Cyfoeth Naturiol Cymru
Natural Resources Wales

Kenfig Phase 2
Dune Rejuvenation Works
Topographic Survey Report

Kenneth Pye & Simon J. Blott

Kenneth Pye Associates Ltd

Report No: 97

Date: March 2014

About Natural Resources Wales

Natural Resources Wales is the organisation responsible for the work carried out by the three former organisations, the Countryside Council for Wales, Environment Agency Wales and Forestry Commission Wales. It is also responsible for some functions previously undertaken by Welsh Government.

Our purpose is to ensure that the natural resources of Wales are sustainably maintained, used and enhanced, now and in the future.

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We work to maintain and improve the quality of the environment for everyone and we work towards making the environment and our natural resources more resilient to climate change and other pressures.

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- Maintaining and developing the technical specialist skills of our staff;
- Securing our data and information;
- Having a well resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

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Report series:	Evidence Report
Report number:	97
Publication date:	7 May 2014
Contract number:	STE0141
Contractor:	Kenneth Pye Associates Ltd
Contract Manager:	Dr. Emmer Litt
Title:	**Kenfig Phase 2 Dune Rejuvenation Works Topographic Survey Report**
Author(s):	**Prof. Kenneth Pye & Dr. Simon J. Blott**
Approved By:	Dr. Emmer Litt
Restrictions:	None

Distribution List (core)

NRW Library, Bangor

Recommended citation for this volume:

KPAL (2014c) Kenfig Phase 2 Dune Restoration Works Topographic Survey, March 2014. NRW Evidence Report No. 97. Kenneth Pye Associates Ltd., Solihull.

Contents

1. Job Summary

KPAL Job No:	070514
Report Date:	07/05/2014
Client:	Natural Resources Wales
Client Job Title:	Kenfig Dune Rejuvenation Works – Phase 2
Survey conducted:	10th March 2014
Instruments used:	Leica Viva NetRover controller and GS08 SmartAntenna mounted on GLS30 pole (2 m) Leica RX900 controller and ATX900 antenna mounted on GLS30 pole (2 m) Leica GX1230 RTK base station mounted on GST20-9 tripod Leica RX1210T Field Controller Pacific Crest ADL Vantage radio transceiver (430-470 MHz)
No. of data points:	690
RTK Control Station:	Wooden post surveyed-in using Leica Smartnet GPRS (BM1). Easting: 278274.566 m Northing: 182438.361 m Height: 10.845 m OD
RTK Backup Station:	Wooden stile (BM2) 19 m NW of Control Station above.
Fixed profiles:	Eighteen existing profile lines (1-18, previously surveyed on 13 May 2013) were resurveyed and compared with data surveyed from 2006 LiDAR and 14 May 2013 ground survey. Chainages along profile lines were interpolated at positions on a theoretical straight-line between the zero and end points of the profile.

Survey undertaken by: S.J. Blott, M. Blott, K. Pye

2. Scope and purpose

The requirements and opportunities for sand mobility trials at Kenfig were identified in a report published in 2011 (Pye & Blott, 2011). Additional data relating to changes in bare sand area between the 1940s and 2009 were presented in Pye *et al.* (2014).

Phase I dune rejuvenation trials at Kenfig commenced in the winter of 2011-2012 and involved stripping of surface vegetation and topographic modification to expose bare sand and to enhance the potential for sand movement within a 5 ha area. Topographic monitoring surveys were carried out in July and October 2012 (KPAL, 2012a,b) and in March 2013 (KPAL2013a); an overview report was produced in July 2013 (KPAL, 2013b).

The Phase II work began in January 2013 and involved vegetation stripping within an approximate 6.5 ha area adjacent to the Phase rejuvenation area. Four notches were also excavated in the frontal dune ridge in order to funnel the wind and encourage transfer of sand blown from the beach, and eroded from the sides and base of the notches, into the area behind the frontal dune ridge.

An initial topographic monitoring survey of the Phase II area was undertaken in May 2013 (KPAL, 2013c).This report provides a summary of a second topographic survey undertaken in March 2014 and compares the results with those of the first survey.

The winter of 2013-14 was wet and stormy. The frontal dunes along southern two thirds of the Kenfig frontage experienced significant wave erosion, although the frontage from Notch 3 northwards was less affected due to the protective effect of a bank of shingle along the dune toe which became enlarged over the winter by alongshore drift from the south.

Although there were a number of periods of strong winds during the winter, aeolian transport of sand was restricted by frequent rainfall which kept the surface sand wet for long periods of time. At the time of survey in March 2014 large areas of the site remained under water, especially on the landward side of the haul road. Visual observations indicated that wind transport of sand from the west side of the haul road was limited to within a few metres of the fence line on the landward side of the haul road. Sand movement further to the east of the haul road was limited to the higher parts of dunes which had been de-vegetated.

3. Survey methods and error checking

Elevations were determined at 690 points using Leica RTK GPS SmartRover equipment listed in the Job Summary above. Many of the survey points were on profile lines which were also surveyed in May 2013 (Figure 1). The limits of defined features, including areas of windblown sand deposition, and the position of the frontal sand dune toe, were also mapped by survey points.

Average vertical and horizontal errors reported by the instrument during the March 2014 survey were well within the expected range (Table 1).

A nearby stile was used as a secondary benchmark (BM2), and comparison of data from the start and end of the March 2014 survey showed only small differences which are within acceptable limits (Table 2).

Ground photographs were taken at a number of locations around the site; locations and directions of view of selected photographs reproduced in this report are shown in Figure 2.

4. Profile comparisons

The raw survey data were mathematically 'corrected' to allow direct comparison of straight line profiles derived from the 26 February 2006 LiDAR survey and the 13 May 2013 ground survey. The vertical accuracy of the LiDAR has not been quantified directly but is estimated to be better than 10-15 cm.

Eighteen profiles are compared in Figure 3. Profiles 1 to 4 along the central axes of the notches show accretion of approximately 0.5 m on the lips at the seaward ends of the notches, and 1 to 2 m of vertical accretion on the floors of the troughs themselves. The northern two notches (1 and 2) also show the accumulation of large sand lobes on the downwind (eastern) side of the notches (c. 2 m of vertical accretion compare with May 2013 levels). Most of the movement can be attributed to the greater extent of bare sand and greater wind funnelling after the works undertaken, and to the relatively windy conditions experienced during the autumn and winter of 2013-14.

Profiles 5 to 8 illustrate that the notches have widened slightly since May 2013 due to wind scour of the sides and slumping of vegetated, root-bound blocks from the top edges of the notches. Each edge has widened horizontally by c. 0.5 to 2 m.

Profiles 9 and 10 indicate that slight accumulation of sand has occurred on the sand lobes on the downwind sides of the slip faces (locally up to 1 m vertical accumulation). All other areas show minimal change since May 2013.

Profiles 11 to 18 show that changes have been minimal on all other areas of the site since May 2013. The largest changes to the east of the haul road are due to flooding of the dune slacks due to the very high rainfall during the preceding winter.

Figure 4 presents a DEM based on the March 2014 survey results, superimposed on the February 2006 LiDAR data. Differences in elevation within the area affected by the sand excavation and placement works between the May 2013 and 2014 surveys are shown in Figure 5.

Figure 6 shows that wave-induced erosion of the frontal dune toe between March/May 2013 and March 2014 was 2 to 6 m along the Phase II frontage, but 7 to 14 m along a large part of the Phase I frontage which was lowered during the rejuvenation works. The 'natural' dune to the south of the Phase I rejuvenation area retreated by an average of about 3 m, although by greater amounts in other areas where the frontal dune was low.

5. References

KPAL (2012a) *Topographic Survey Report Kenfig Dune Restoration Works*, prepared for Natural Resources Wales, 18th July 2012. Kenneth Pye Associates Ltd., Crowthorne.

KPAL (2012b) *Topographic Survey Report Kenfig Dune Restoration Works*, prepared for Natural Resources Wales, 22nd October 2012. Kenneth Pye Associates Ltd., Crowthorne.

KPAL (2013a) *Topographic Survey Report Kenfig Dune Restoration Works, prepared for Natural Resources Wales, 15th March 2013*. Kenneth Pye Associates Ltd., Solihull.

KPAL (2013b) *Kenfig Dune Restoration Works Phase I Overview Report.* Report prepared for Natural Resources Wales, 30 July 2013. Kenneth Pye Associates Ltd., Solihull.

KPAL (2013c) *Topographic Survey Report Kenfig Dune Restoration Works, Phase 2*. Report prepared for Natural Resources Wales, 29th May 2013. Kenneth Pye Associates Ltd., Solihull.

Pye, K. & Blott, S.J. (2011) *Kenfig Sand Dunes - Potential for Dune Reactivation*. CCW Contract Science Report No. 971, 19pp, 2 tables, 31 figures and 2 appendices, Countryside Council for Wales, Bangor.

Pye, K, Blott, S.J. & Howe, M.A. (2014) Coastal dune stabilization in Wales and requirements for rejuvenation. *Journal of Coastal Conservation* 18, 27-54.

