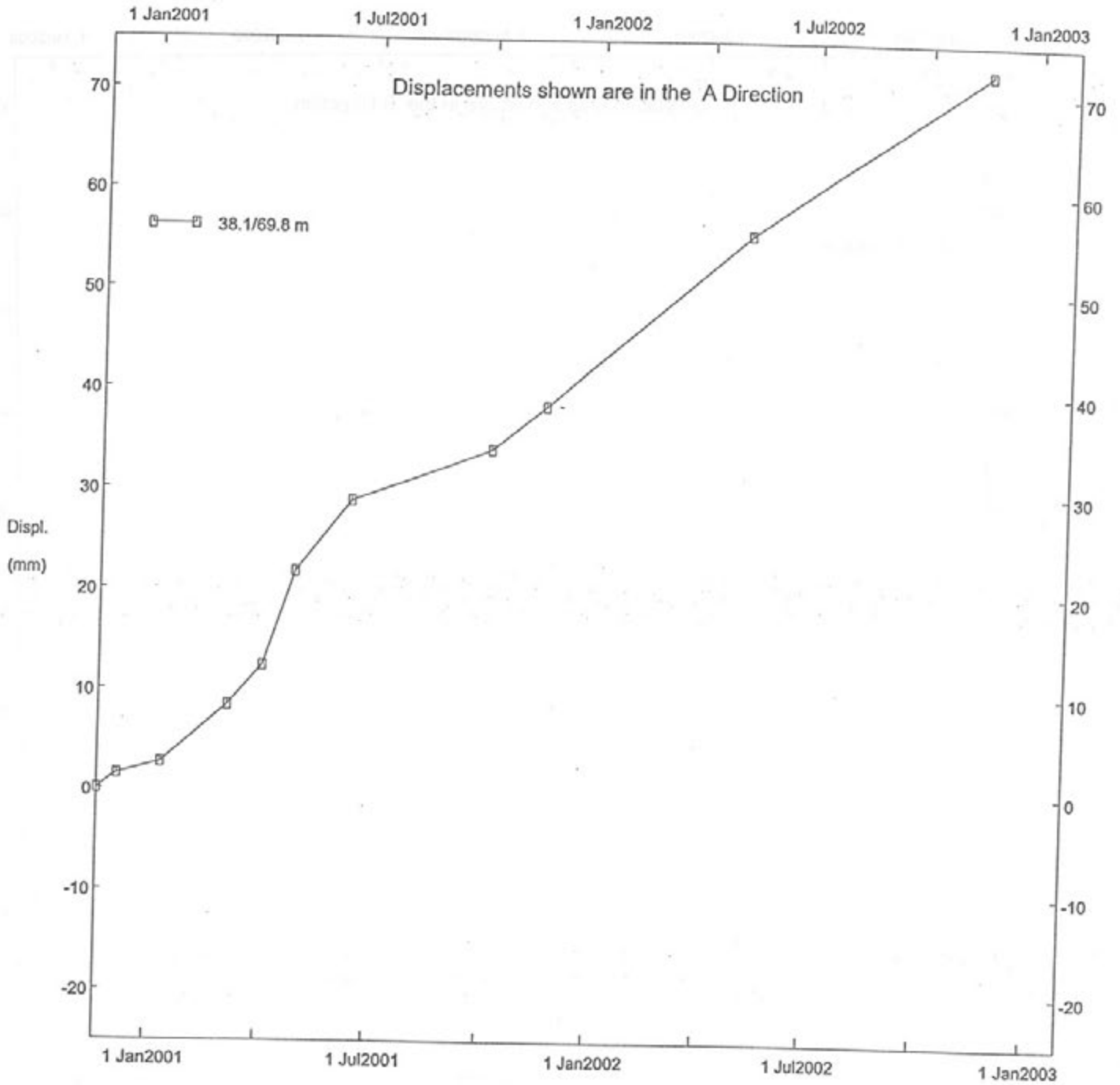
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Lower Avery Lane



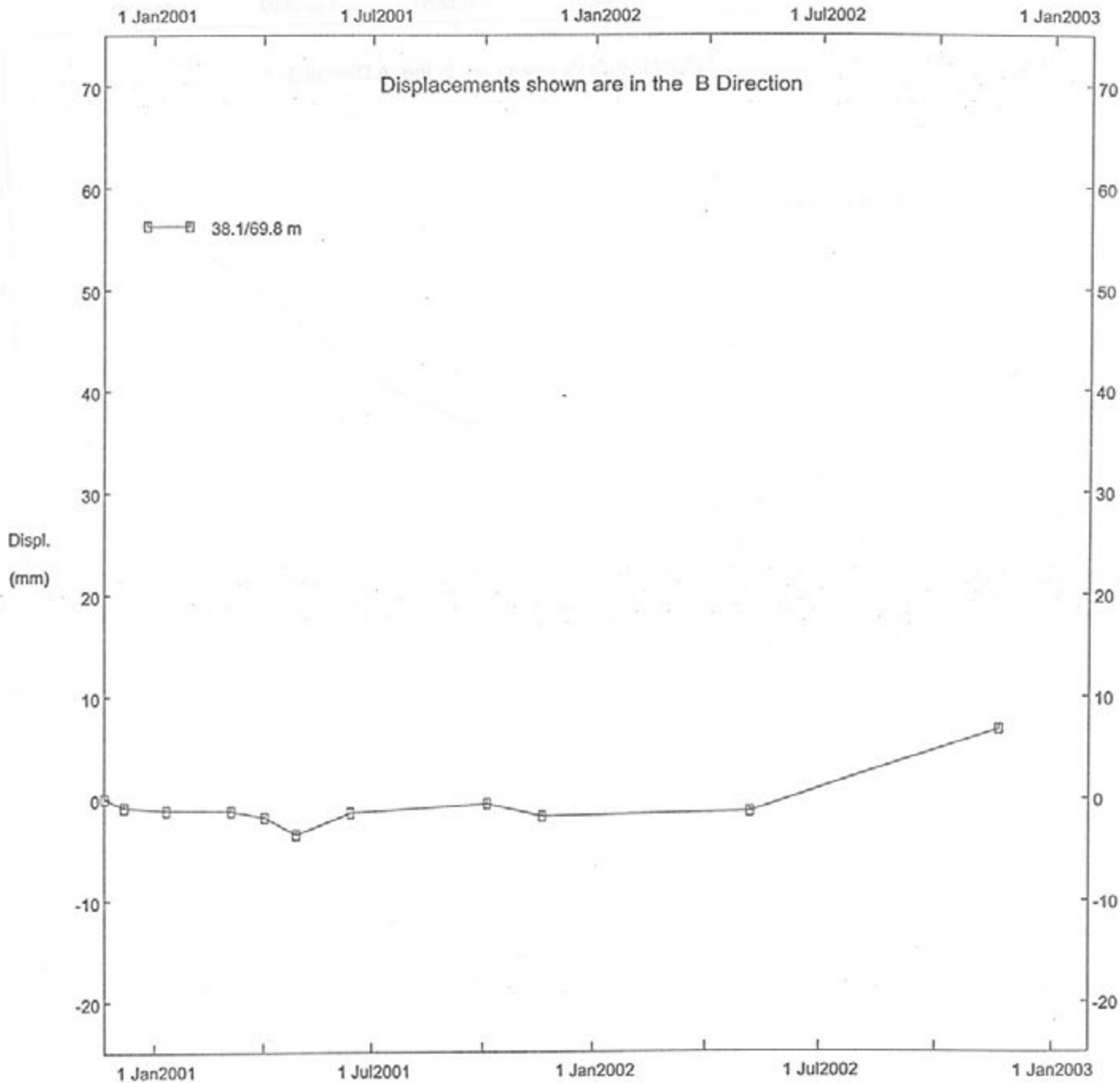
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