

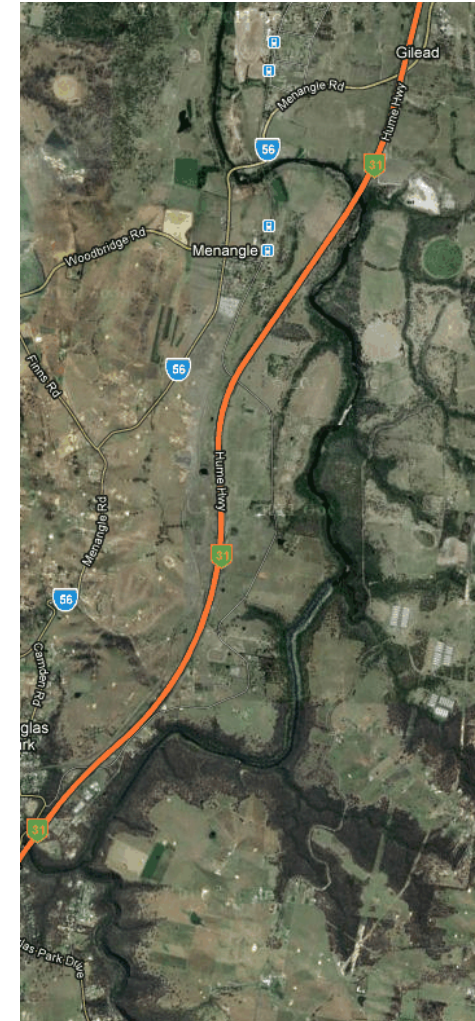
# Using profiles to measure subsidence caused by longwall mining

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# Overview

- Background
  - The Hume Highway
  - Longwall coal mining
- The issue
- Monitoring
- Profile evaluation
- Conclusions





# Background - the Hume Highway

- Main thoroughfare between Melbourne & Sydney



- Length: 887 km
- 20 million tonnes of road freight annually
- 30,000 vehicles per day
- 26% heavy vehicles