6. Tables

Table 1. Average error reported by the instrument for all 690 data points

	1-D (height) quality control	2-D (position) quality control
Average	9.2 mm	5.7 mm
StDev	4.9 mm	3.1 mm

Table 2. Measured location and height of Benchmark 2 (stile)

	Easting	Northing	Height
Surveyed with Smartnet corrections (10 March 2014)	278262.772	182449.812	8.855
Surveyed with base & rover, start of survey Error:	278262.761 -11 mm	182449.790 -22 mm	8.845 -10 mm
Surveyed with base & rover, end of survey Error:	278262.786 +14 mm	182449.798 -14 mm	8.855 0 mm

7. Figures

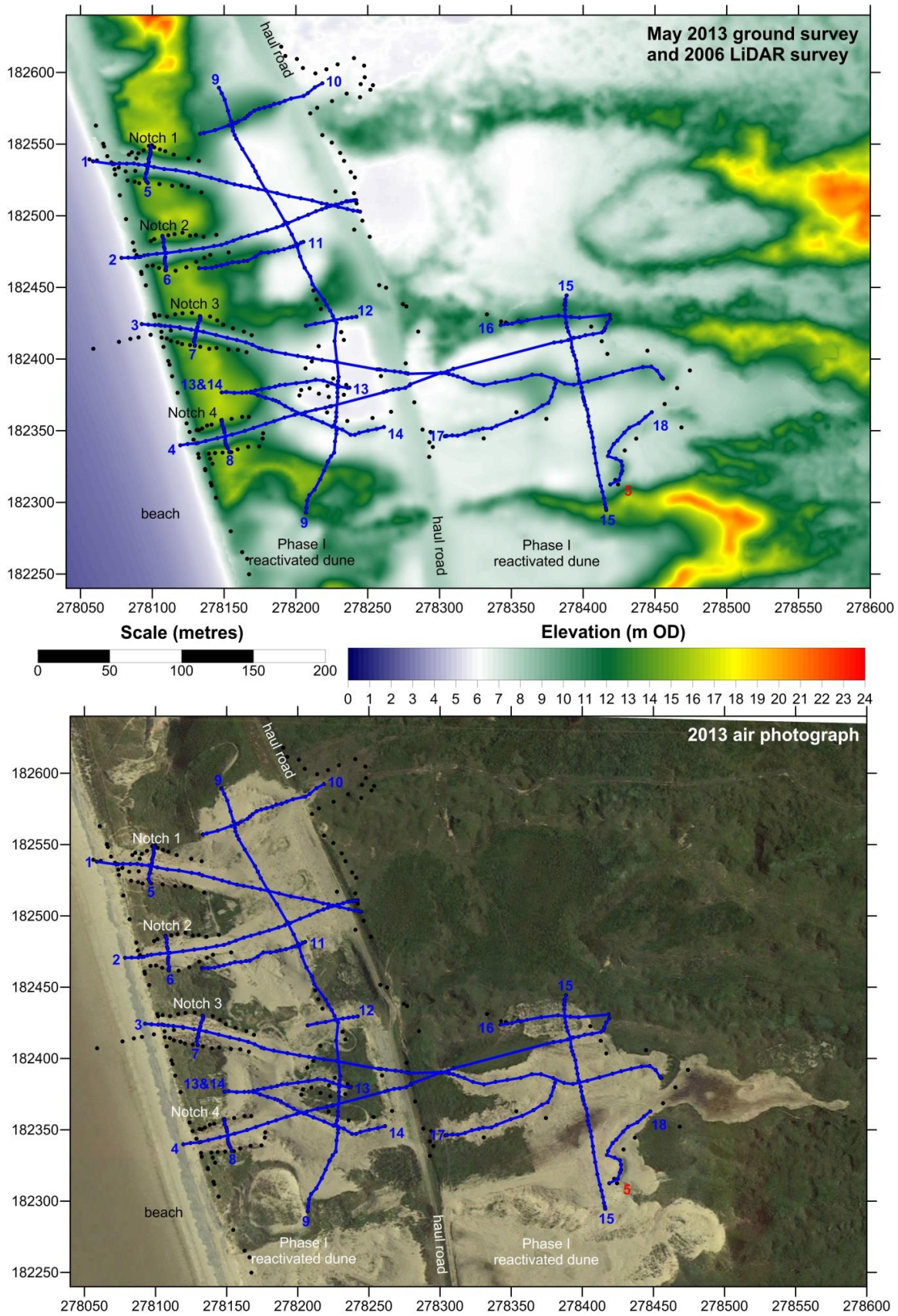


Figure 1. Locations of data points (black dots) and cross-profiles (blue lines), overlaid on a DEM generated from May 2013 ground survey and 2006 LiDAR data (upper figure), and 2013 aerial photographs (lower figure)

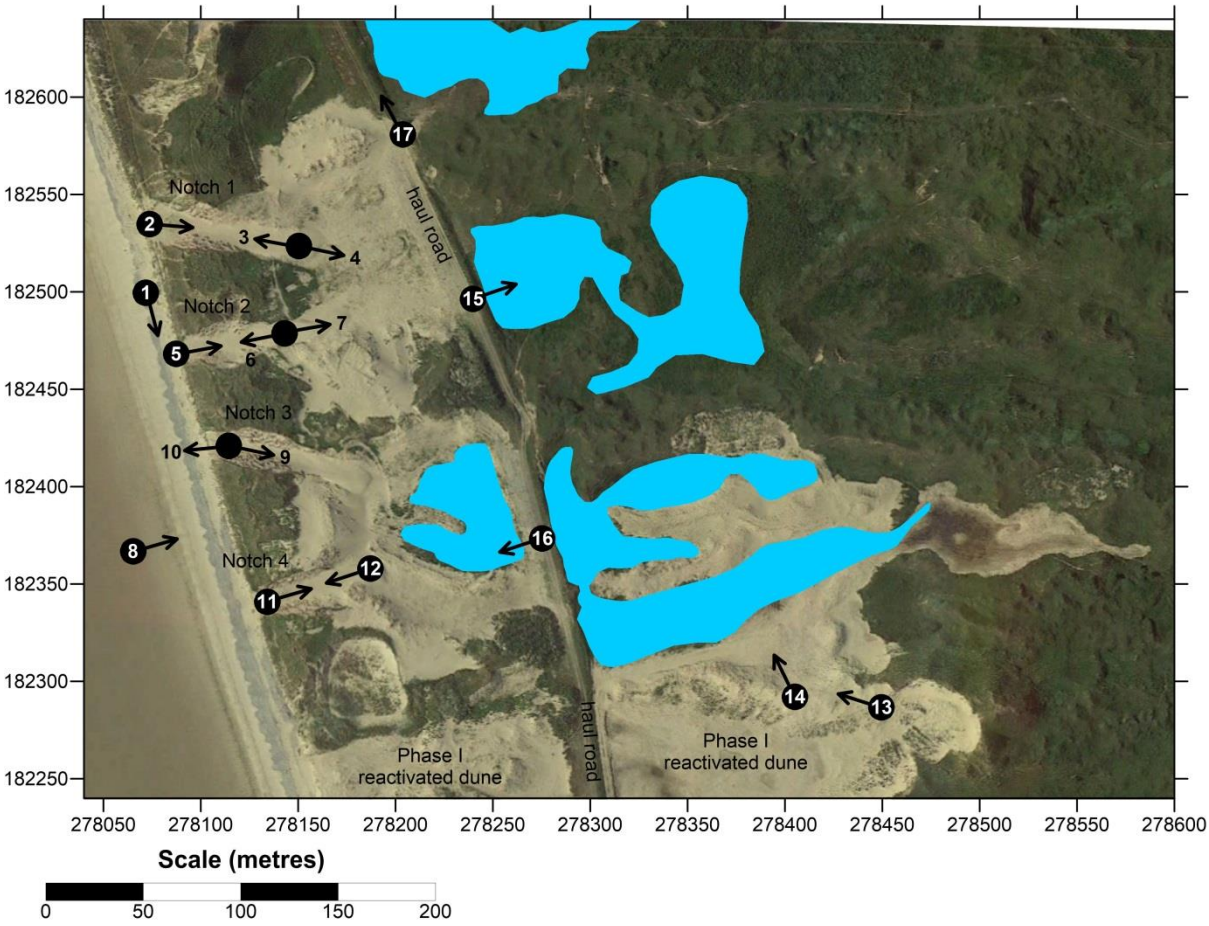


Figure 2. Locations of field photographs 1 to 17 reproduced in this report. Arrows indicate direction of view; base 2013 aerial photography from Google Earth

