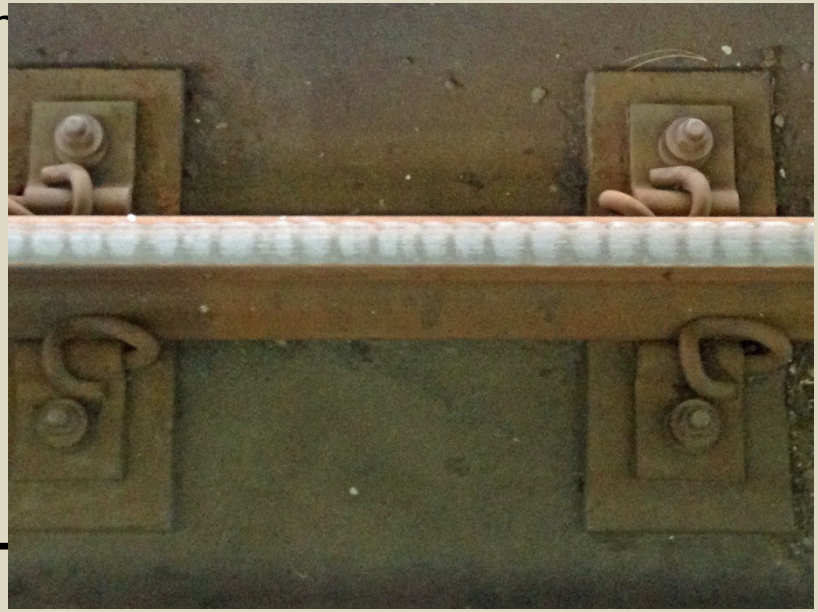
Identifying Potential Reasons for Rail Clip Failure