Lower Avery Lane



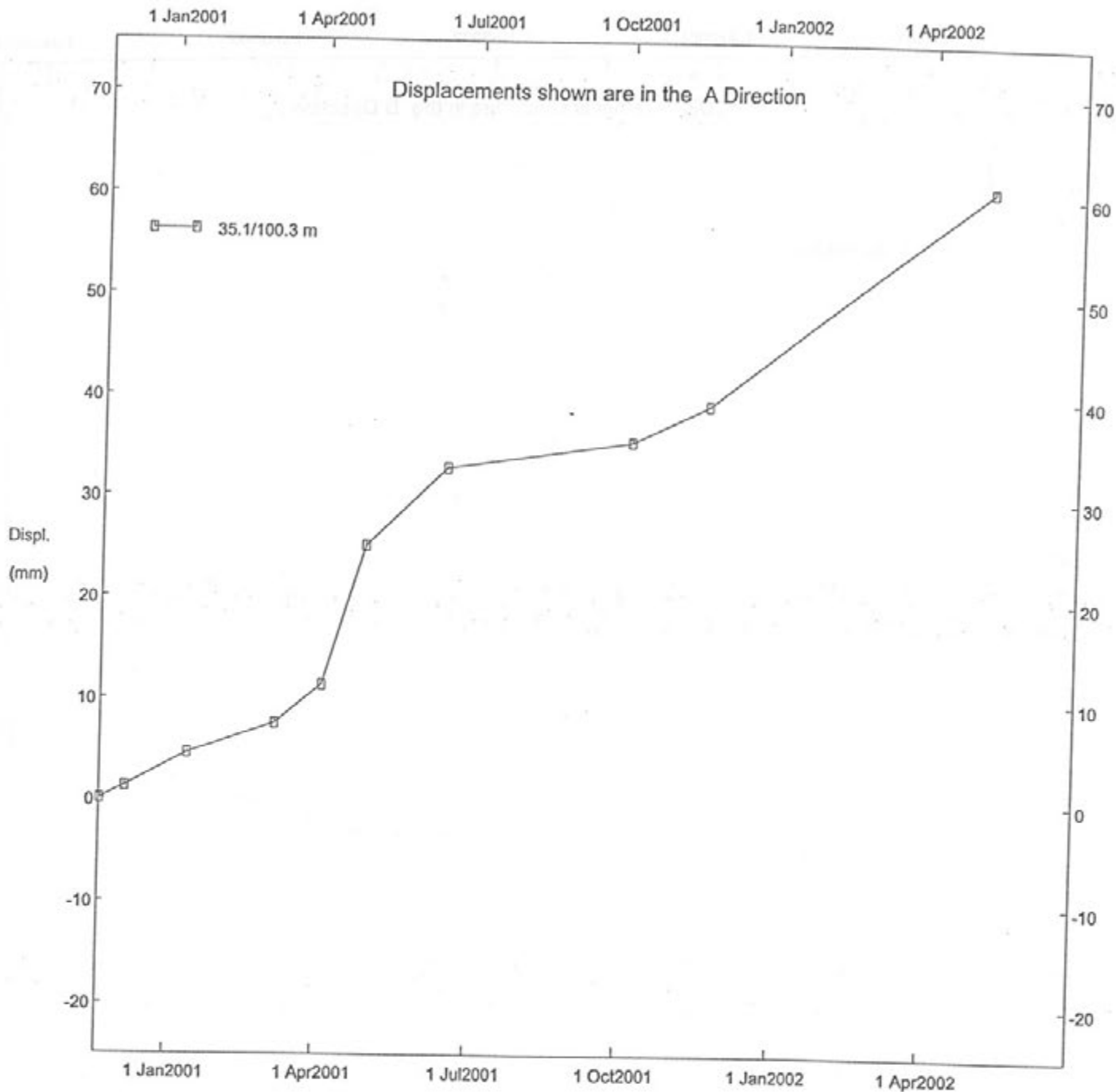
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Upper Avery Lane



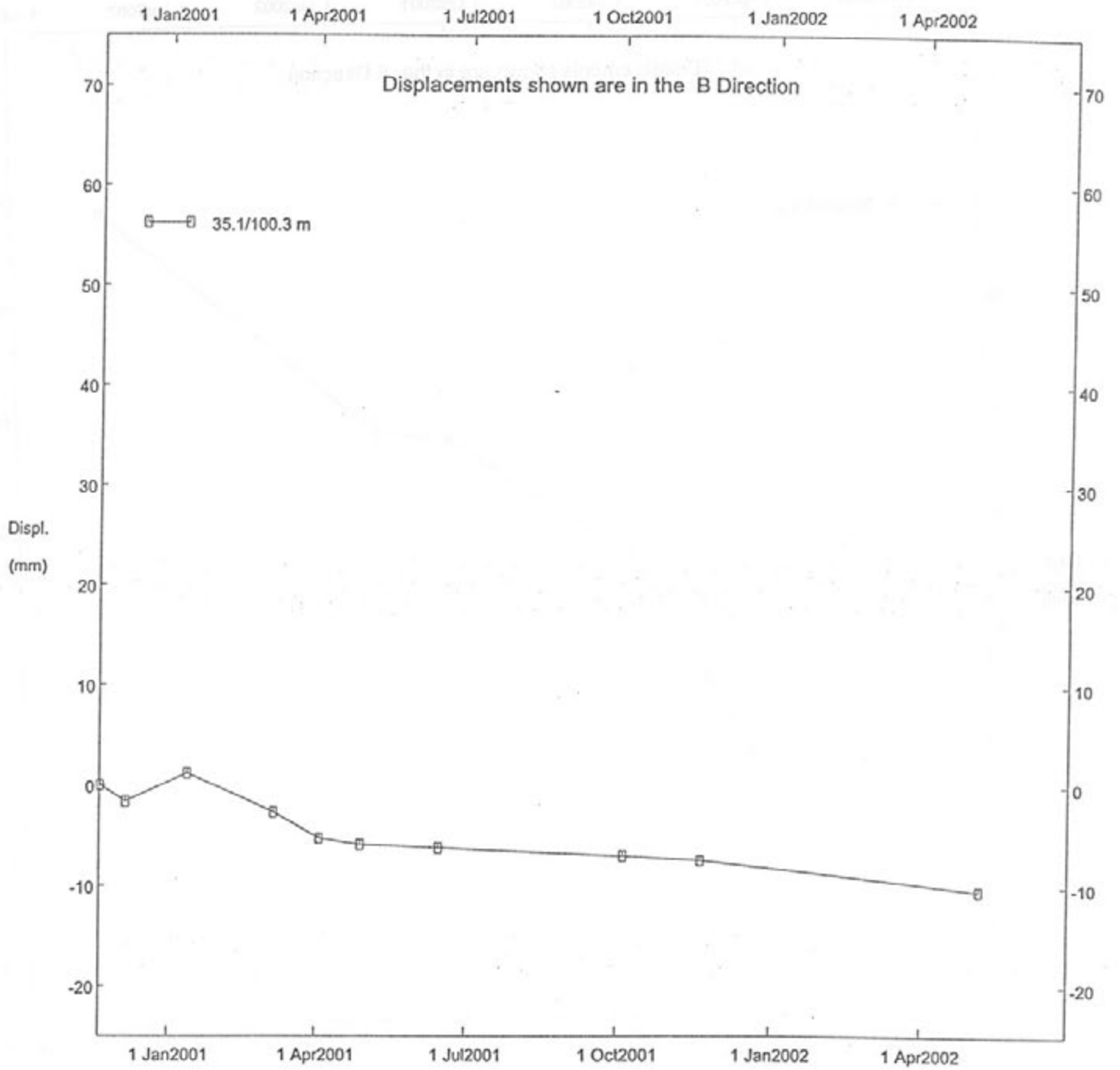