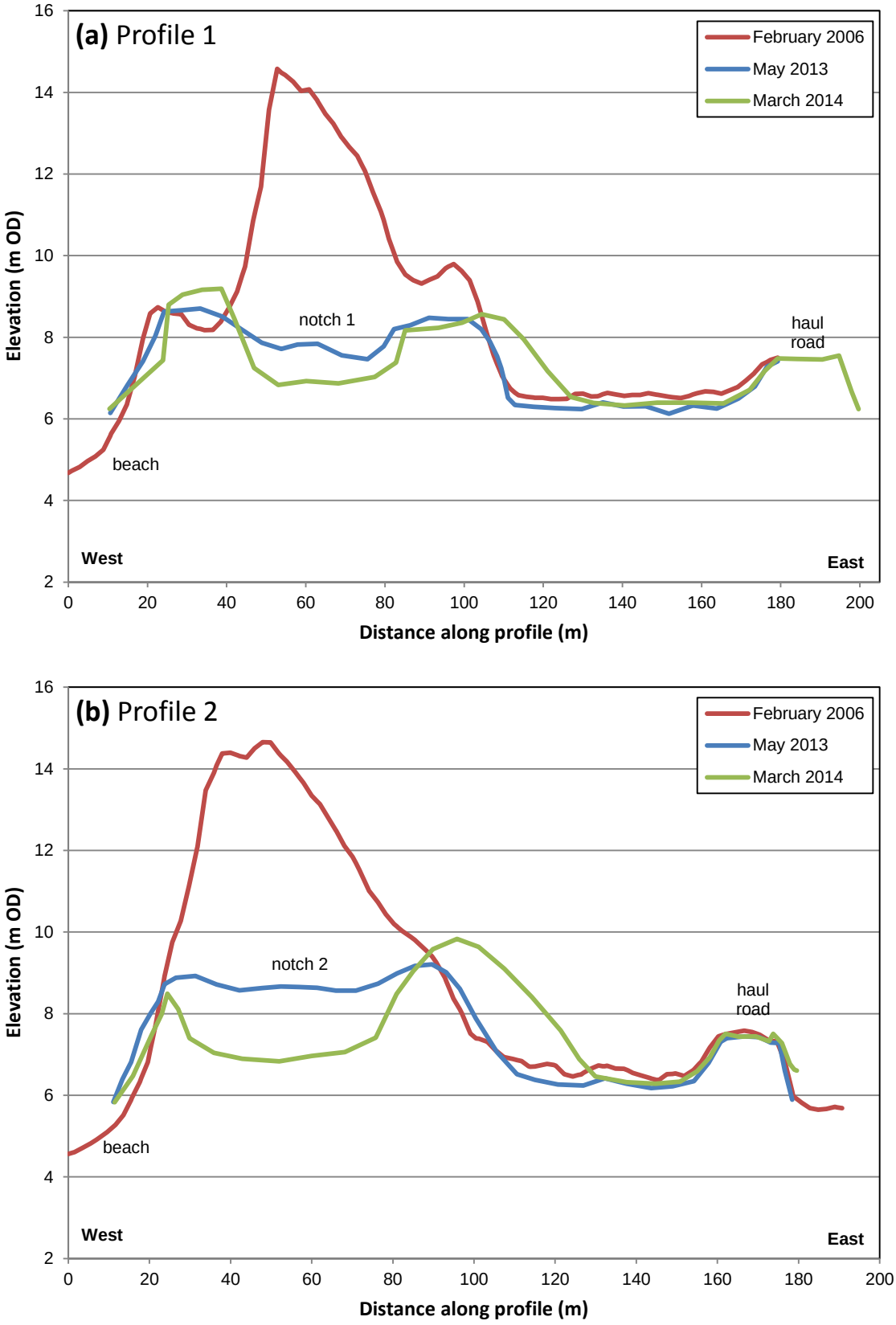


Figure 3. Comparison of surface levels at profiles 1 and 2 indicated by LiDAR survey on 26th February 2006 (pre-trials) and ground surveys on 13 May 2013 and 10 March 2014.

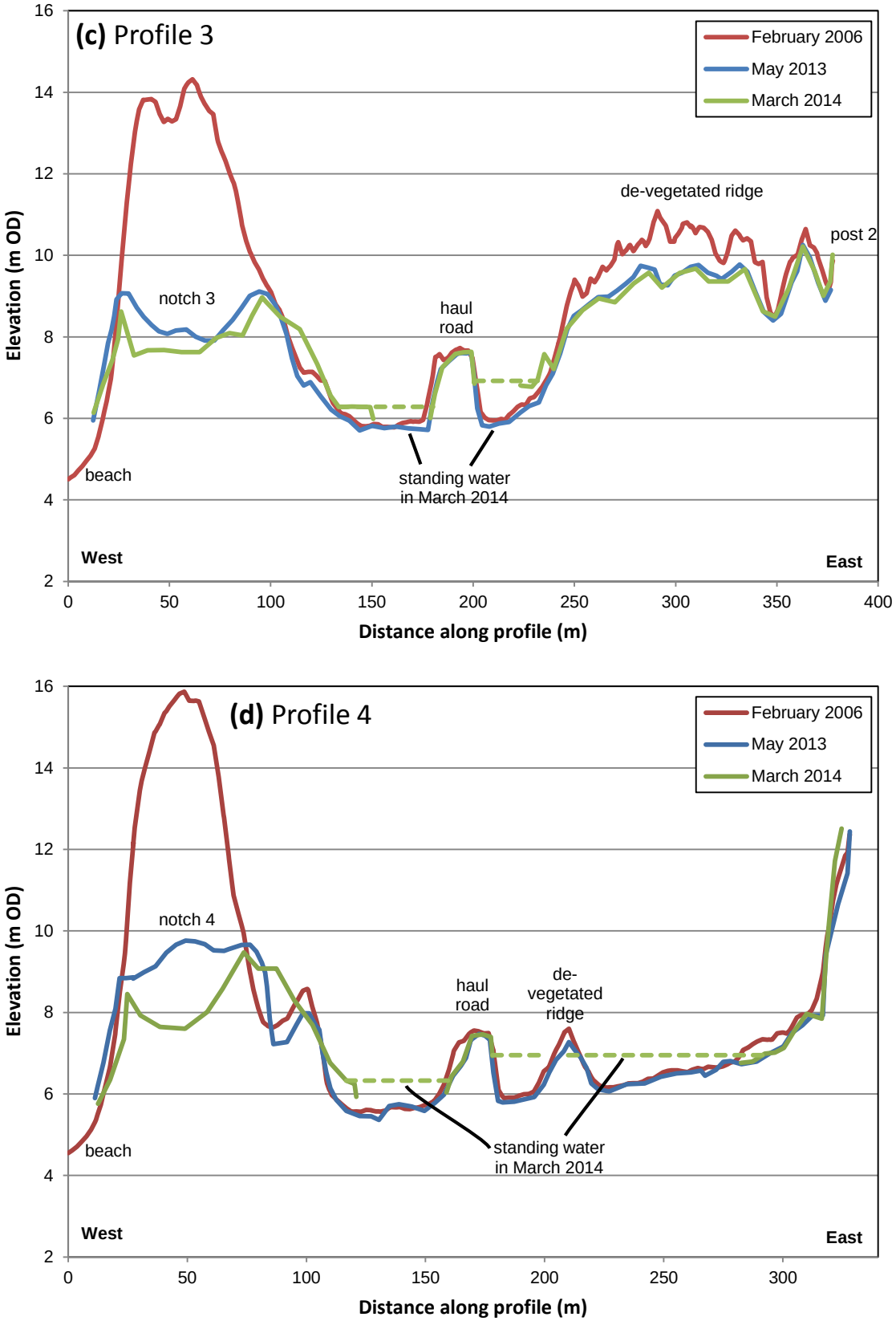


Figure 3. continued. Comparison of surface levels at profiles 3 and 4 indicated by LiDAR survey on 26th February 2006 (pre-trials) and ground surveys on 13 May 2013 and 10 March 2014.