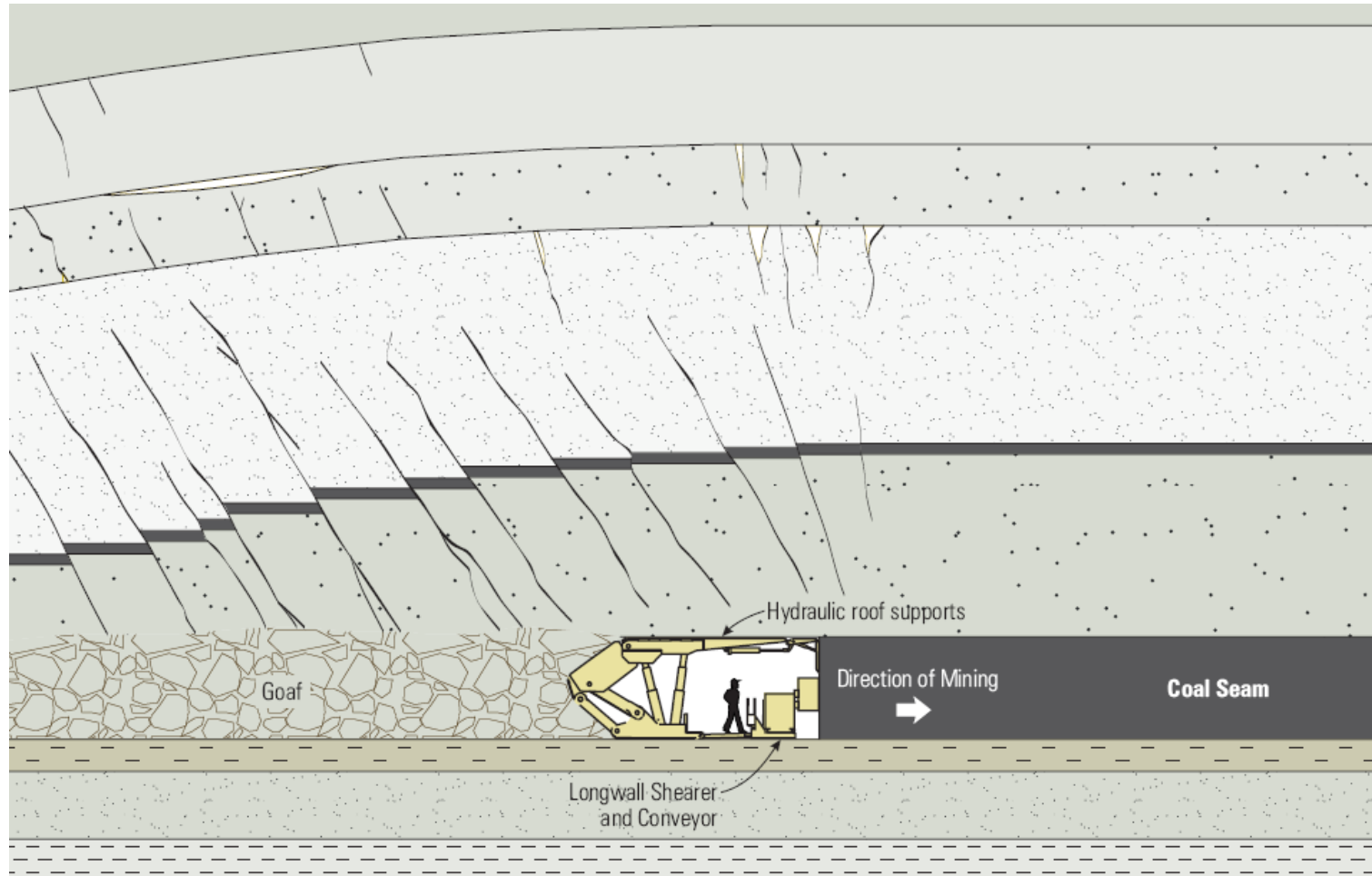
# Bushrangers - Ned Kelly



*“Such is life”*



# Background - longwall coal mining

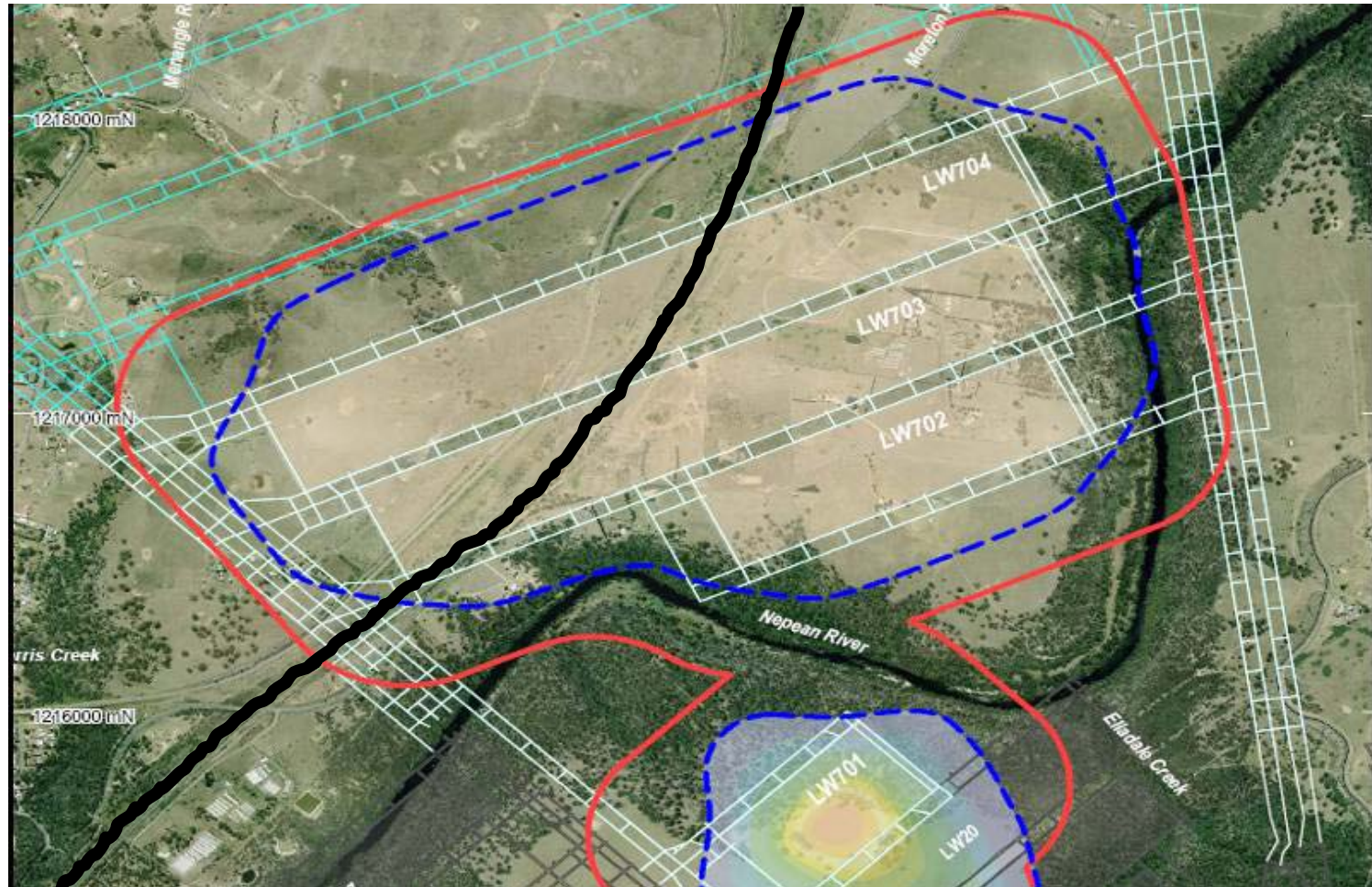


# Background - longwall coal mining

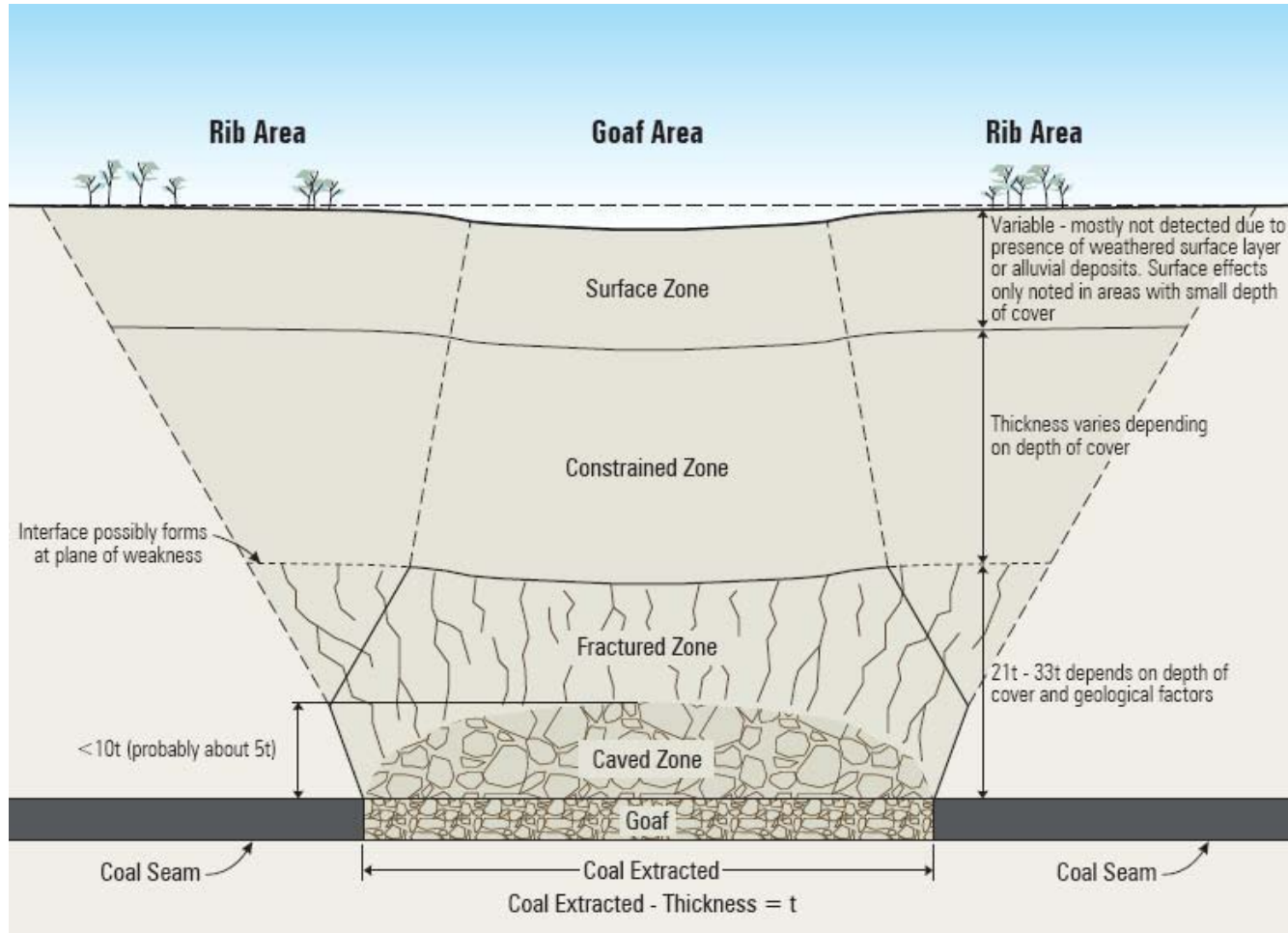




# The issue – mining under highway



# The issue - subsidence



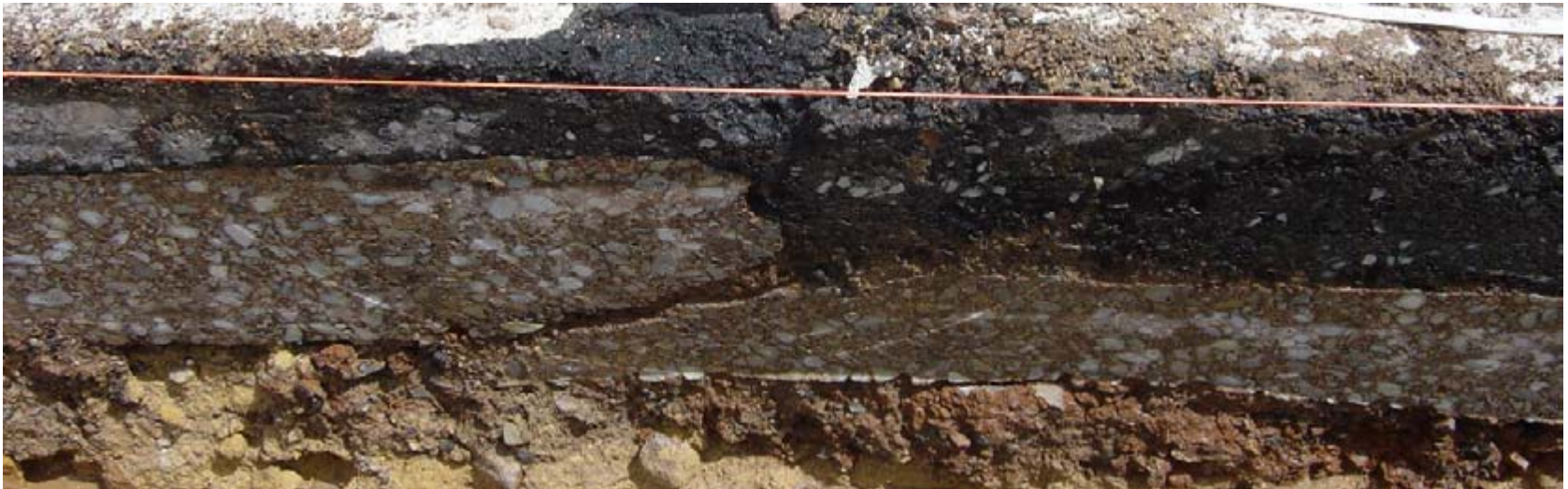


# Predicted subsidence

Stage of mining	Predicted subsidence (mm)
After longwall 702	< 20
After longwall 703	703
After longwall 704	1076