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Upper Avery Lane



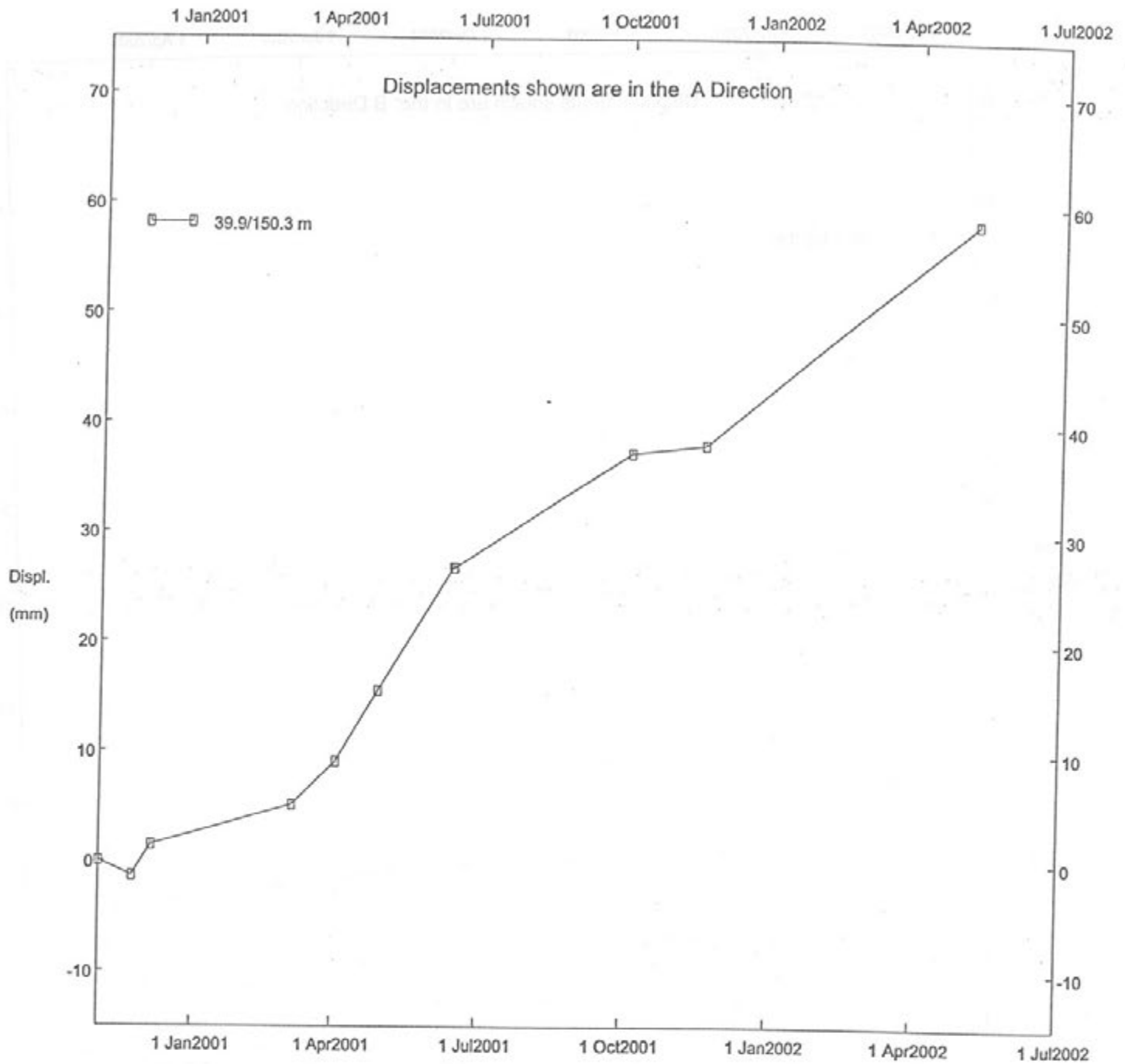
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Abbott