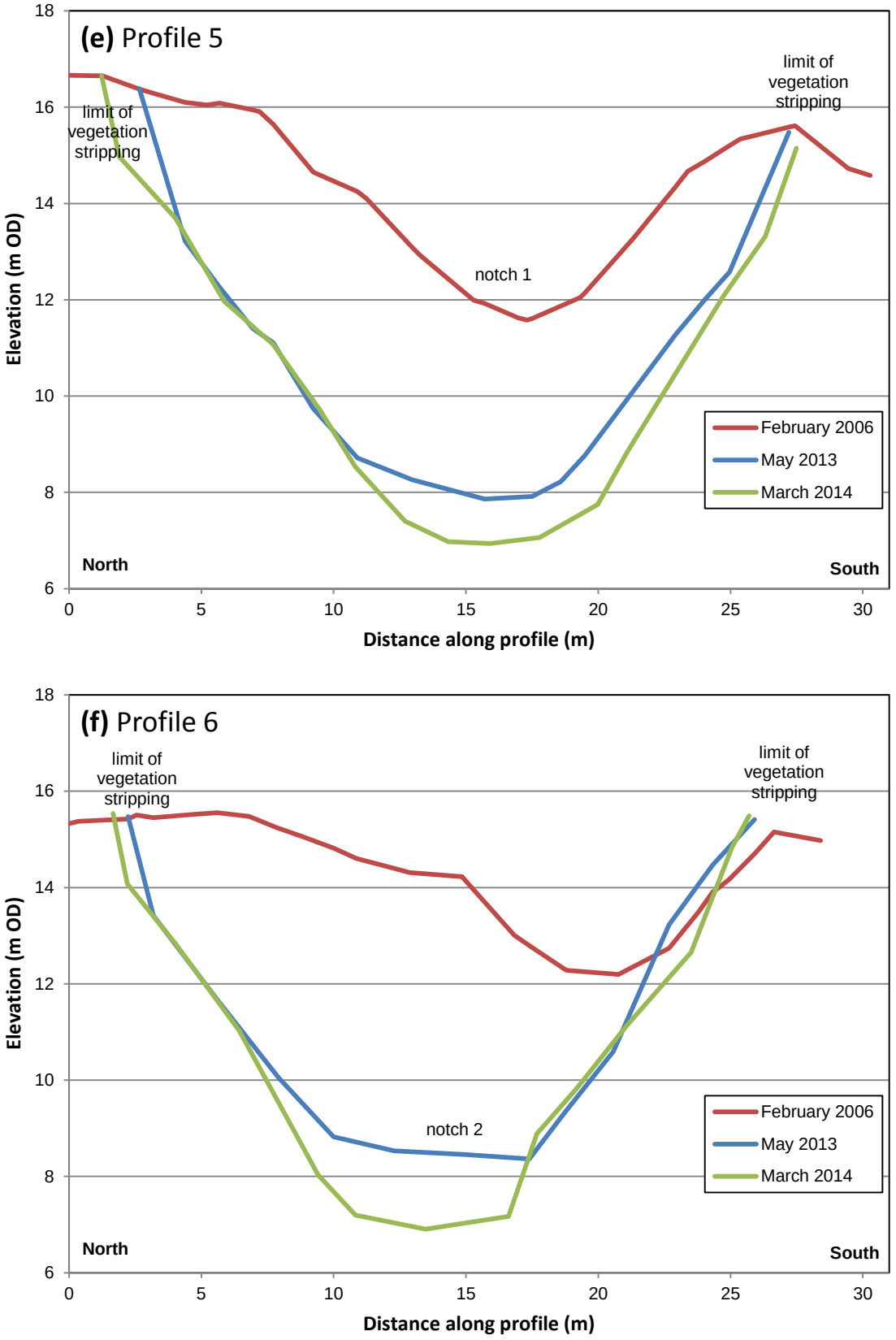


Figure 3. continued. Comparison of surface levels at profiles 5 and 6 indicated by LiDAR survey on 26th February 2006 (pre-trials) and ground surveys on 13 May 2013 and 10 March 2014.

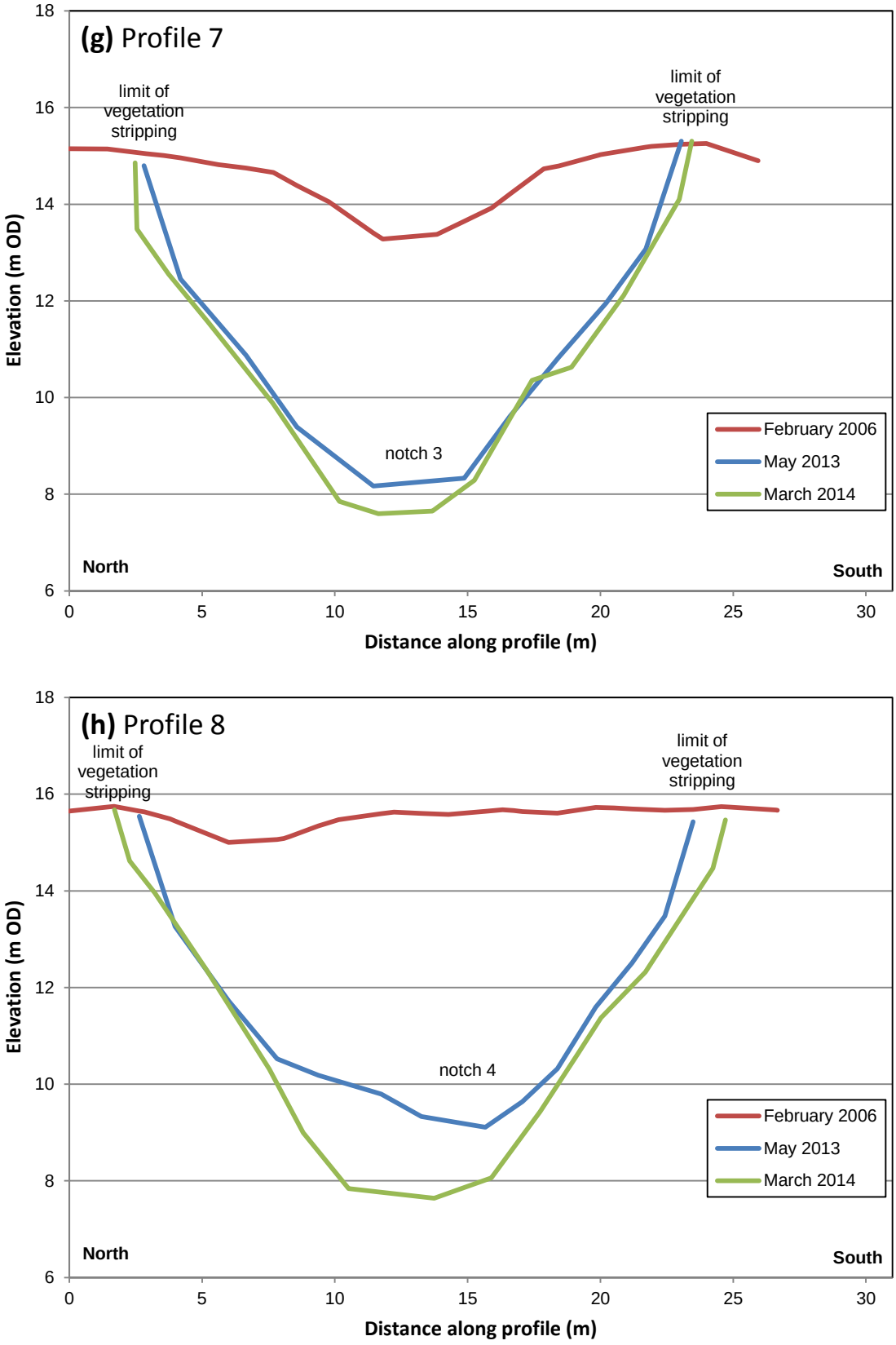


Figure 3. continued. Comparison of surface levels at profiles 7 and 8 indicated by LiDAR survey on 26th February 2006 (pre-trials) and ground surveys on 13 May 2013 and 10 March 2014.