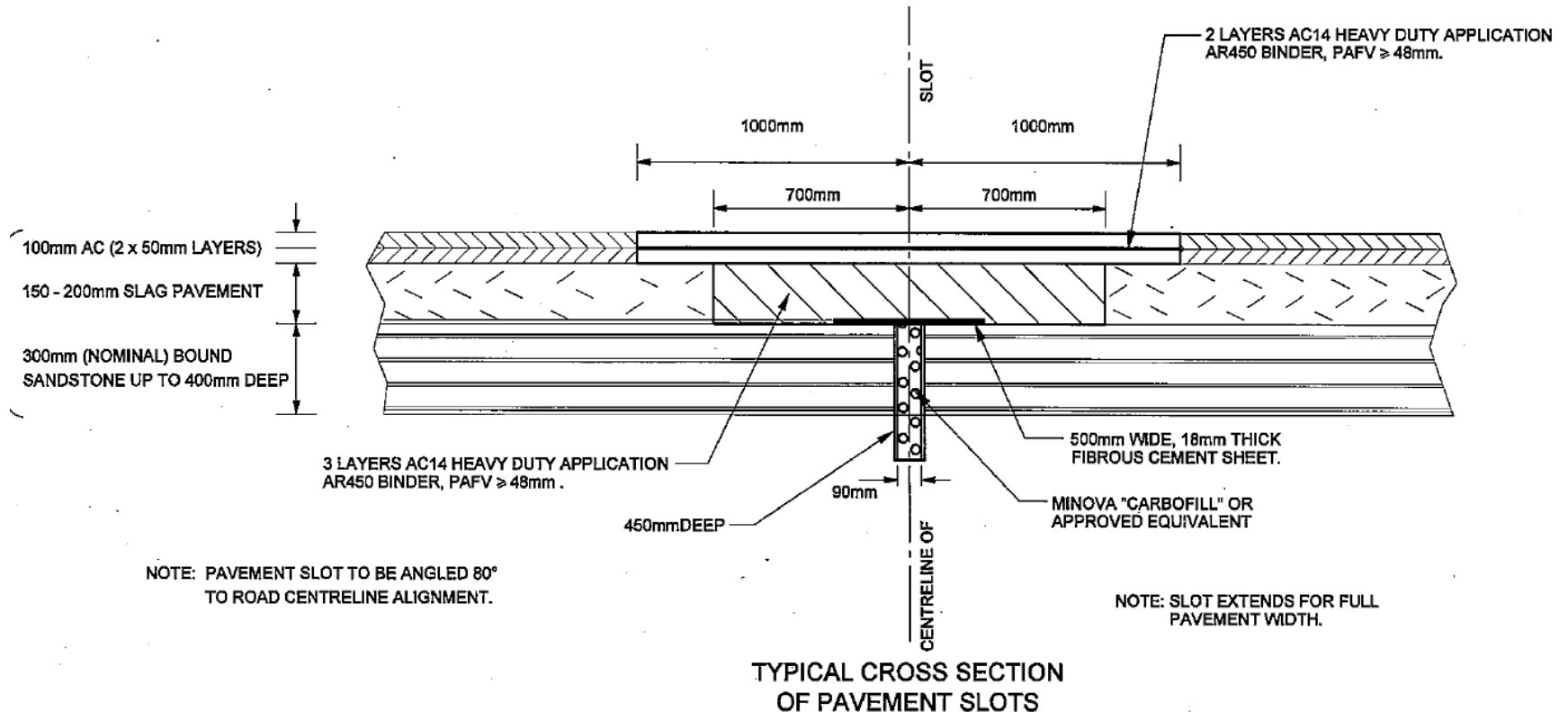
# Predicted impact

- A step or hump from compressive failure of the bound sandstone sub base

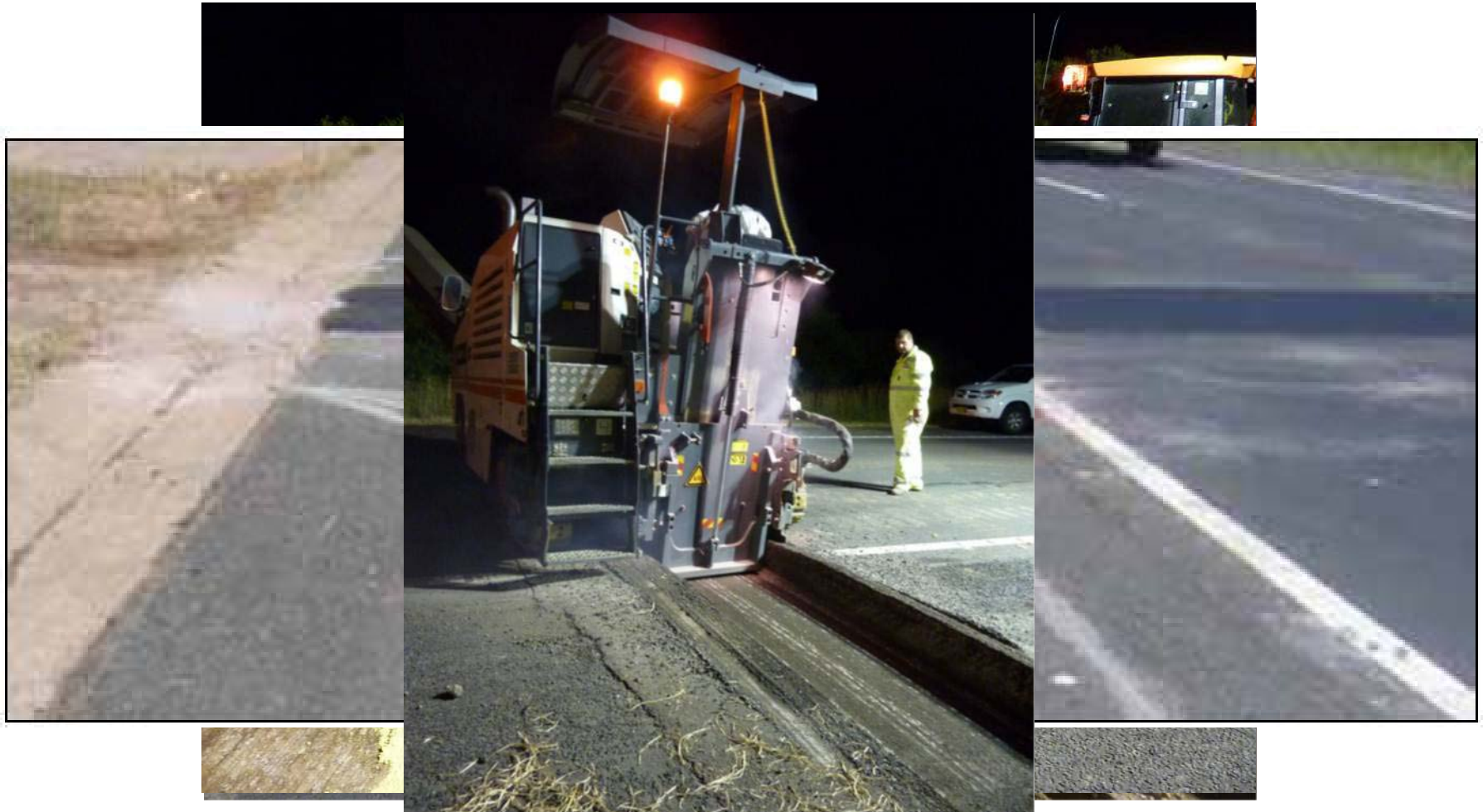




# Solution - expansion slot

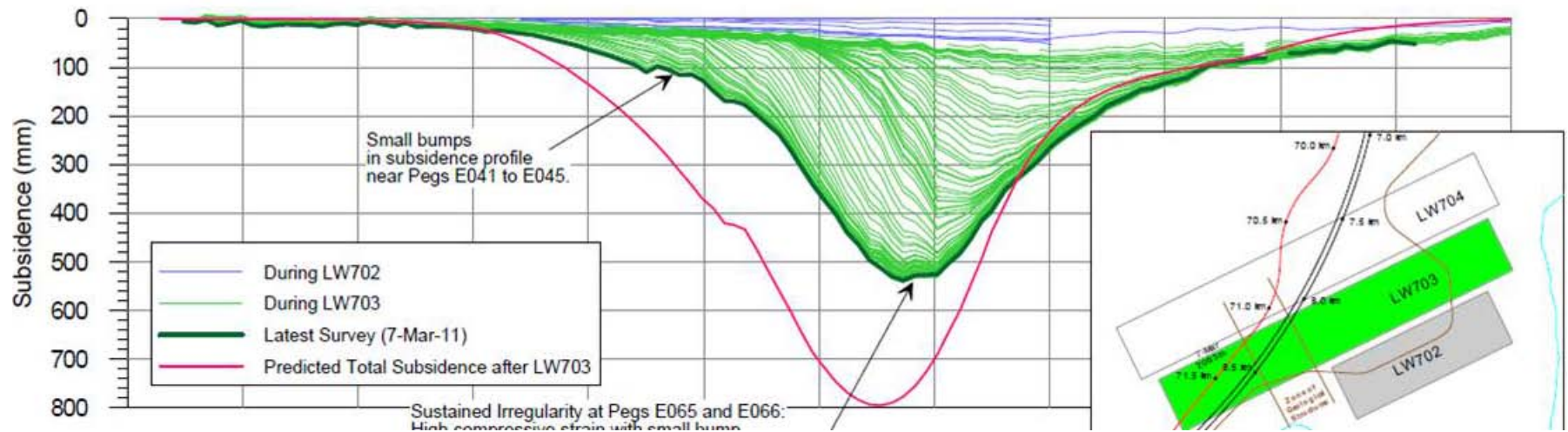


# Expansion slots





# Monitoring - meetings and reports



# Subsidence monitoring

- rod and level
- slot displacement
- visual surveys
- regular measurement of surface profile