Drive near Bettcher



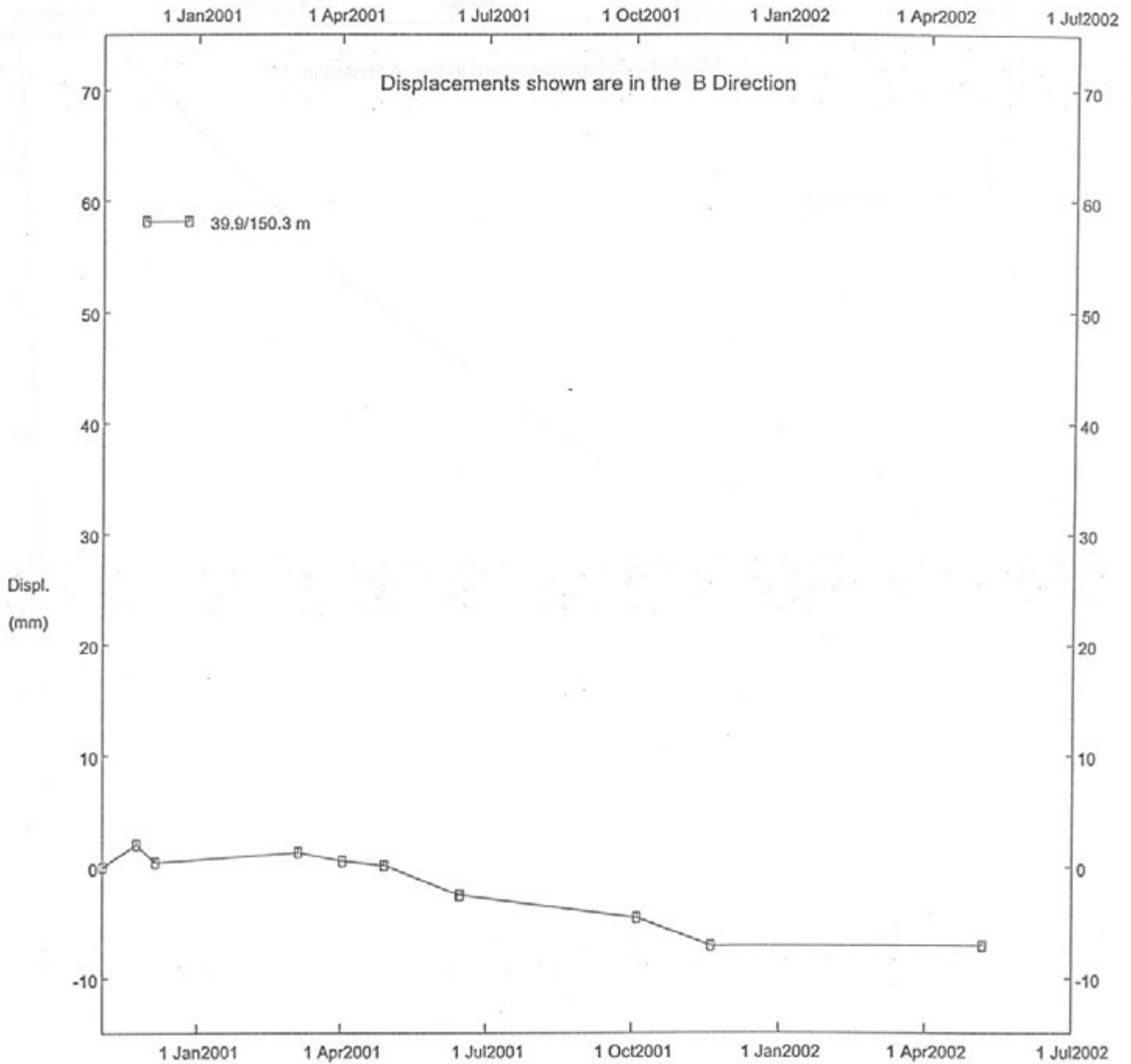
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Abbott Drive near Bettcher



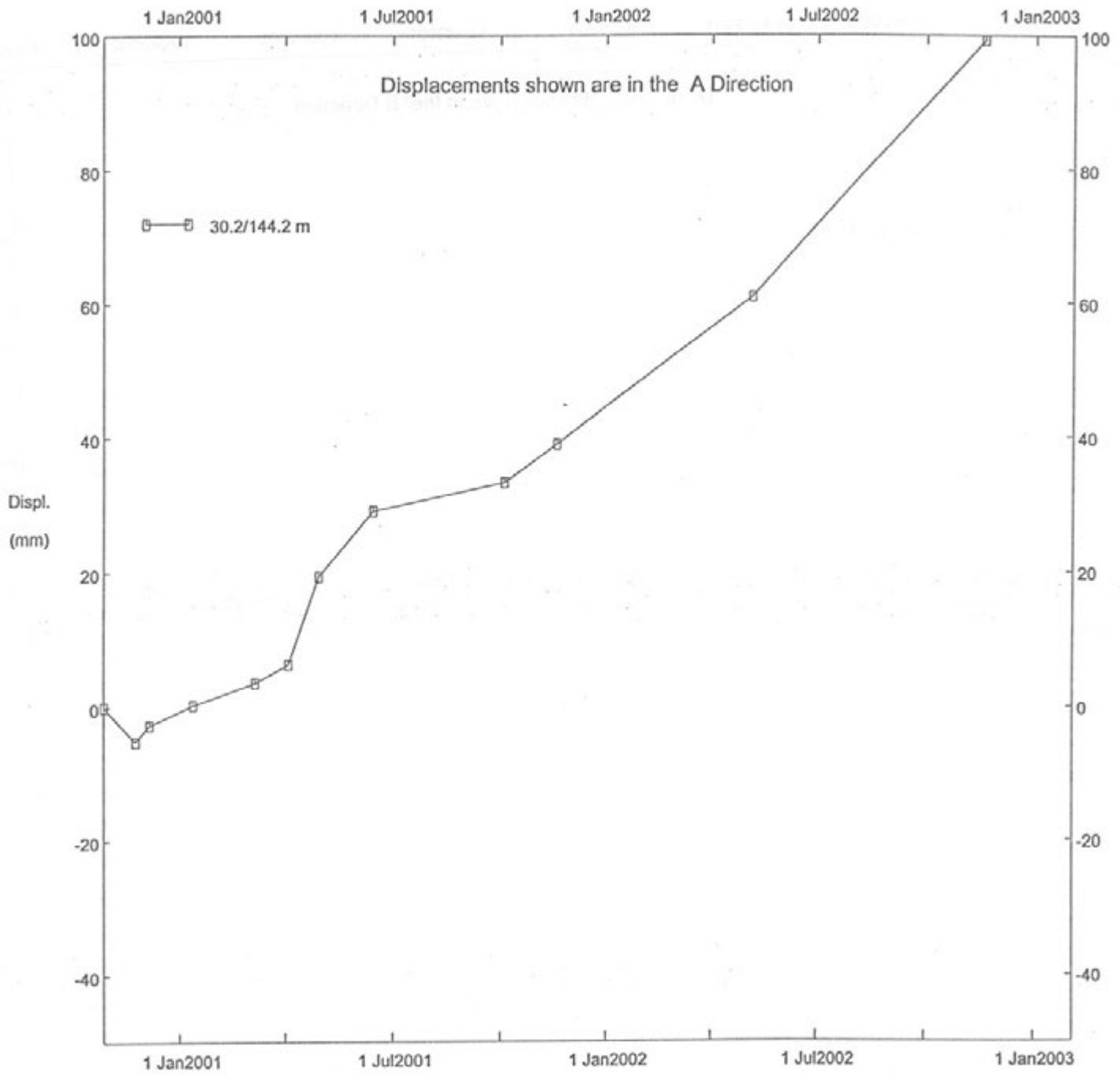