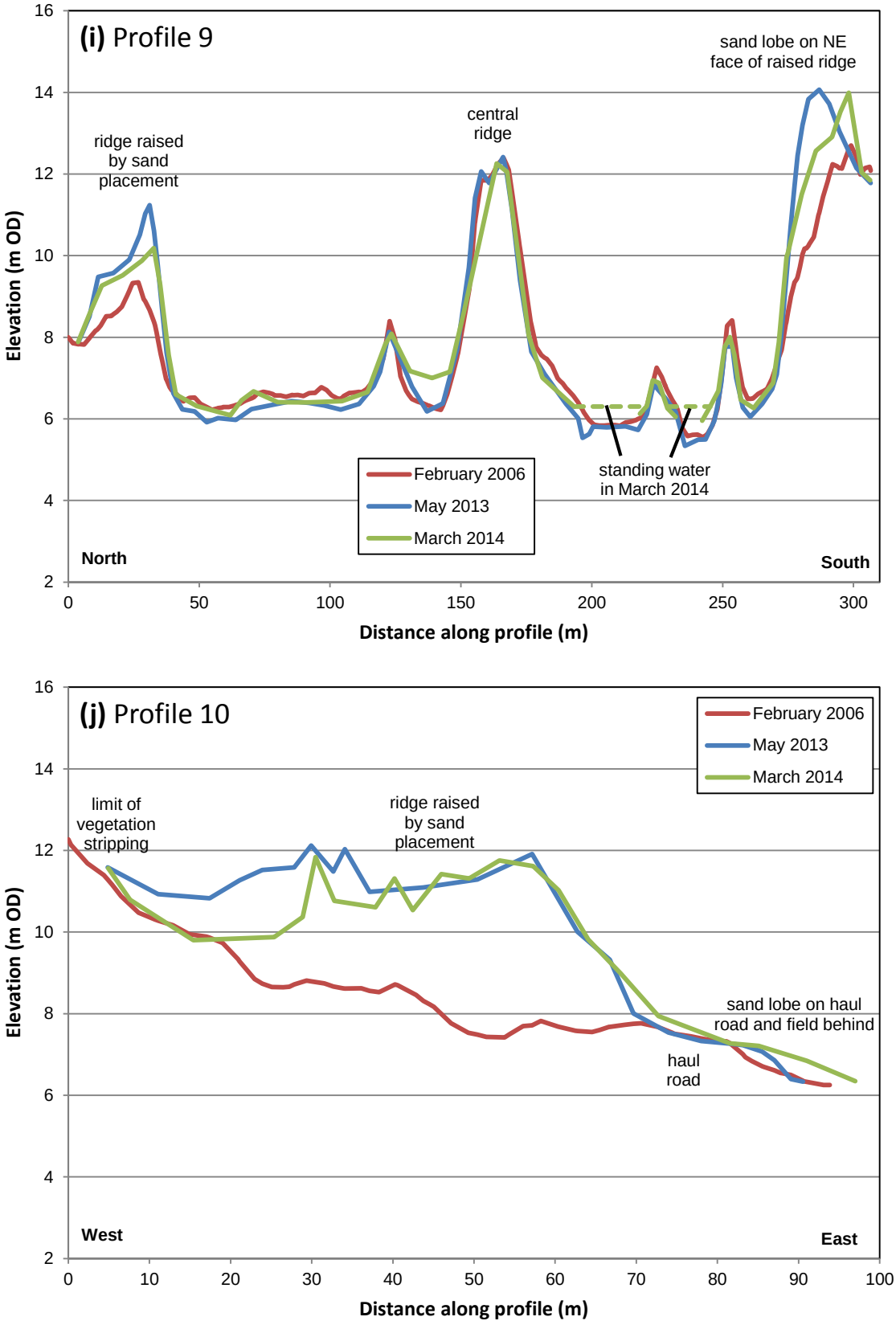


Figure 3. continued. Comparison of surface levels at profiles 9 and 10 indicated by LiDAR survey on 26th February 2006 (pre-trials) and ground surveys on 13 May 2013 and 10 March 2014.

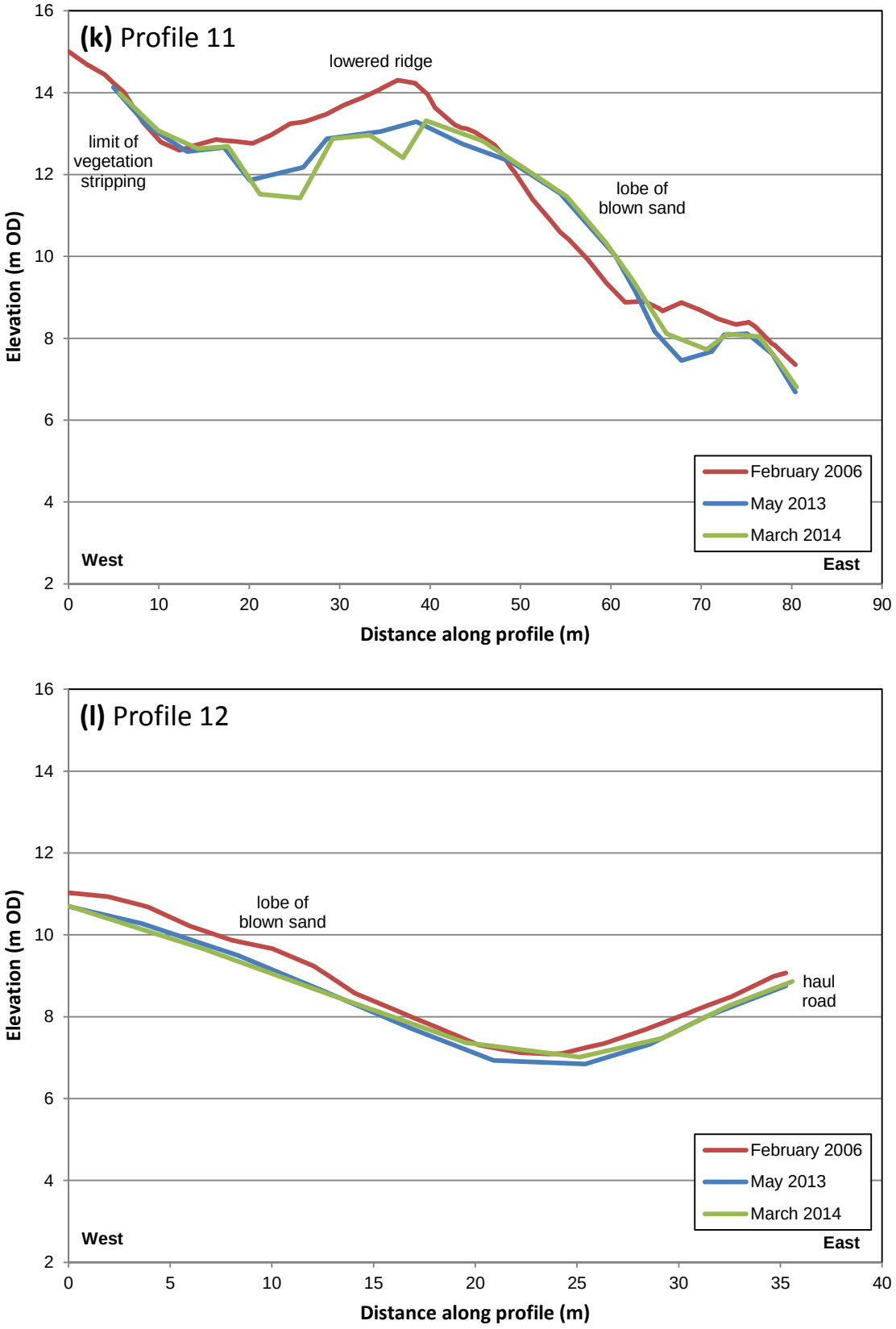


Figure 3. continued. Comparison of surface levels at profiles 11 and 12 indicated by LiDAR survey on 26th February 2006 (pre-trials) and ground surveys on 13 May 2013 and 10 March 2014.

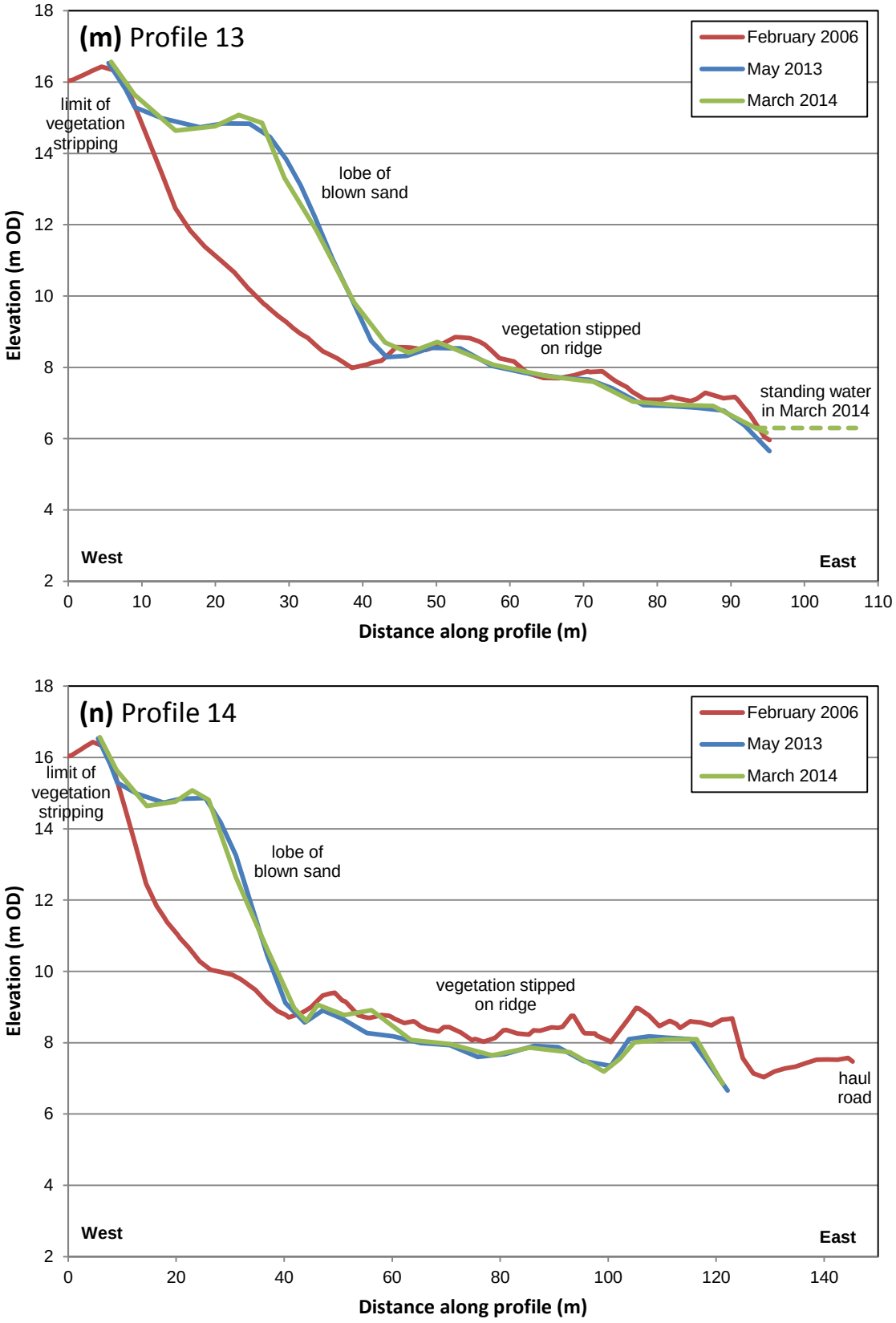


Figure 3. continued. Comparison of surface levels at profiles 13 and 14 indicated by LiDAR survey on 26th February 2006 (pre-trials) and ground surveys on 13 May 2013 and 10 March 2014.