Noise Reductions through Rail Grinding

Hugh Saurenman, Shawn Duenas

ATS Consultin



ATSConsulting
acoustics, transportation + strategy

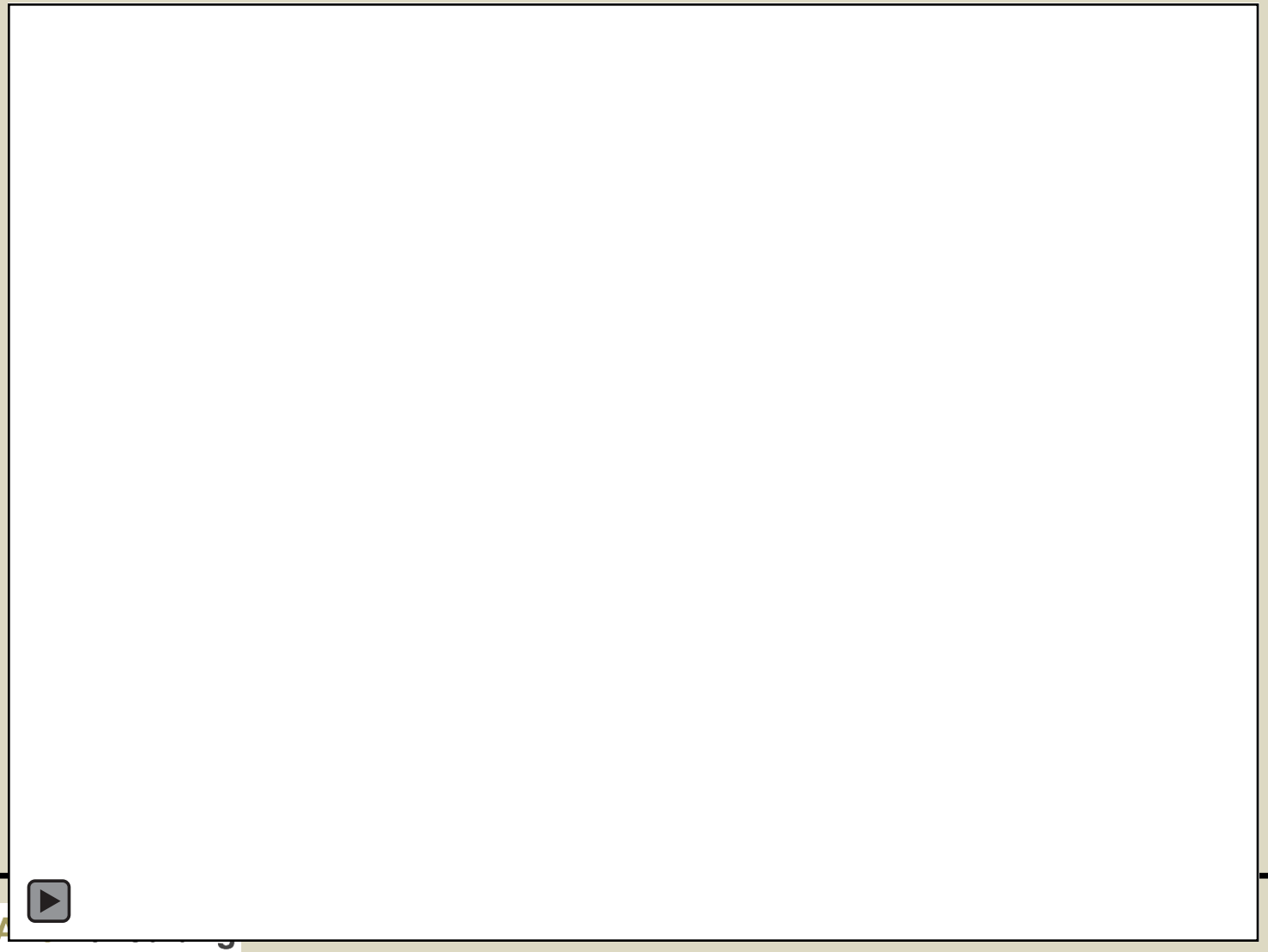
Background

- BART Rail Corrugation Problem
- Failure of clips at Sound Transit
- Solution in both cases: improved rail grinding appears to be the solution

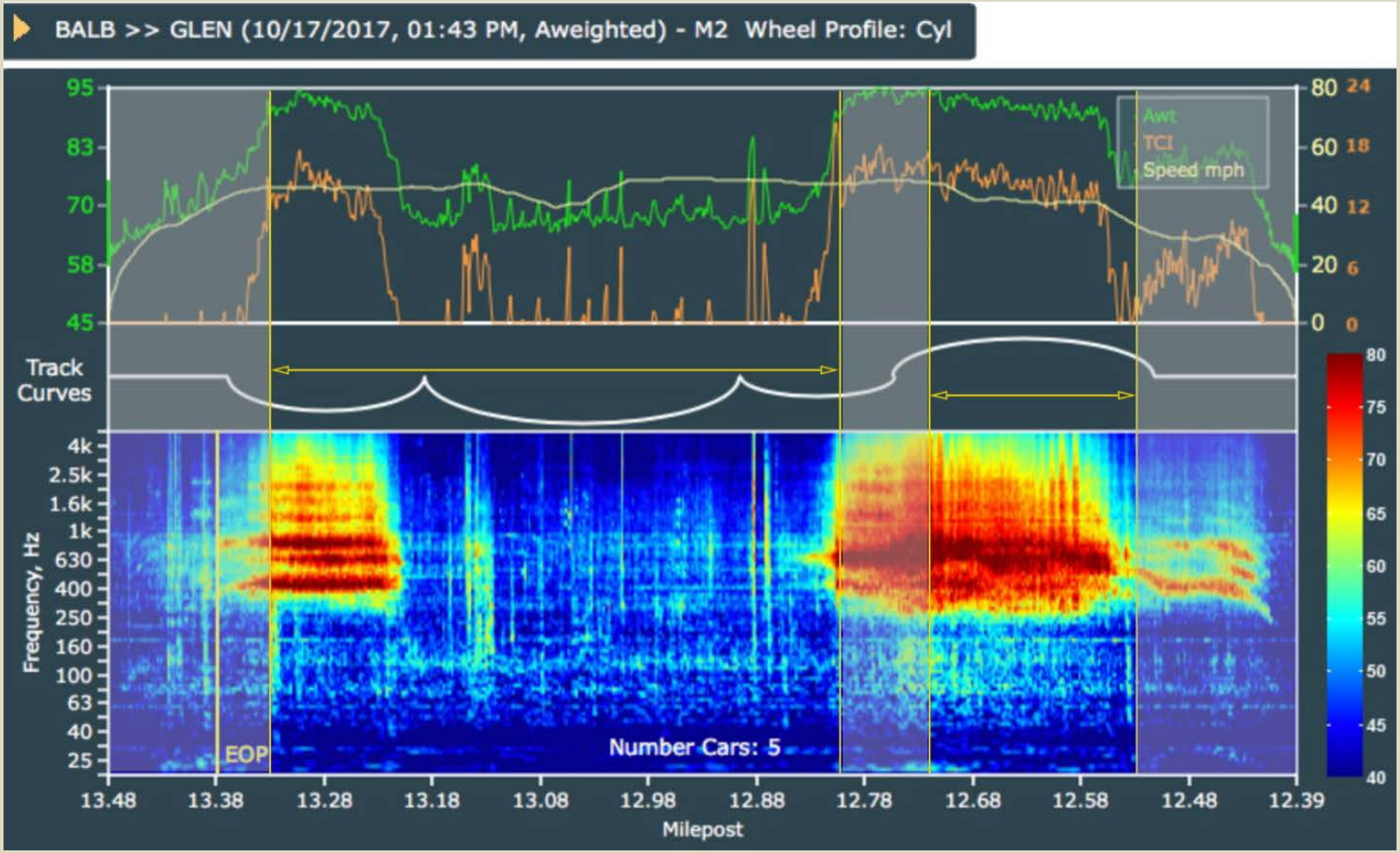
Rail Grinding for Low Noise at BART and Sound Transit