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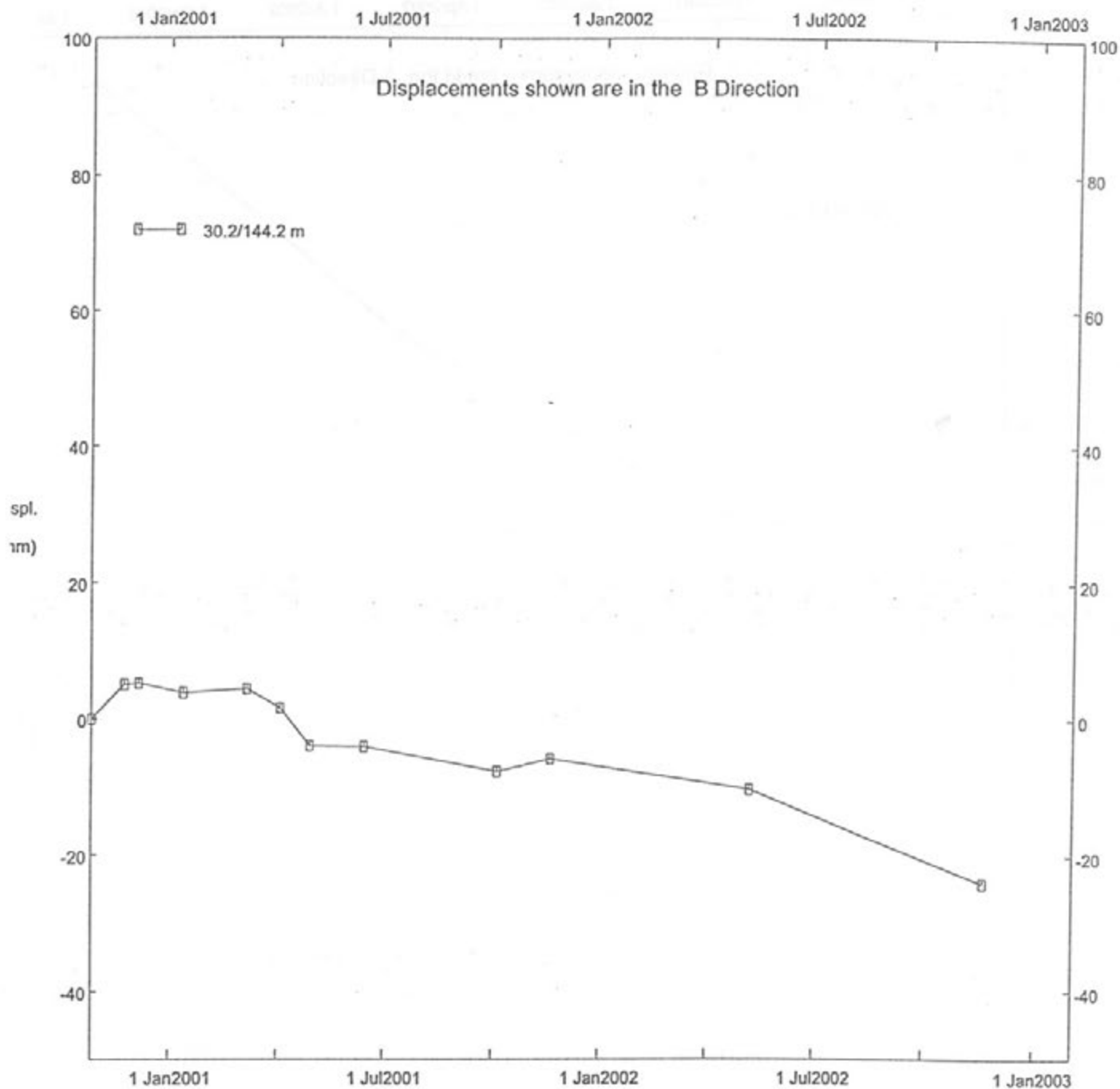
Voyageur School



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