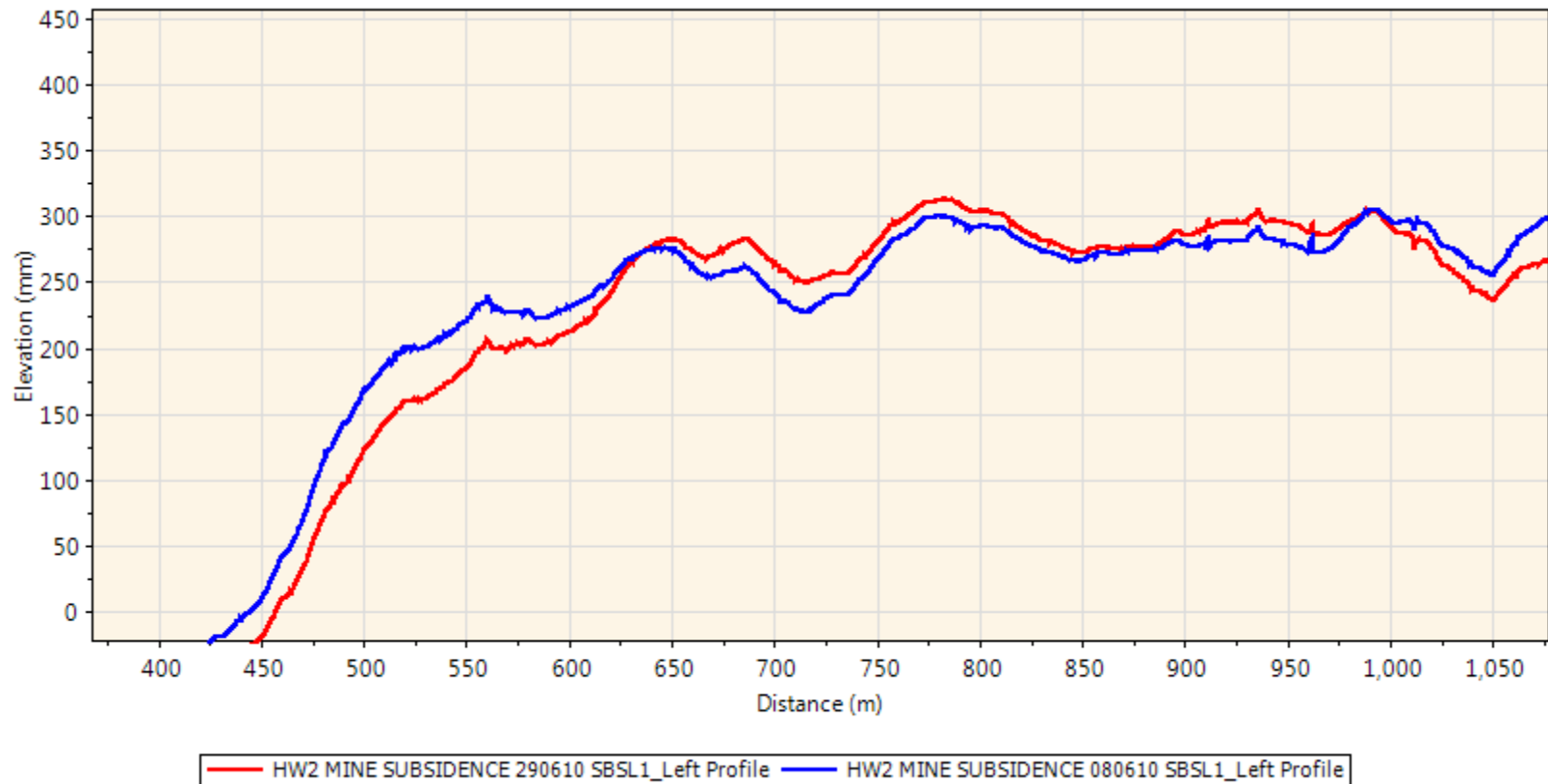


# Profiler analysis

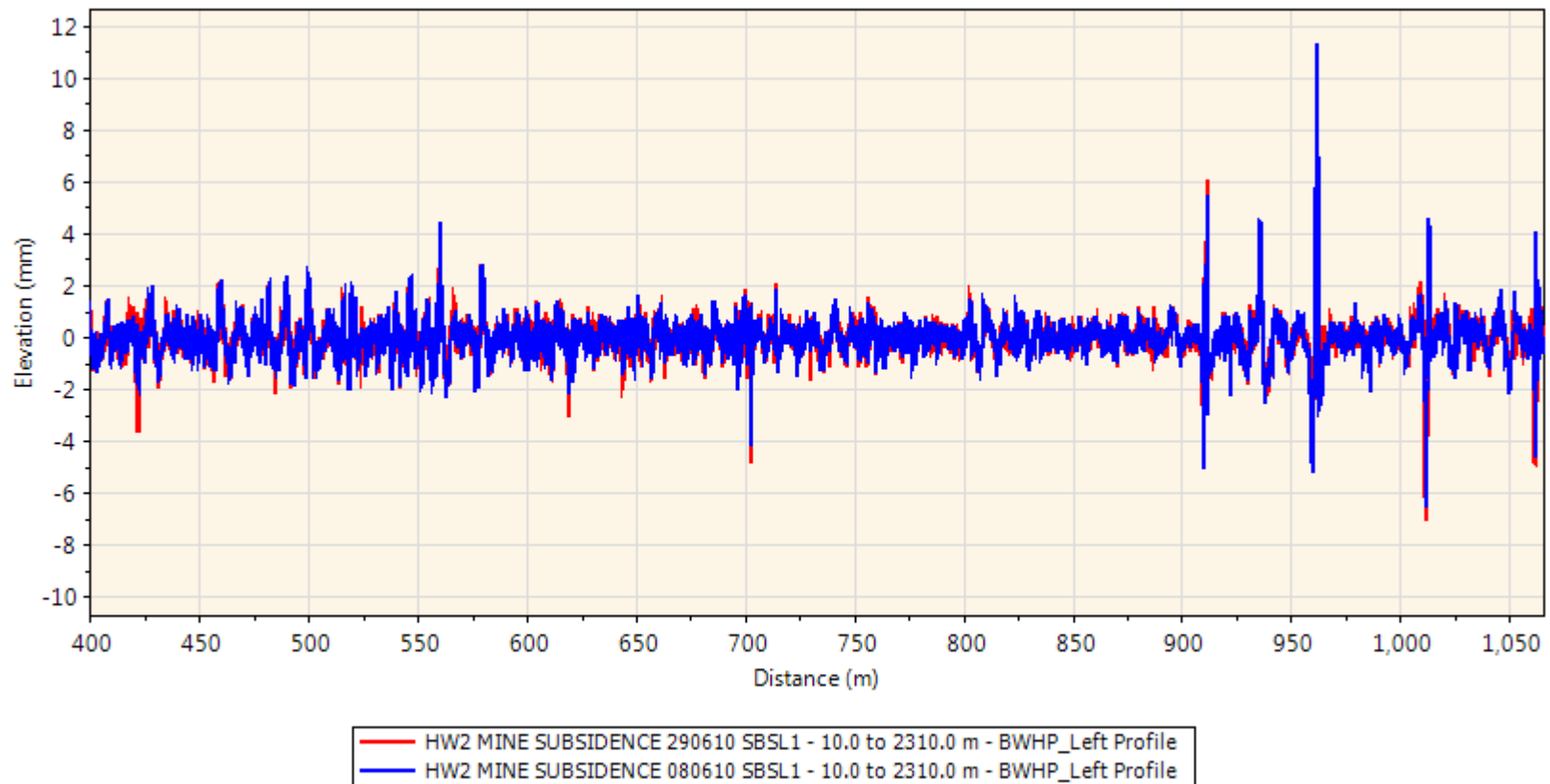
- Aim: compare consecutive profiles and look for change
- Problem: long wavelength drift