- BART: Progess at controlling noise through:
  - New vehicles
  - New wheel profiles (switch from cylindrical profile to tapered profile)
  - New rail profiles (supposed to work better with new wheel profiles)
  - Outside expert (ARM) managing rail grinding program
- Sound Transit:
  - Developing grinding specification to reduce noise and remedy clip breaking problem

Rail Grinding at Sacramento RT

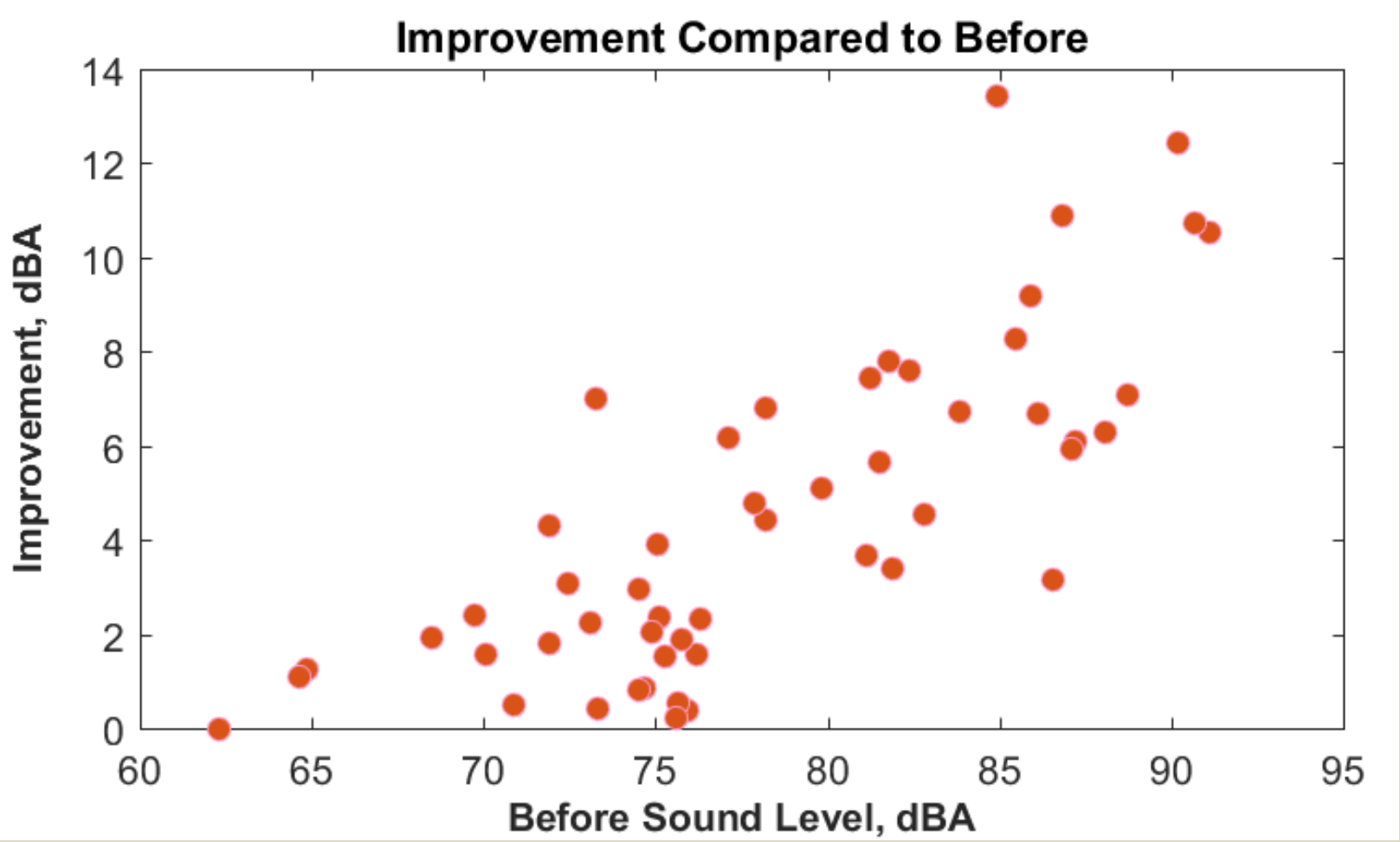


Balboa to Glen Park before grinding
(Image from CorrTracker)