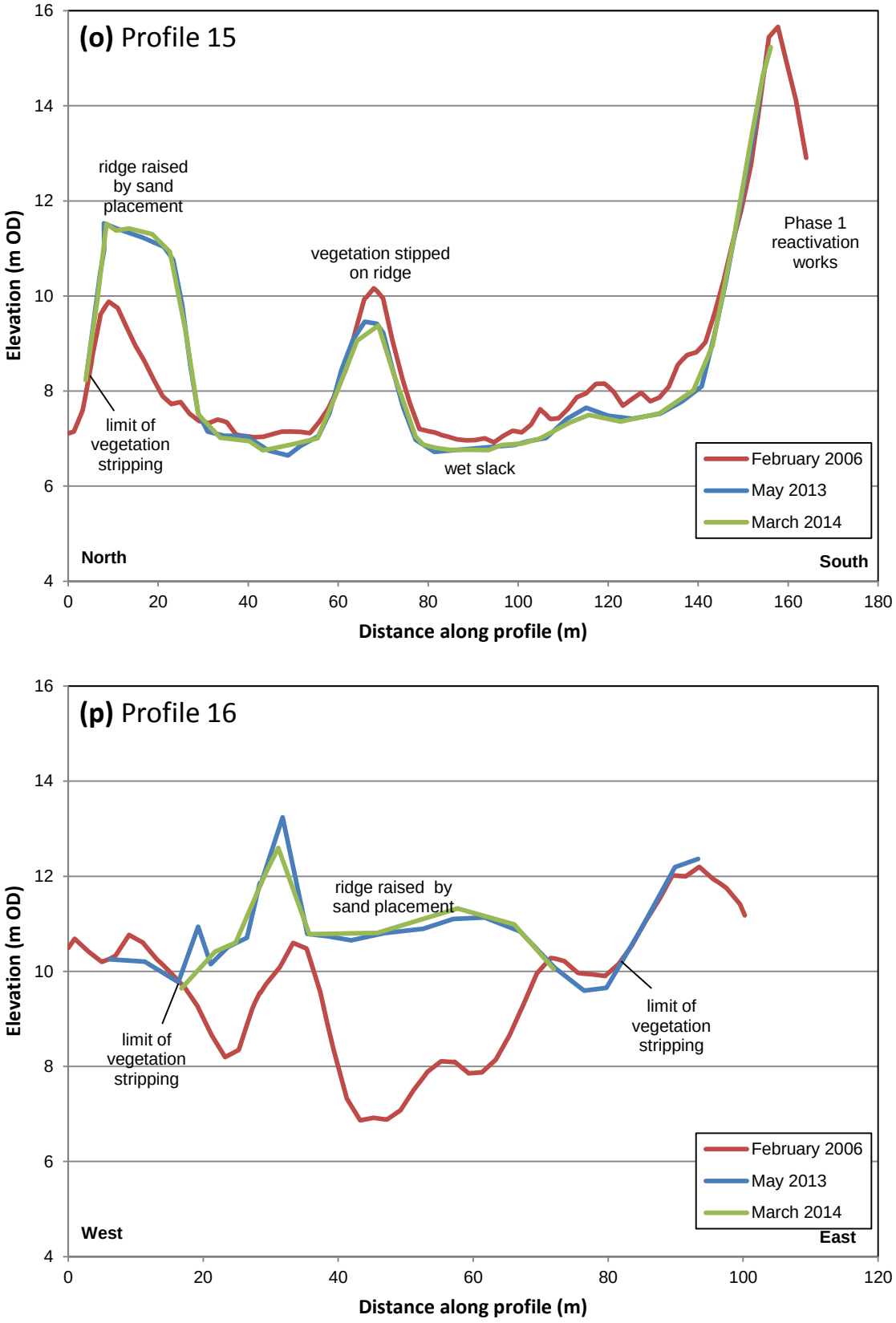
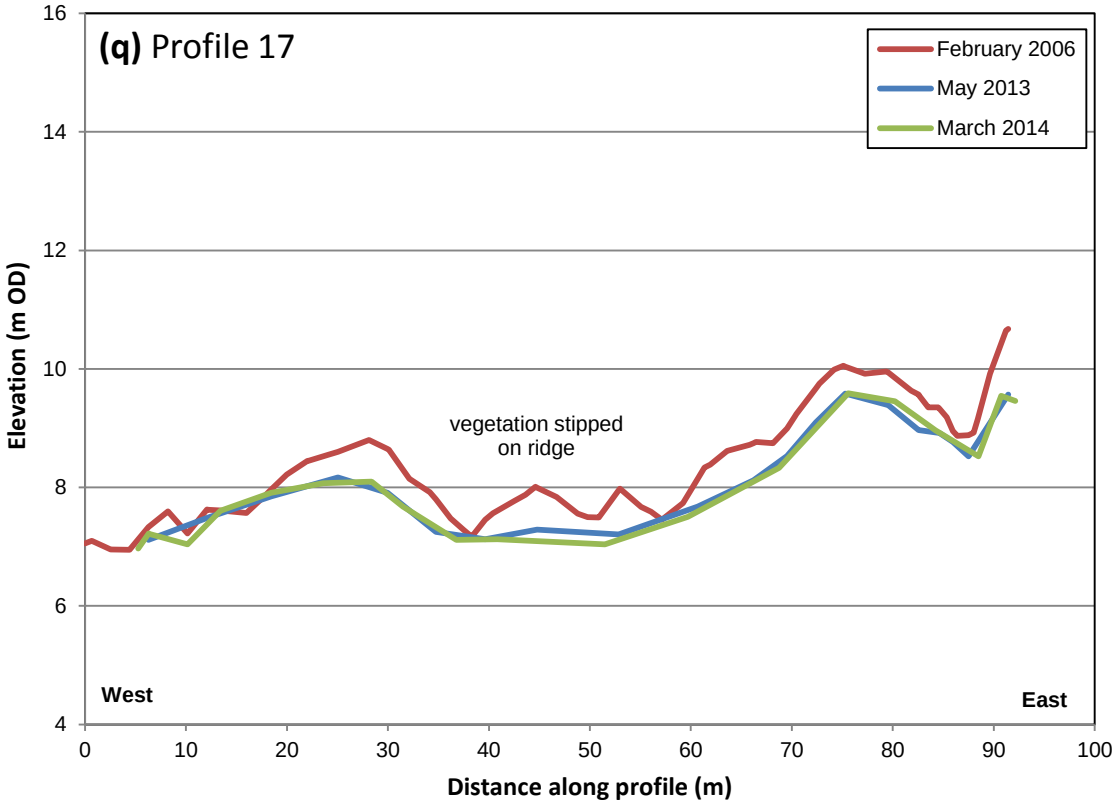


Figure 3. continued. Comparison of surface levels at profiles 15 and 16 indicated by LiDAR survey on 26th February 2006 (pre-trials) and ground surveys on 13 May 2013 and 10 March 2014.



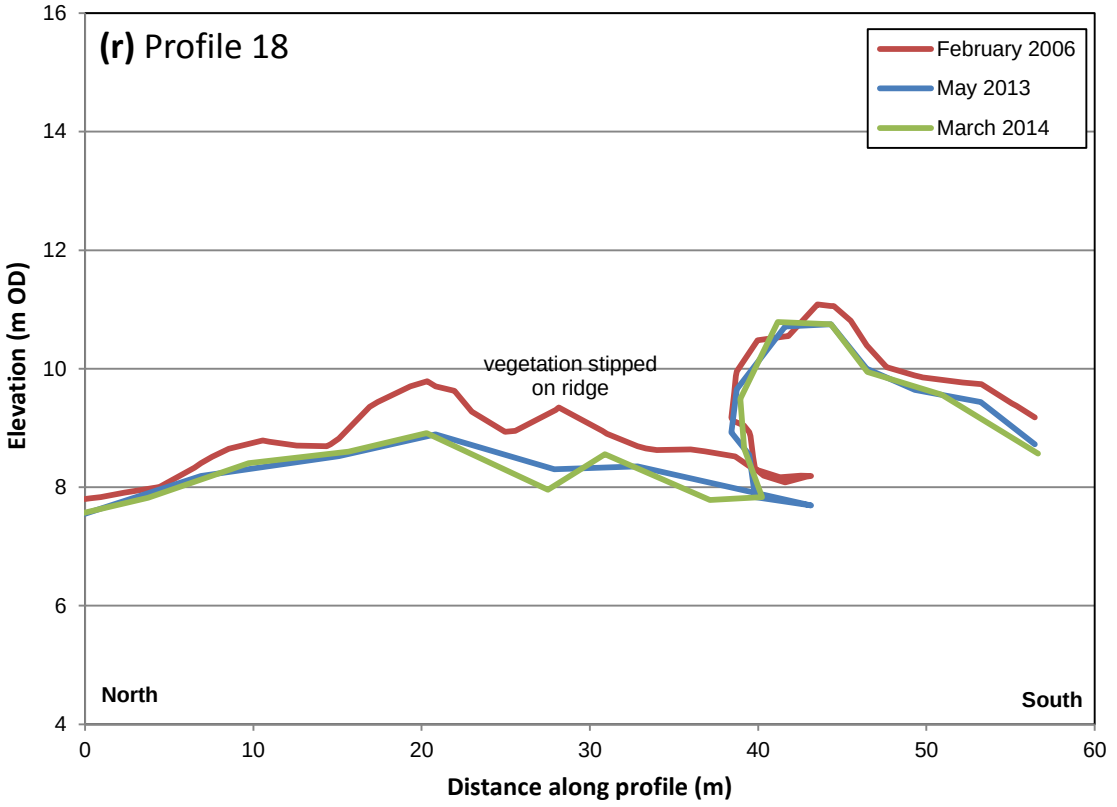


Figure 3. continued. Comparison of surface levels at profiles 17 and 18 indicated by LiDAR survey on 26th February 2006 (pre-trials) and ground surveys on 13 May 2013 and 10 March 2014.