# Long wavelength drift

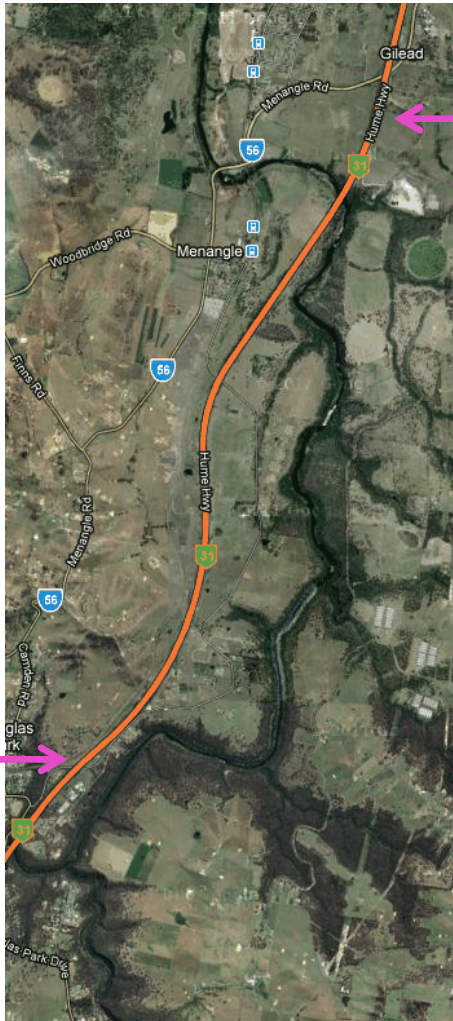


# Solution – high pass filter





# Data collection



- Length: 2300 metres
- Fixed control points

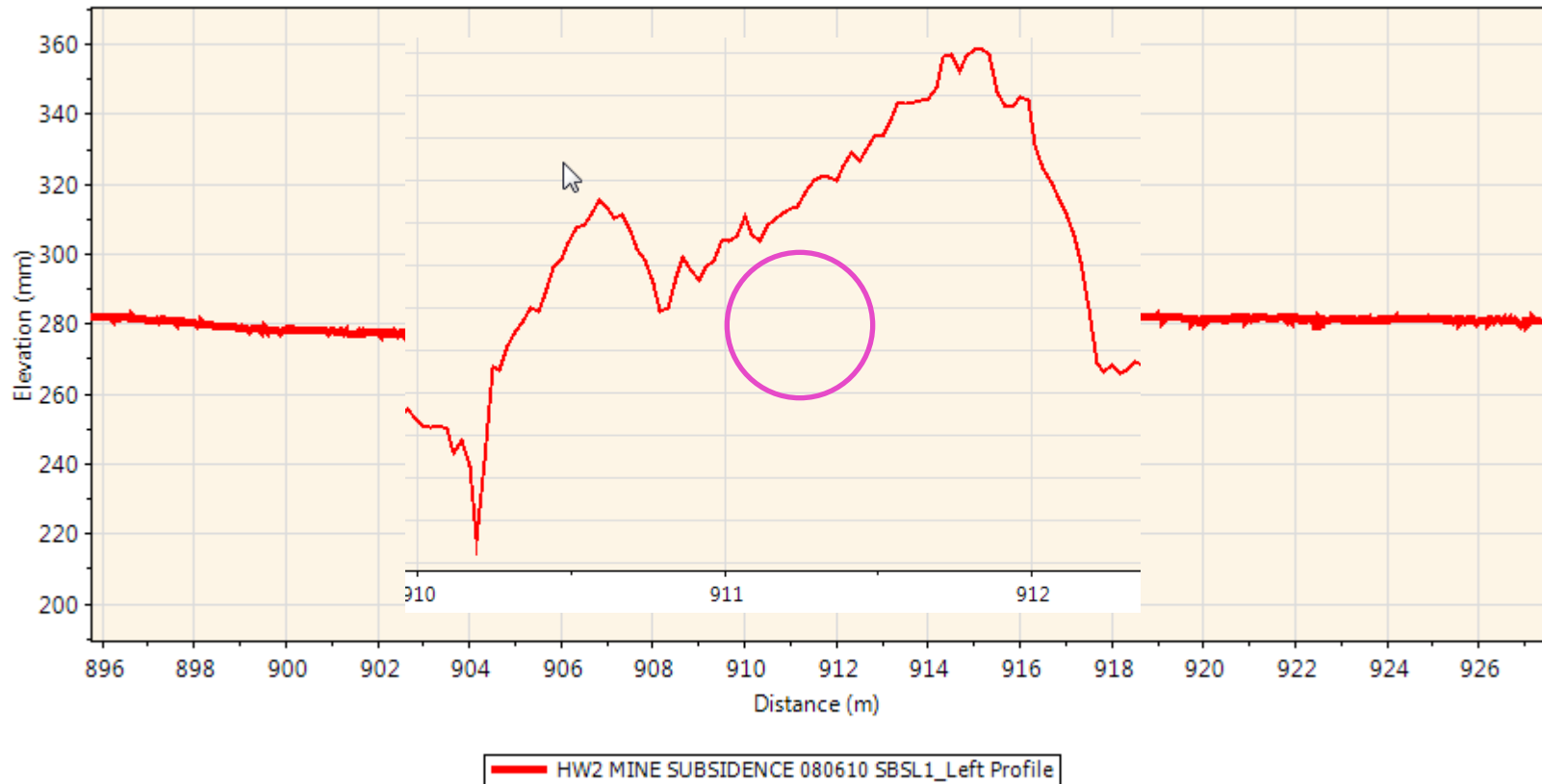


# 9 step analysis methodology

1. Generate ERD files
2. Identify reference features in profiles
3. Adjust sample interval
4. Align profiles using auto-correlation function
5. Crop profiles (start and end)
6. High pass profiles
7. Flip profiles in counter direction
8. Interpolate sample interval to match
9. Subtract profile from original profile