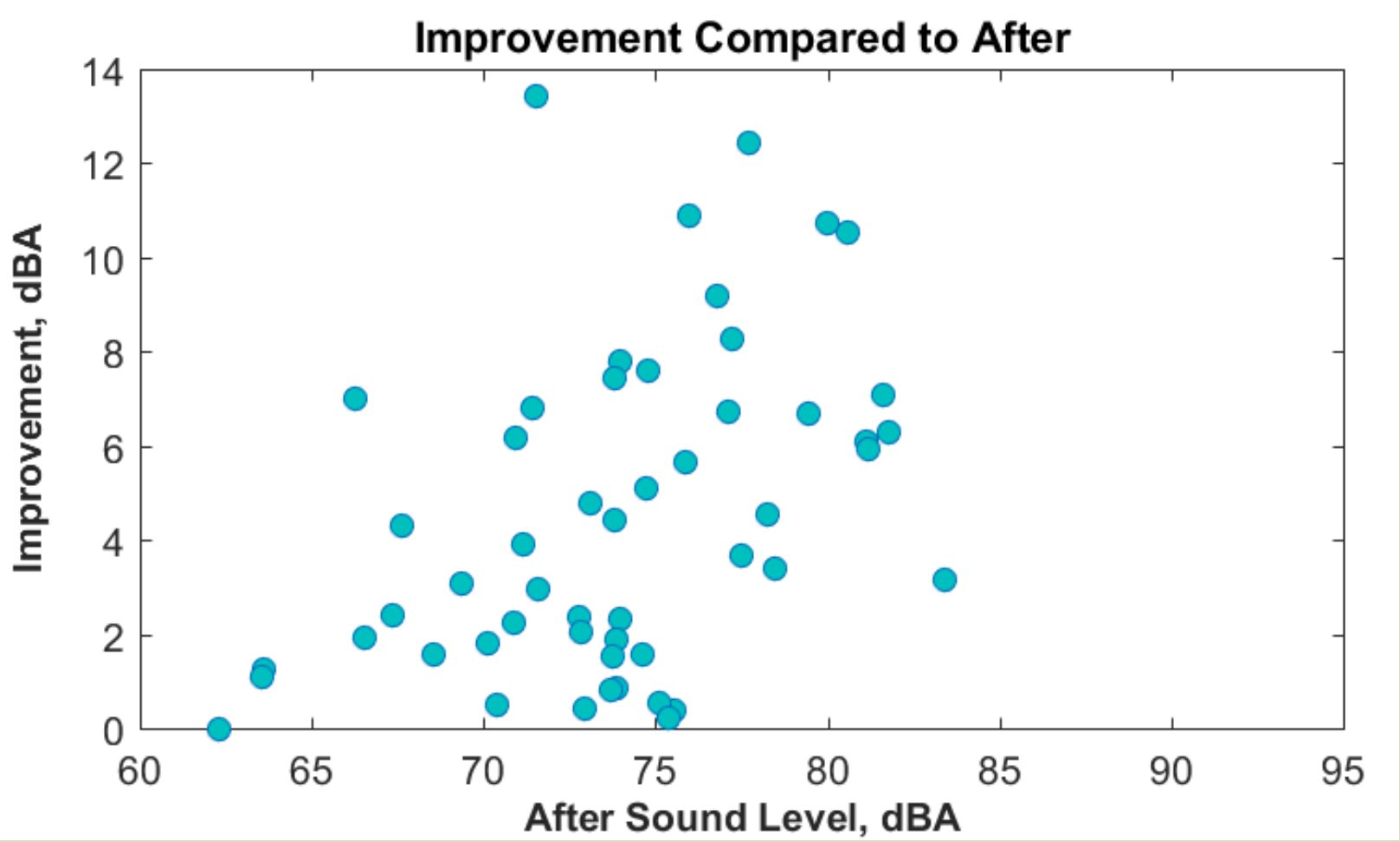
Balboa to Glen Park after grinding

Change in Average Sound Level
Improvement vs. Before Sound Level



ATSConsulting
acoustics, transportation + strategy

Change in Average Sound Level
Improvement vs. After Sound Level



ATSConsulting
acoustics, transportation + strategy

Summary of BART Status

- Noise levels appear to be dropping due to:
  - Improved rail grinding
  - Change to wheel and rail profiles
  - More effective use of rail grinders
  - New vehicles
- No evidence that new vehicles with new wheel profile are causing problems.