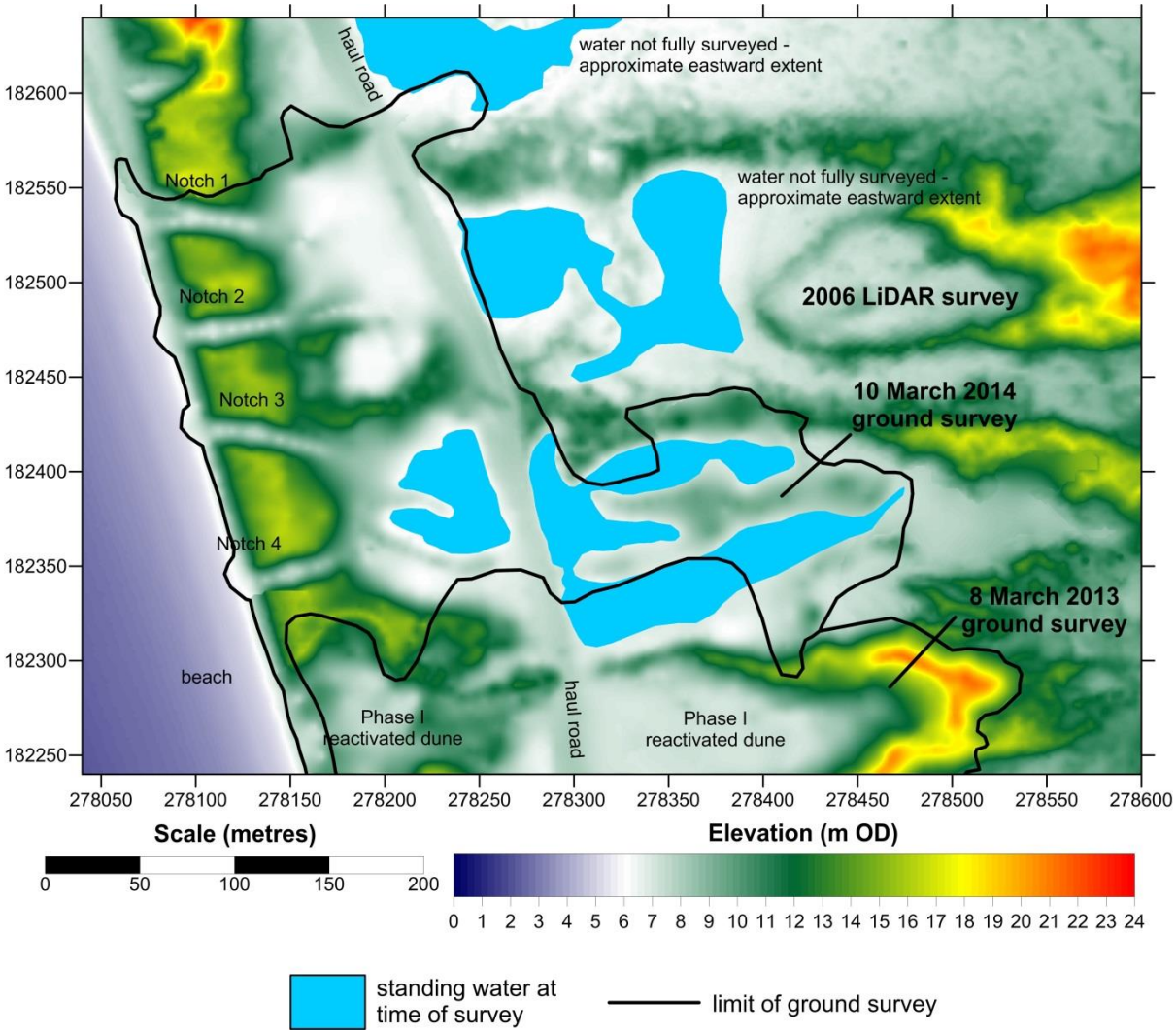


Figure 4. Digital elevation model of the rejuvenation area surveyed on 10 March 2014; black line indicates the limit of the survey. The Phase I restoration area to the south, surveyed on 8 March 2013, is also shown. Elevations for areas outside the black lines are from the February 2006 LiDAR survey

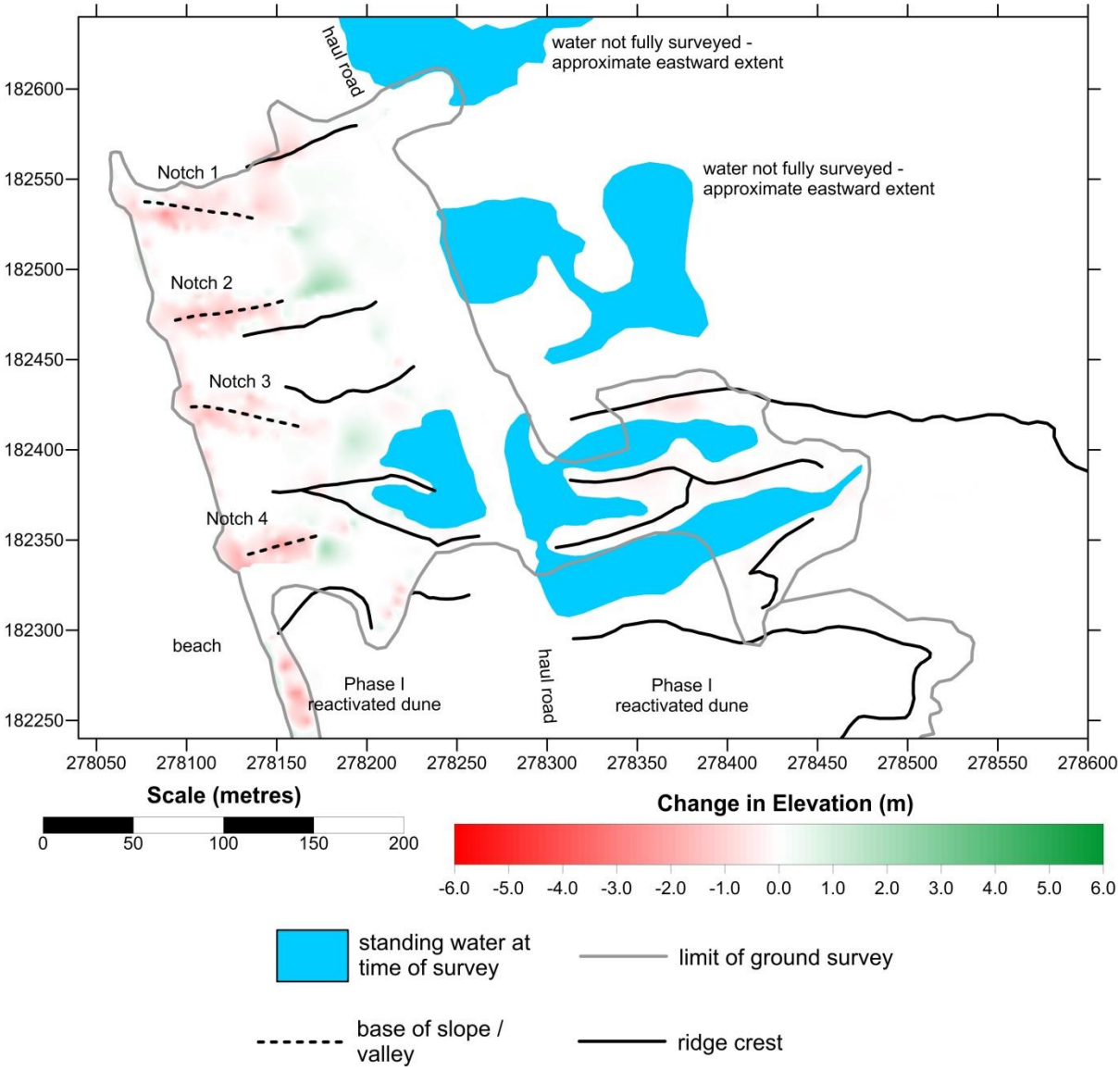


Figure 5. Change in elevation between the ground surveys on 13 May 2013 and 10 March 2014