## 2. Identify reference features

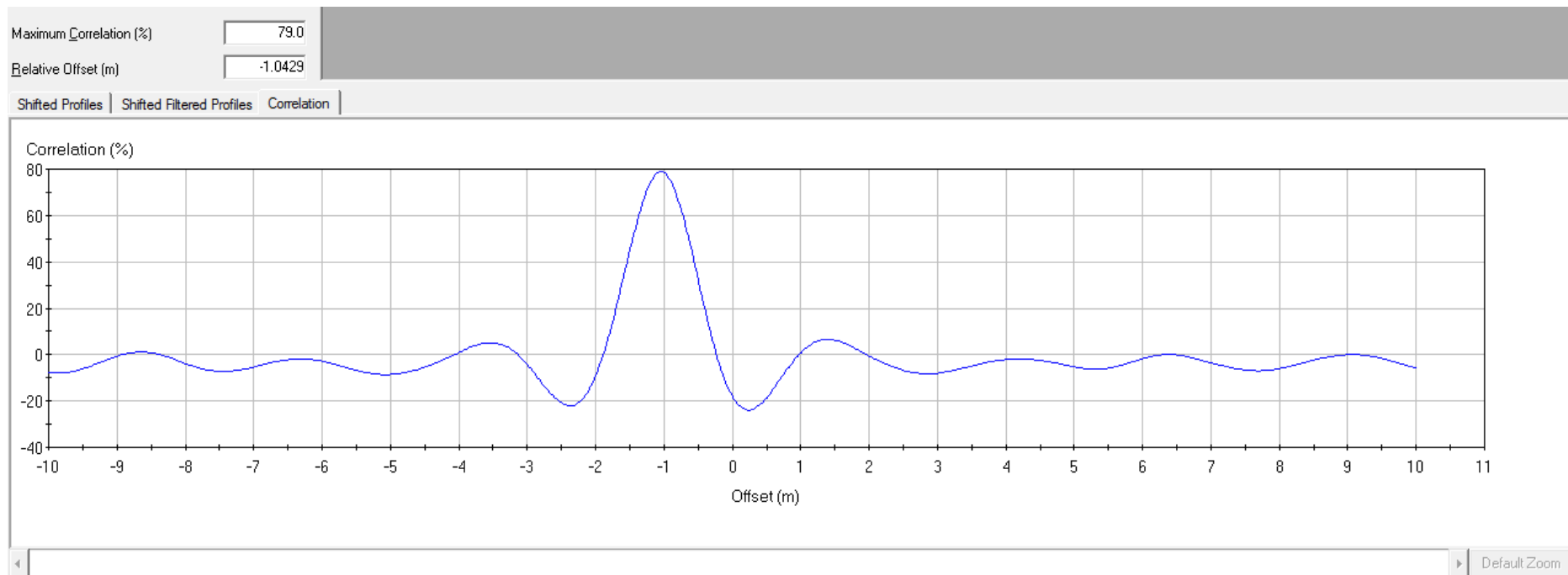




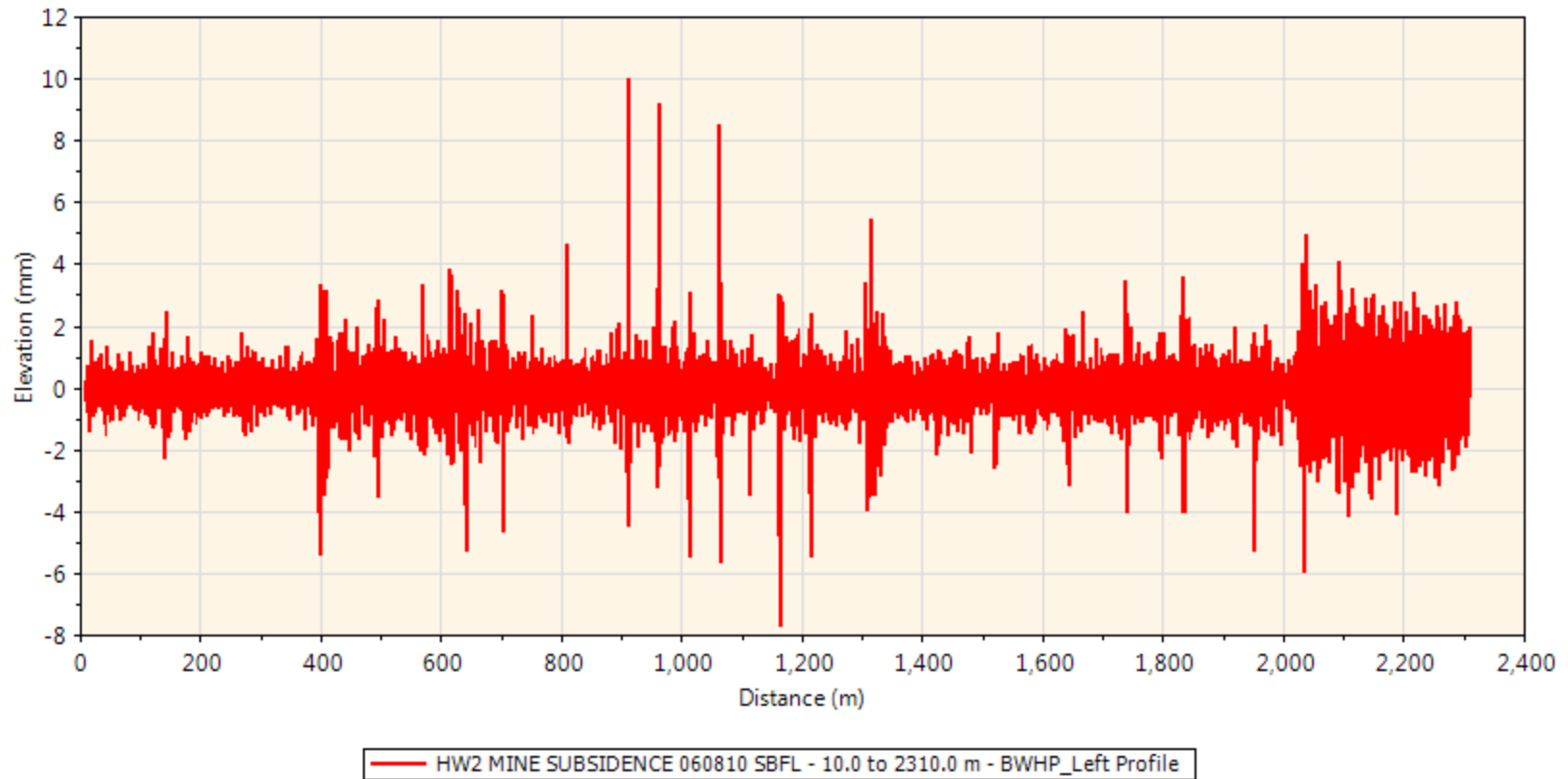
# 3. Adjust sample interval

Date	Start (m)	End (m)	Length (m)	Difference (m)
8/06/2010	953.5429	2160.1797	1206.6368	
22/10/2010	951.9143	2159.3450	1207.4307	0.79390