- Waiting to see the effect of these changes on the formation and growth of corrugation.

  Expectation is that corrugation will be less of a problem.

Sound Transit History of Rail Grinding

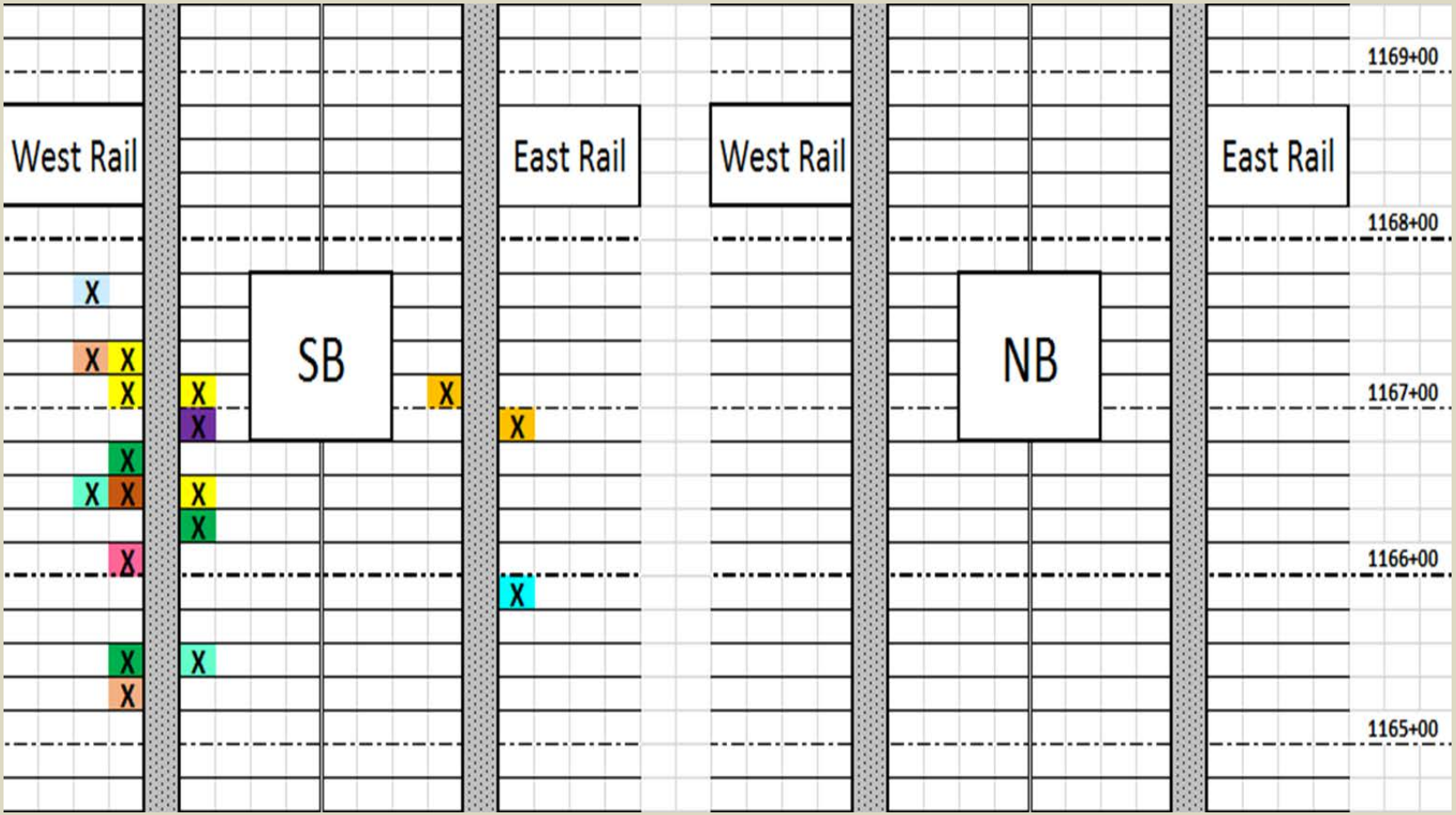
- Millscale Removal 2009
  - Very rough grinding, which caused high noise levels
  - Numerous complaints from the communities
- 2010-2011, Profile grinding that improved situation
- 2015-2016, Millscale grinding on new extensions
  - Problem with clips breaking
  - Cause apparently due to 28mm (1.1”) wavelength left by rail grinding