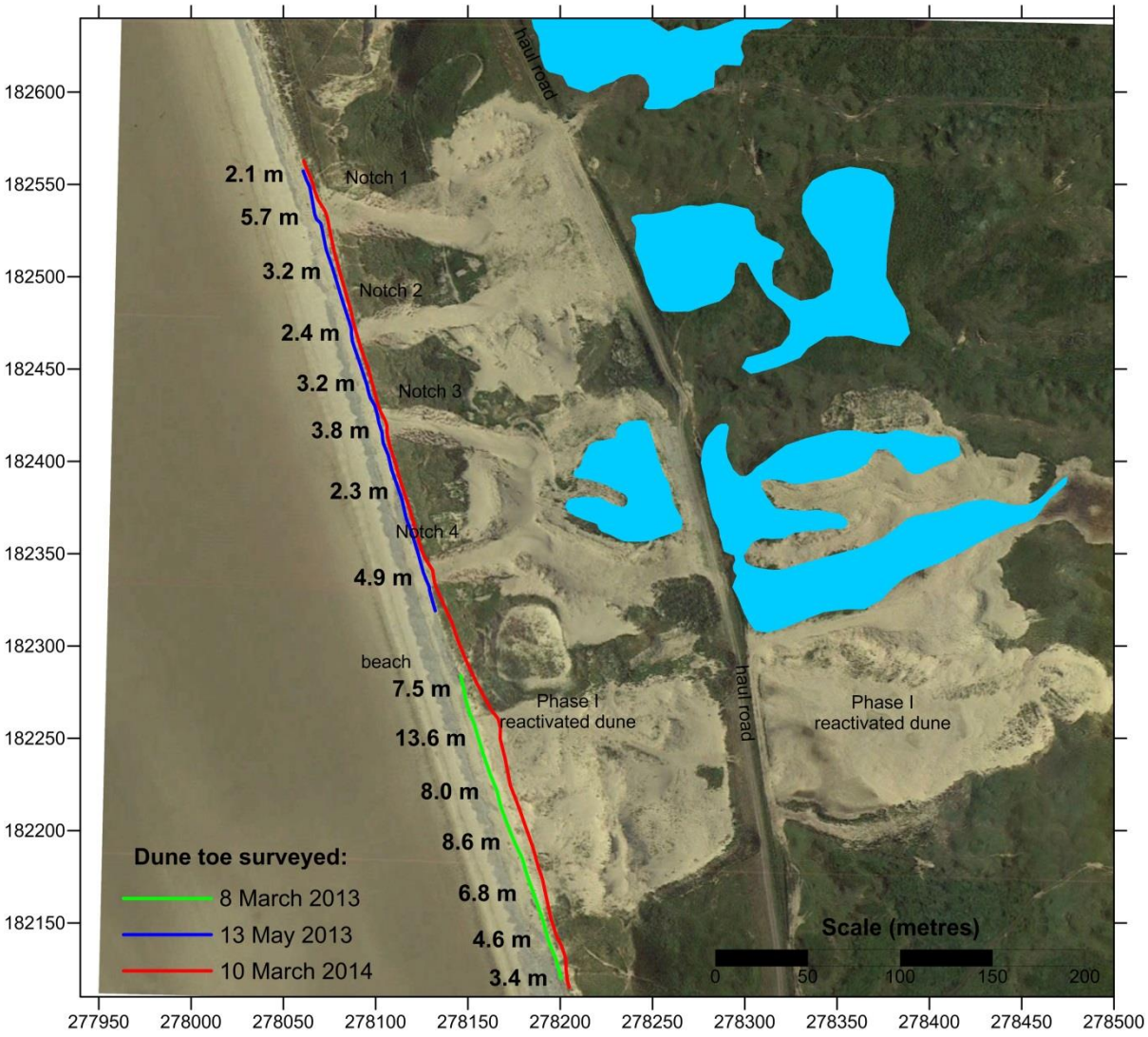


Figure 6. The position of the dune toe surveyed during ground surveys on 13 May 2013 and 10 March 2014. The horizontal distance of erosion between 2013 and 2014 is indicated at 15 points along the coast.

8. Field photographs

Taken 10 March 2014

Photograph 1. Slight wave trimming of frontal dunes and gravel upper beach between Notch 1 and Notch 2

Photograph 2. Notch 1 looking inland

Photograph 3. Notch 1 looking seaward

Photograph 4. View inland from landward side of Notch 1

Photograph 5. Notch 2 looking landward

Photograph 6. Notch 2 looking seaward

Photograph 7. View inland from the landward side of Notch 2

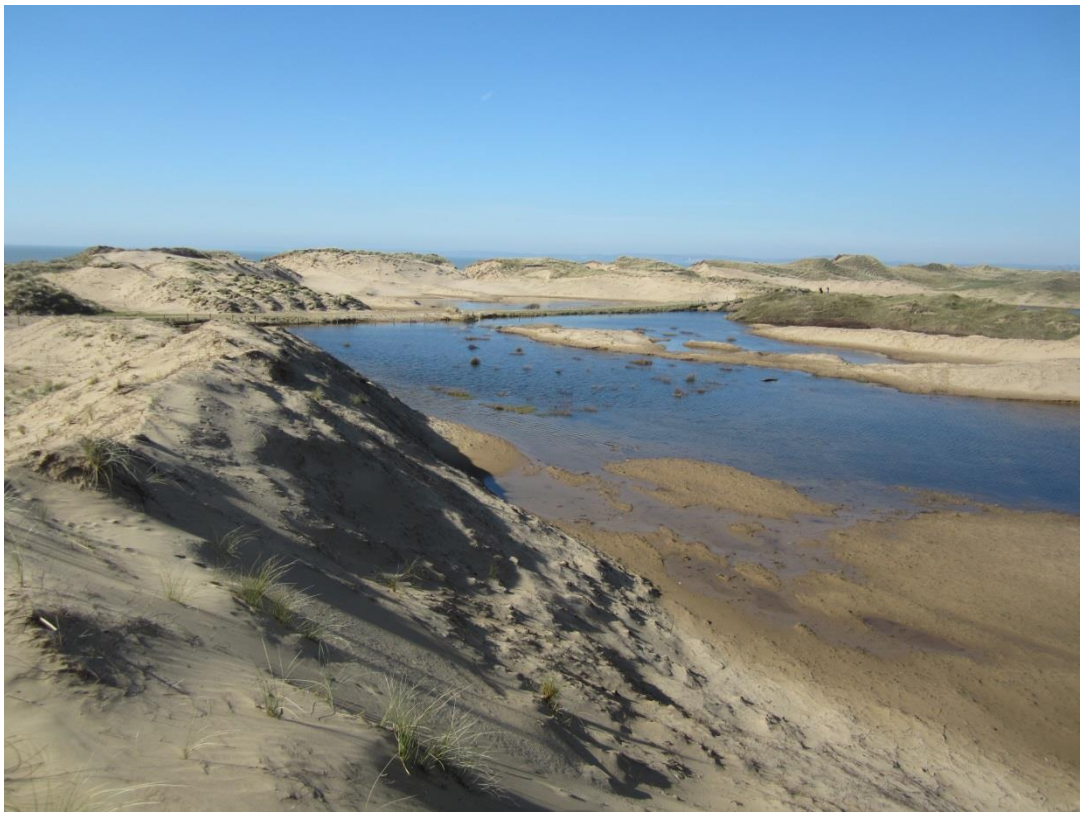
Photograph 8. Wave-eroded dune cliff between Notch 3 and Notch 4.

Photograph 9. Notch 3 looking landward.

Photograph 10. Notch 3 looking seawards

Photograph 11. Notch 4 looking landward

Photograph 12. Notch 4 looking seaward.



Photograph 13. View northwestwards across the inland part of the Phase II area

Photograph 14. View northwards across the inland part of the Phase II area.

Photograph 15. View towards the ENE from the haul road, across the inland part of the Phase II area

Photograph 16. View towards the WNW from the haul road, across the seaward part of the Phase II area

Photograph 17. Sand accumulation on the eastern side of the haul road, northern end of the Phase II area

Data Archive Appendix

Data outputs associated with this project are archived at 'Kenfig Dune Restoration; project 420, media 1490' on server–based storage at Natural Resources Wales.

The data archive contains:

[A] The final report in Microsoft Word and Adobe PDF formats.

[B] An Excel file named (Kenfig Burrows Survey 10-03-2014.xls) of data points (x,y,z)

Metadata for this project is publicly accessible through Natural Resources Wales' Library Catalogue http://libcat.naturalresources.wales/webview/ (English Version) and http://libcat.naturalresources.wales/cnc/ (Welsh Version) by searching 'Dataset Titles'. The metadata is held as record no [115776]

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