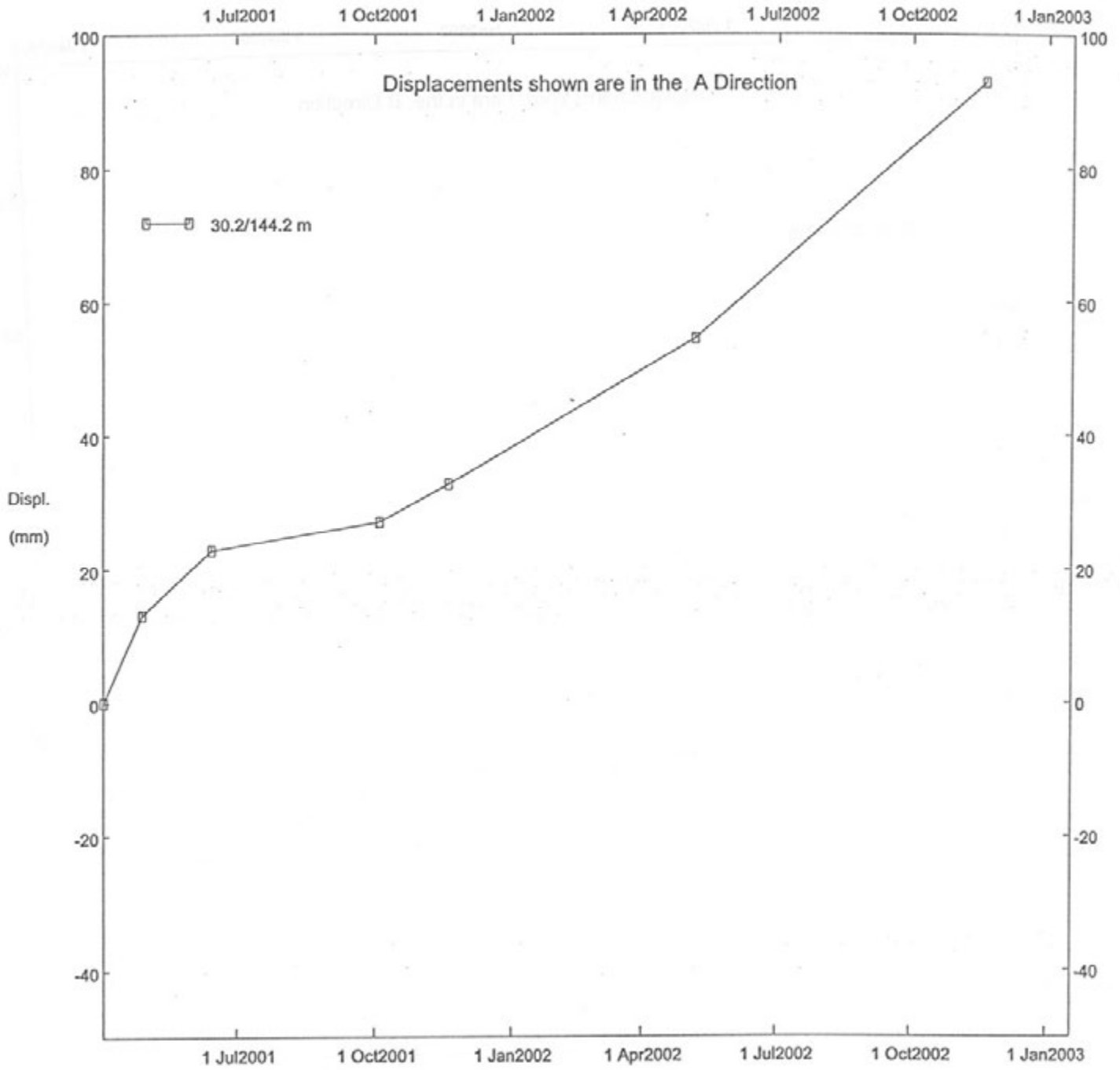
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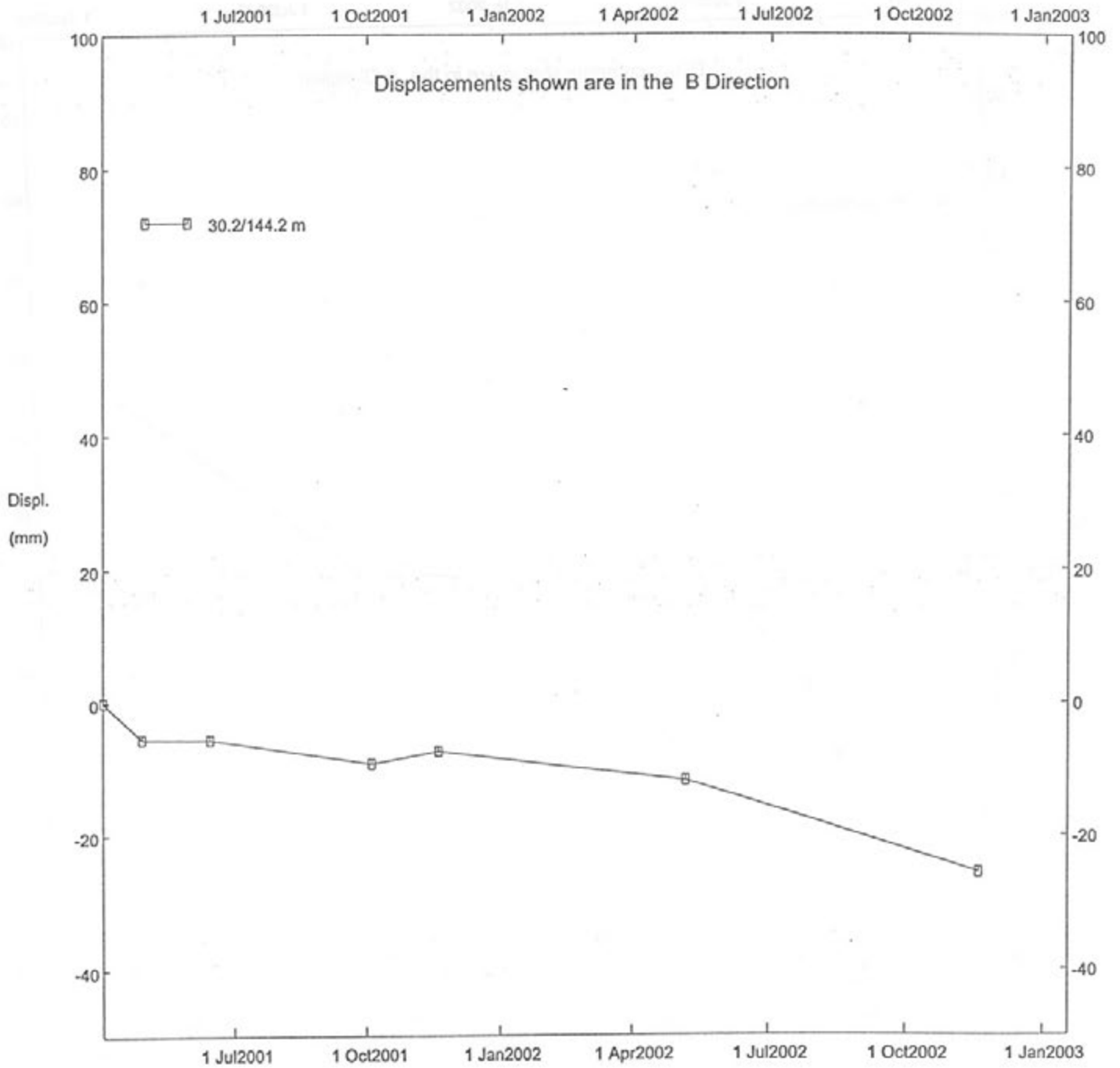




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