Clip Failures – As of 4/11/2017 – 1 Year

	North Bound Track				South Bound Track			
	East Rail		West Rail		East Rail		West Rail	
	Field Side	Gage Side	Field Side	Gage Side	Field Side	Gage Side	Field Side	Gage Side
GAUGE/FIELD	4	5	5	6	18	22	36	21
EAST/WEST	9		11		40		57	
NORTH/SOUTH	20				97			
TOTAL	**132**							

ATSConsulting
acoustics, transportation + strategy

Map of Clip Failures



ATSConsulting
acoustics, transportation + strategy

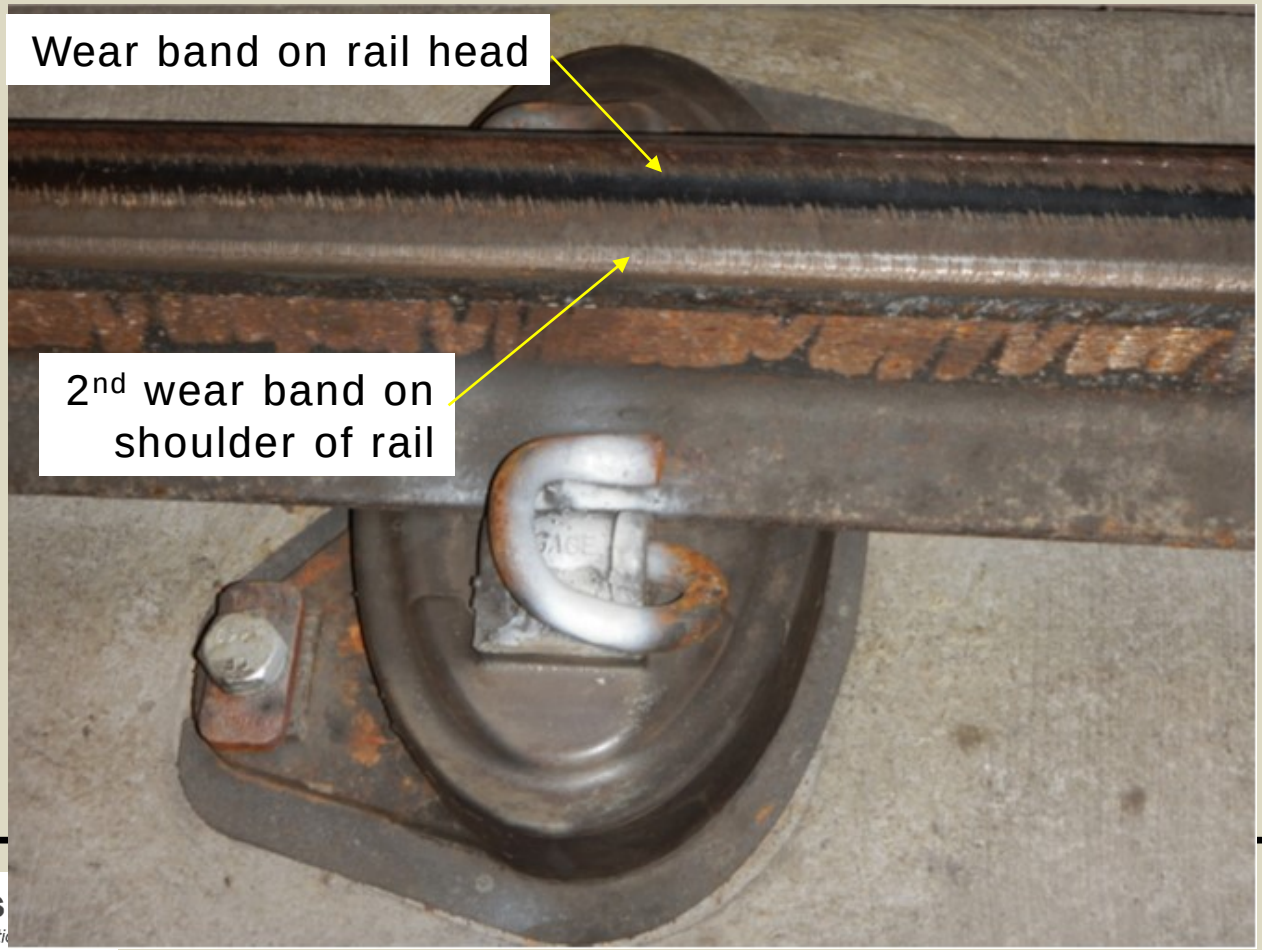
ATS Program included:

- Two sites
  - o UWS to CHS (subway)
  - o SEA to ALS (aerial)
- Visual inspection of the rails
- Rail roughness/corrugation measurements using a Corrugation Analysis Trolley
- Noise measurements on the safety walks
- Onboard noise measurements using the CorrTracker system

ATSConsulting
acoustics, transportation + strategy

Visual Inspection

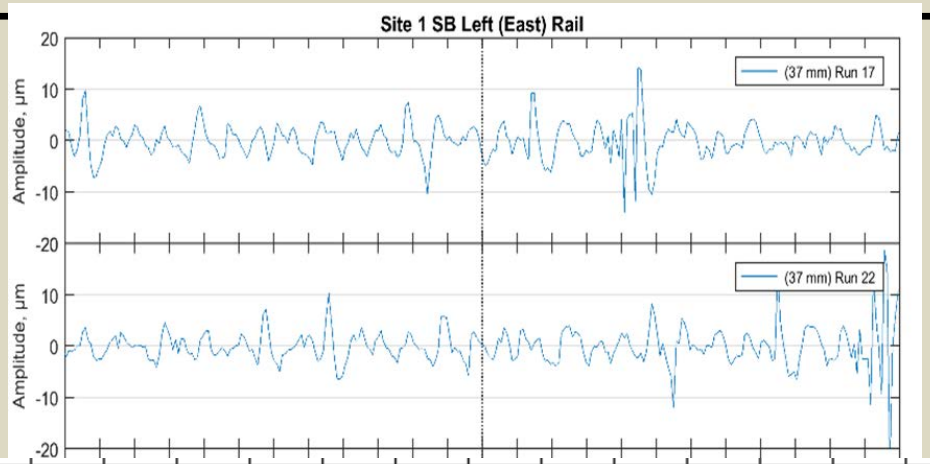
UW Station to Capital Hill Station,
two point contact