# 4. Profile alignment

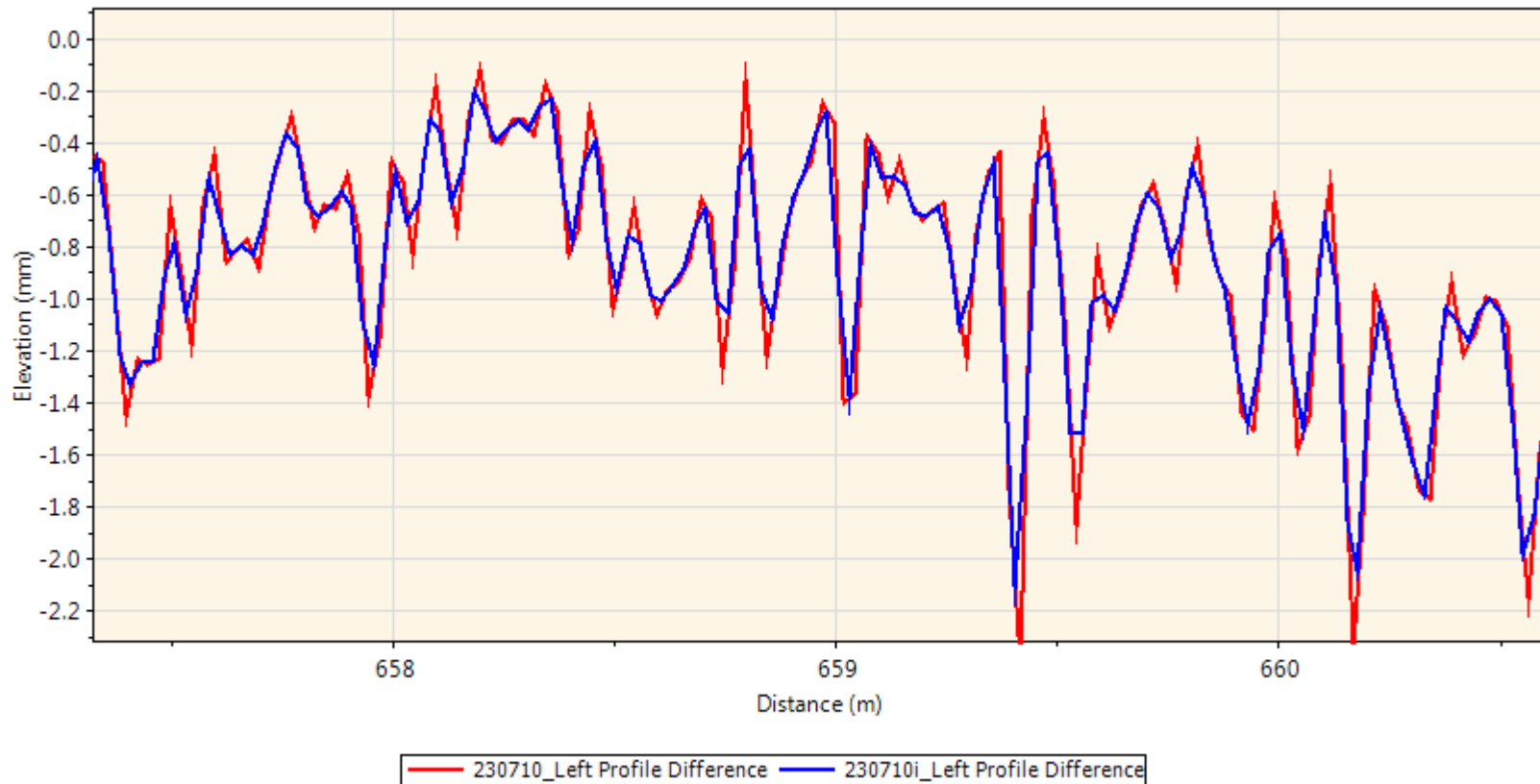


# 5&6. Crop and highpass filter profile

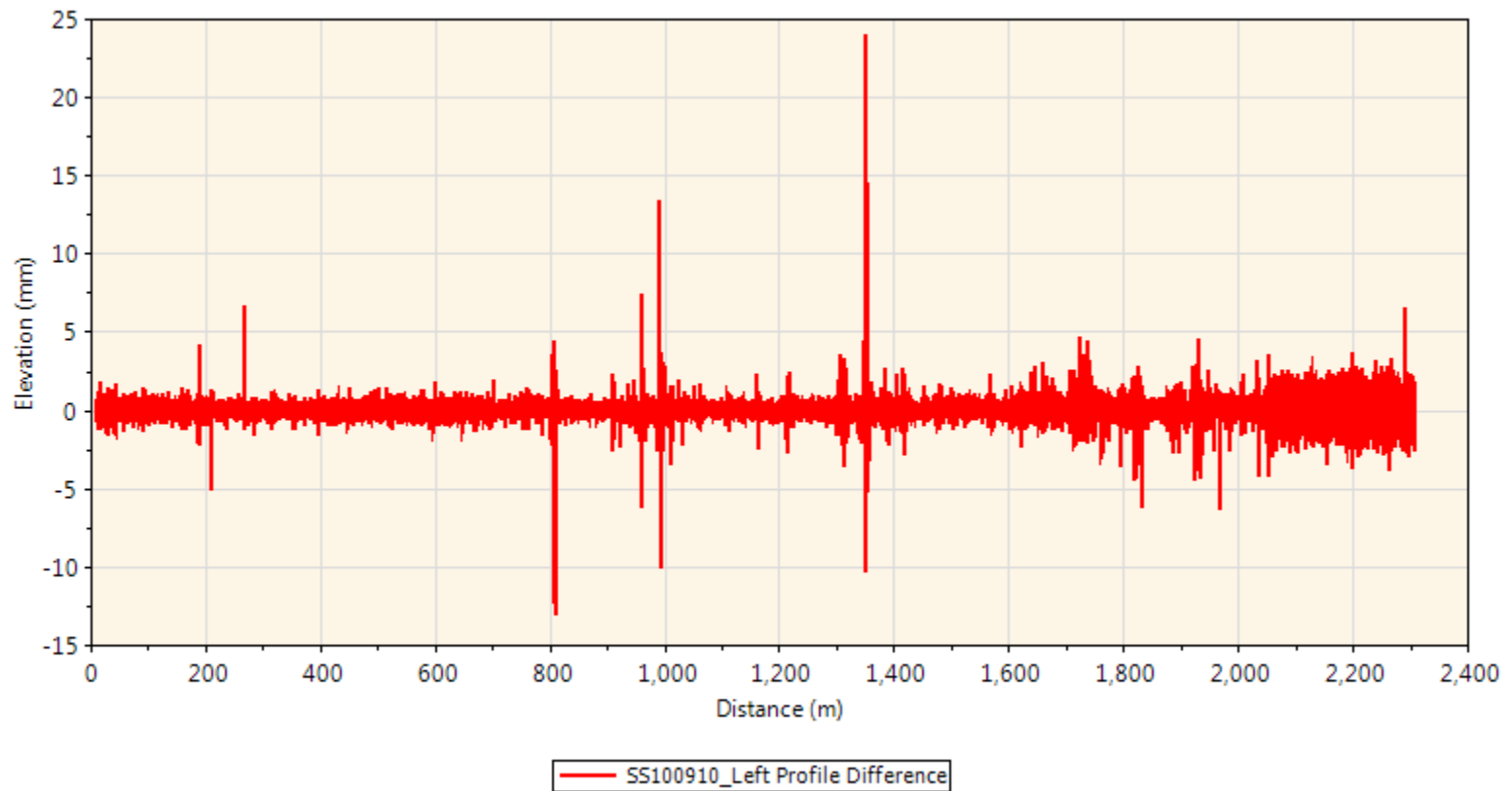




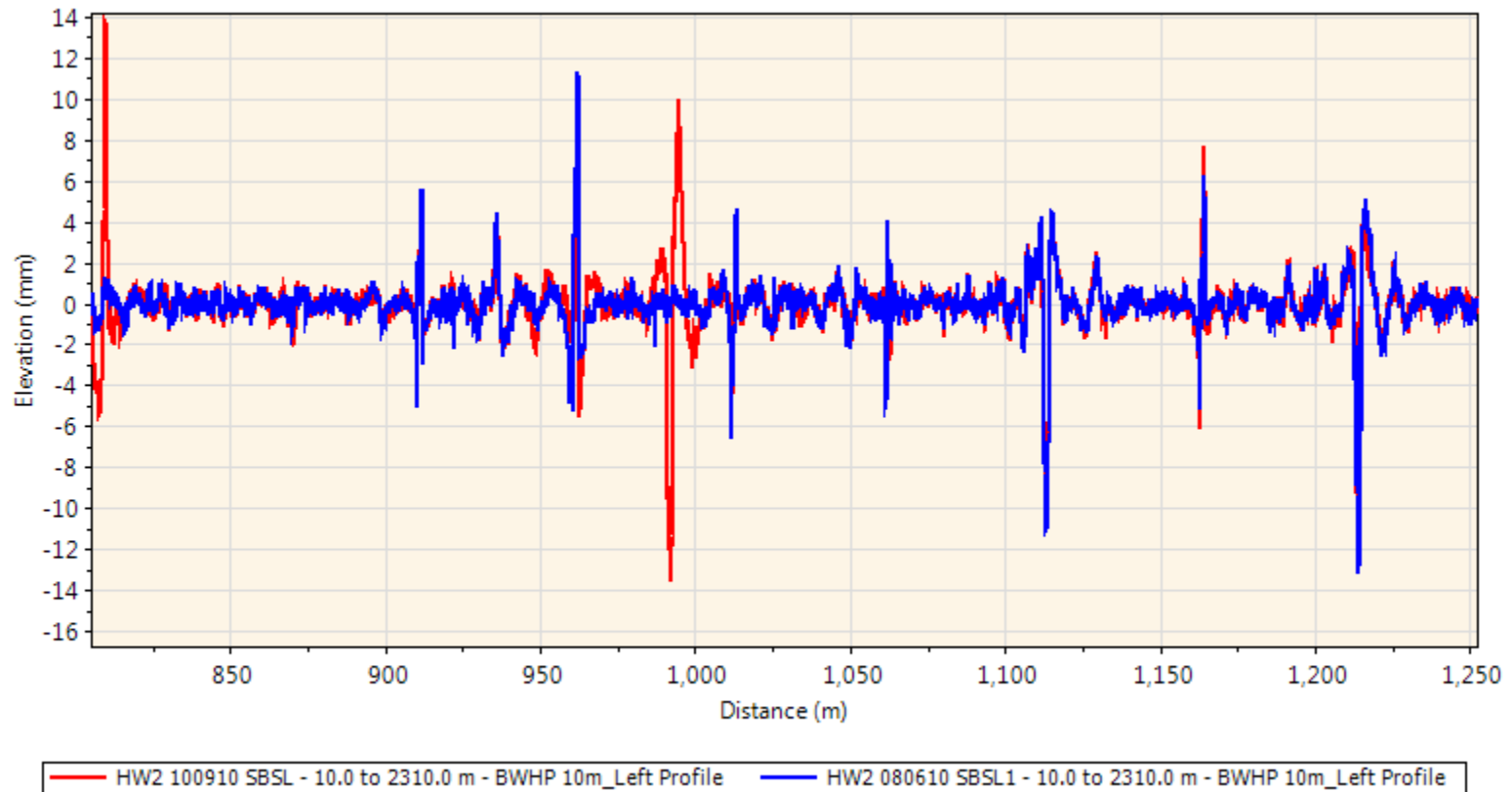
# 8. Interpolation



# 9. Differences

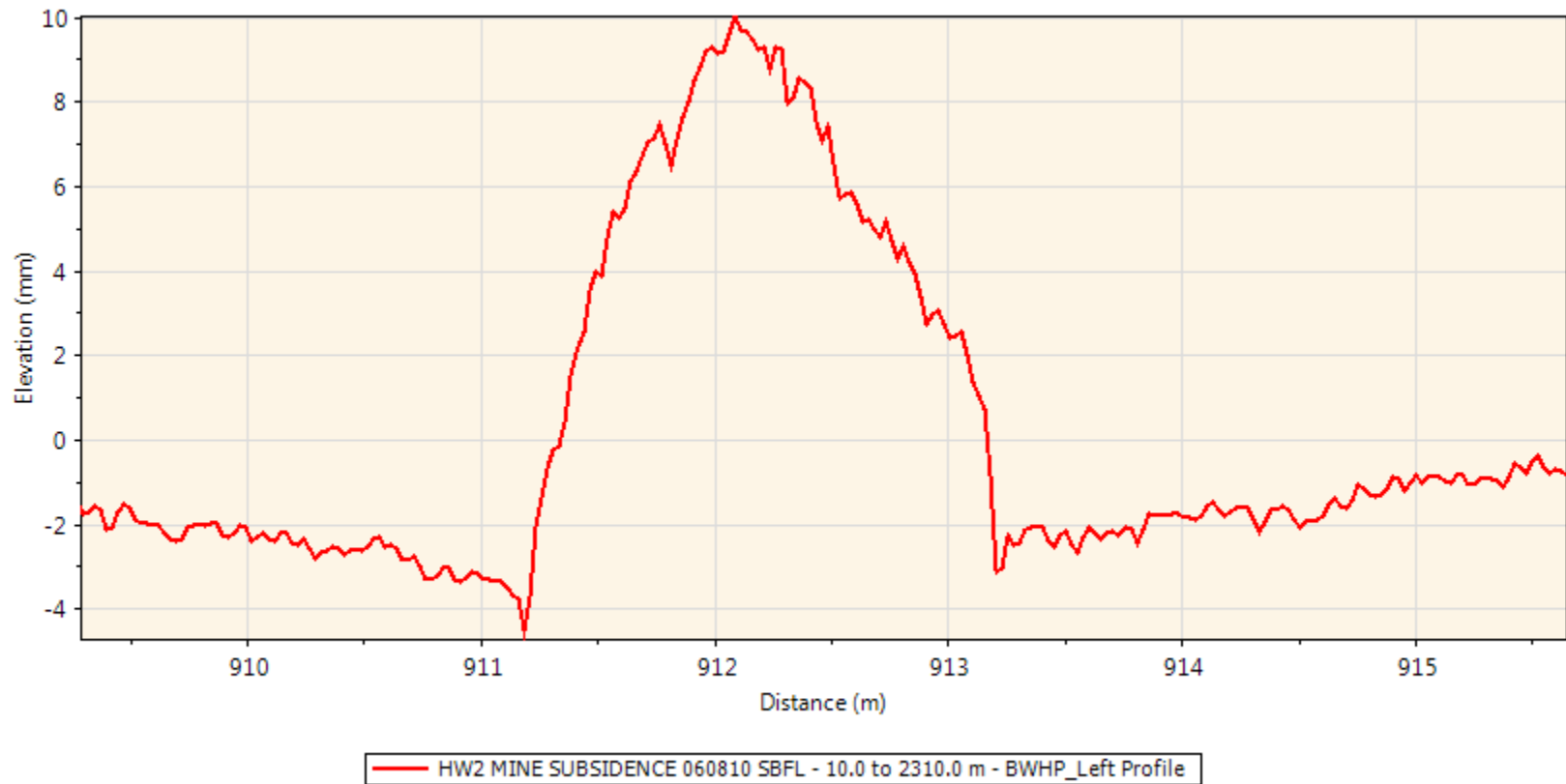


# 9. Differences



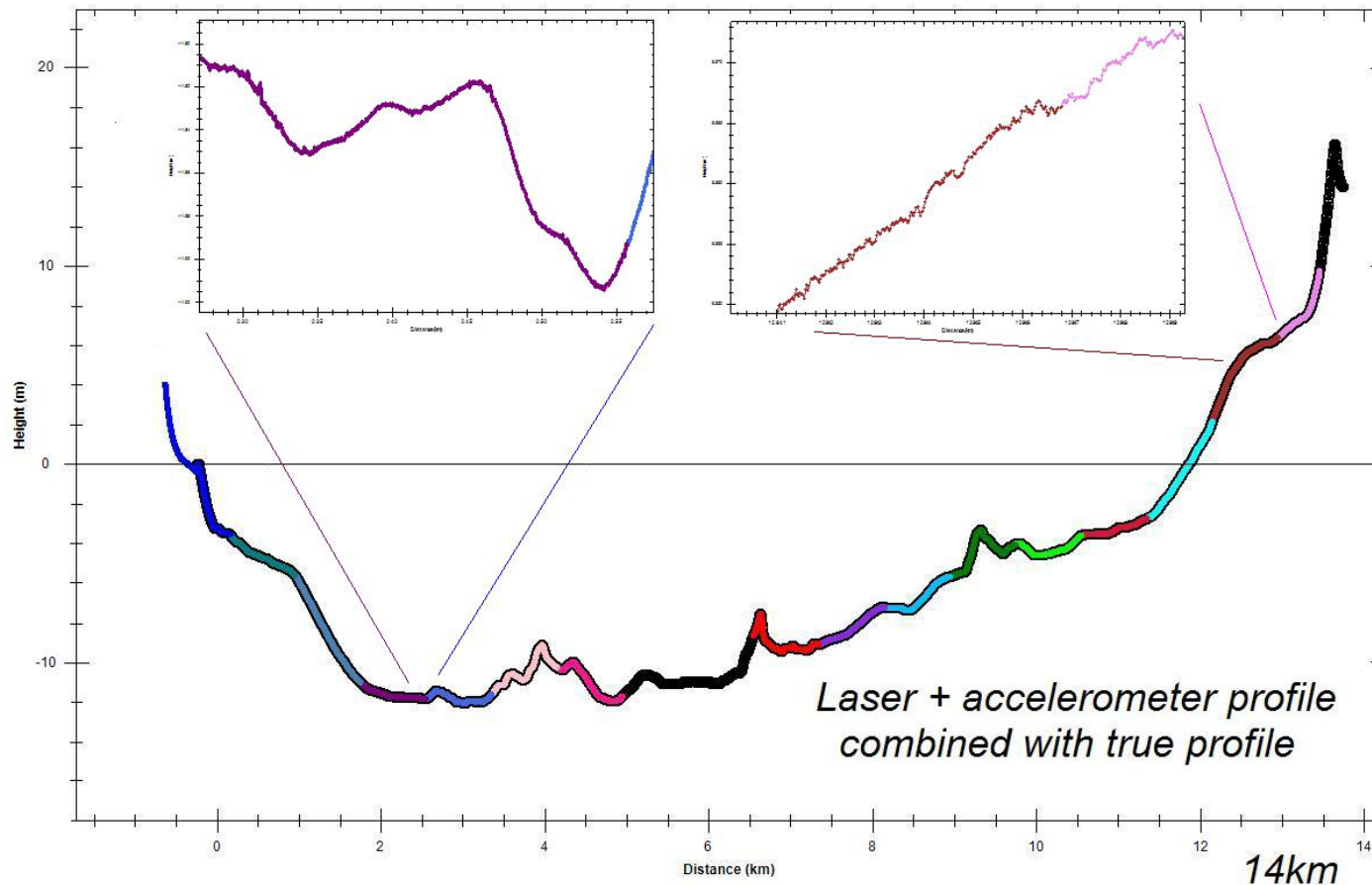


# Identify slot location and size



# Possible improvement to system

- Use of IMU to adjust long wave length drift



# Conclusions

- Variations  $> 10$  mm identified
- ProVal was essential to the process
- Better to know where the bump will develop rather than measuring it after the fact
- Technique could be improved by incorporating long wavelength profile measurement capability



# The things you see.....



# Thank you