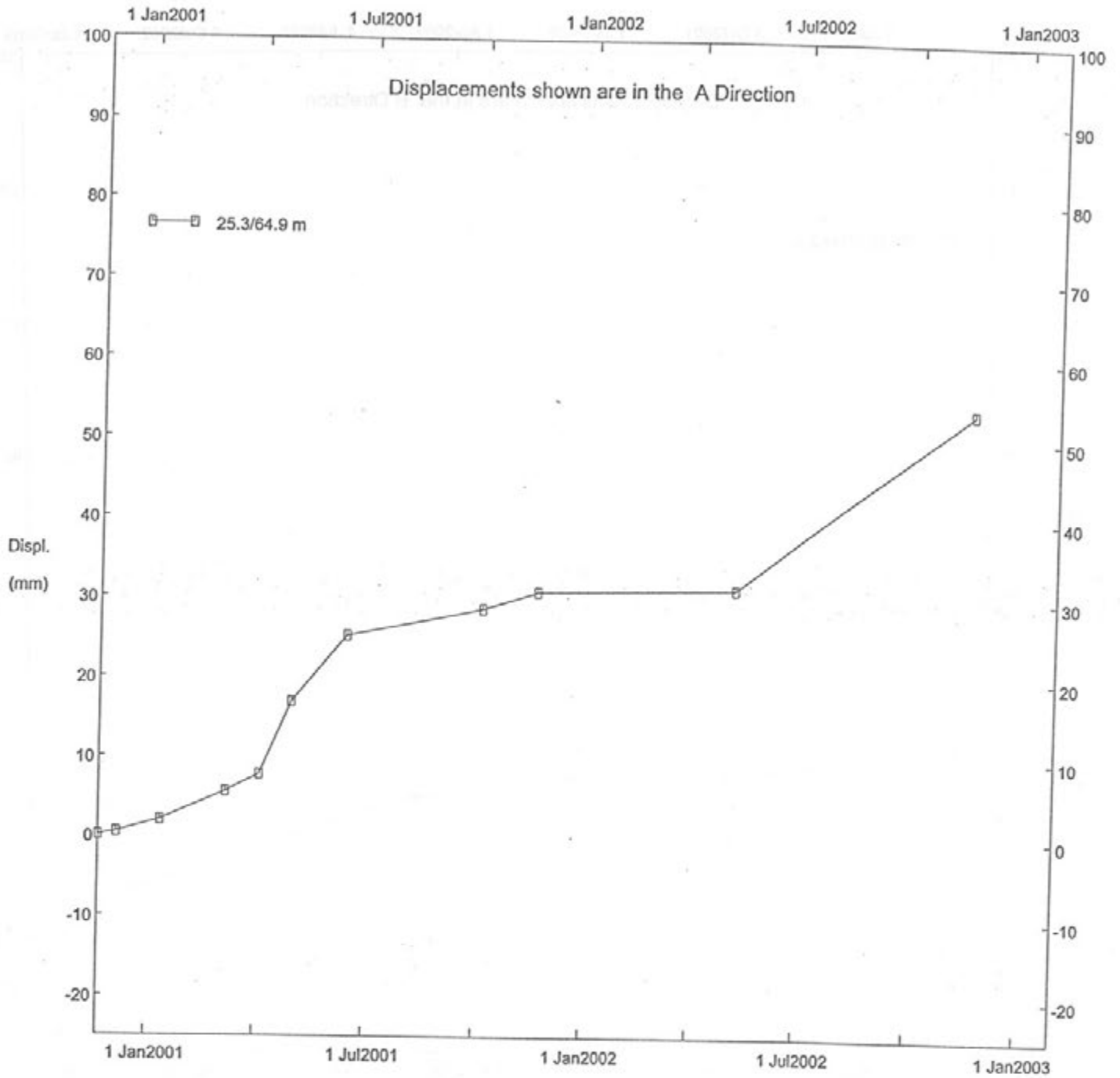
Abbott Drive





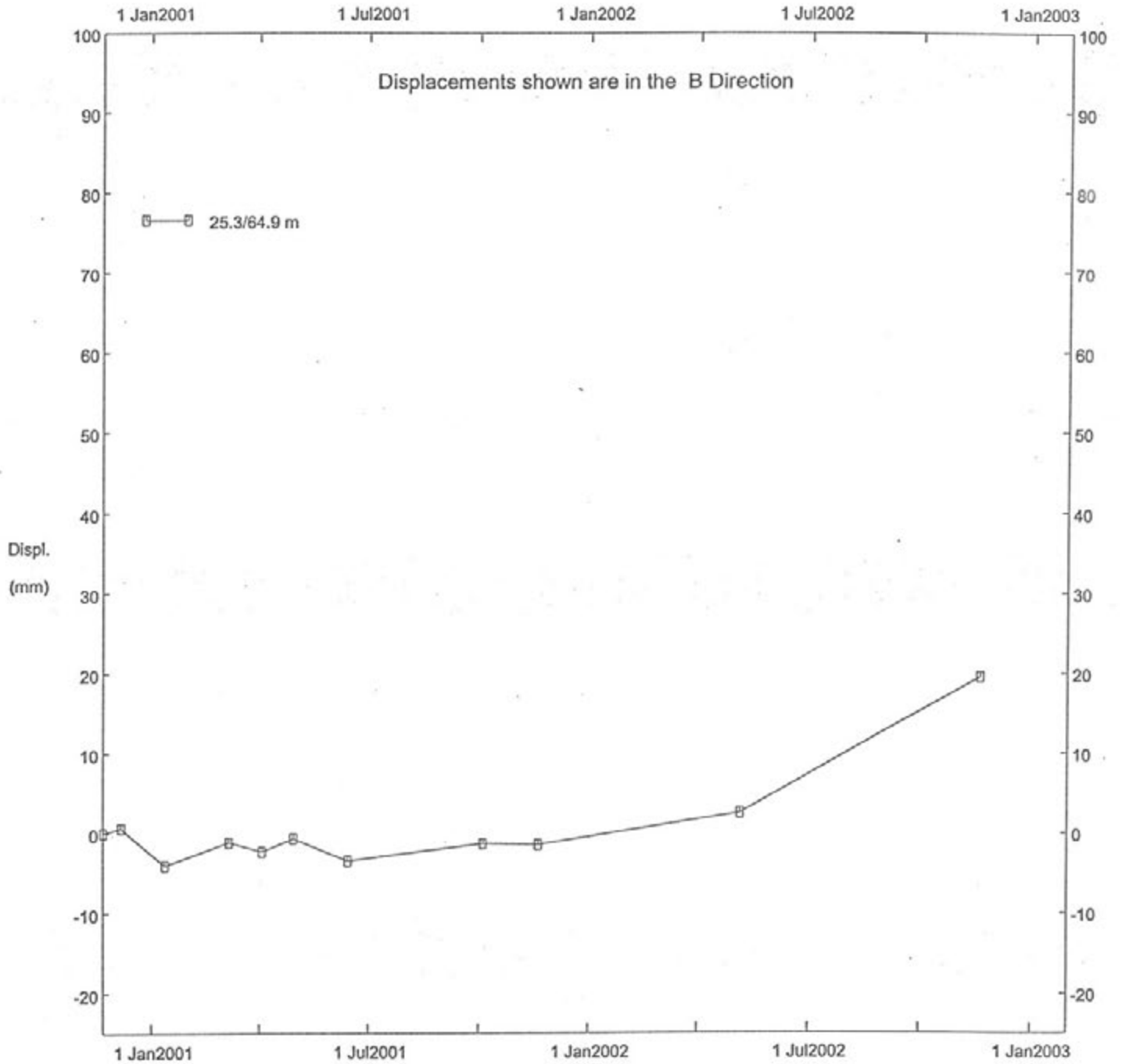
KX03904 W. Quesnel Stability Study, Inclinator SI-5 Corr.

Abbott Drive



KX03904 W. Quesnel Stability Study, Inclinator SI-7 Corr.

Pierce Crescent & Lewis Drive



KX03904 W. Quesnel Stability Study, Inclinometer SI-7 Corr.

Pierce Crescent & Lewis Drive