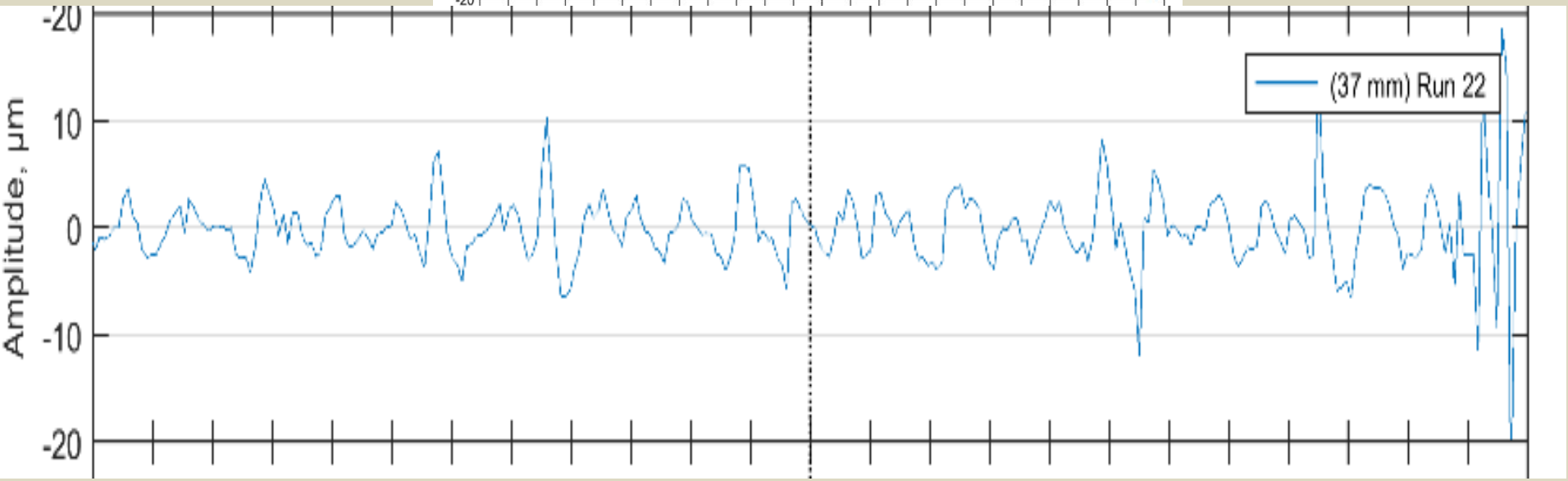


Visual Inspection

- SeaTac Station to Angle Lake Station

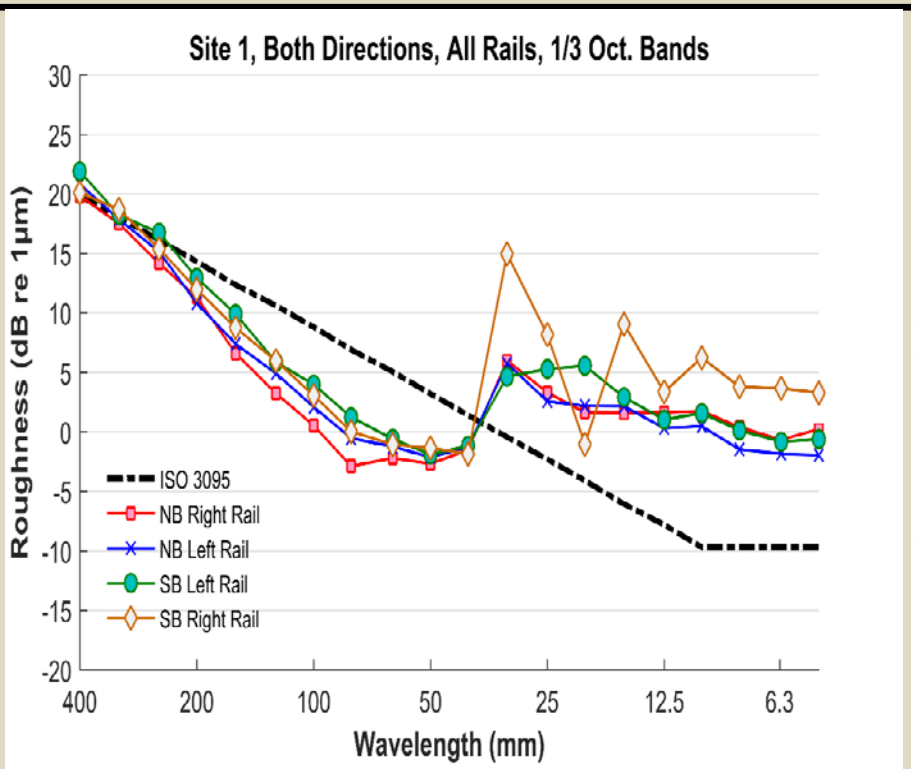
Raw Rail Roughness, UWS-CHS

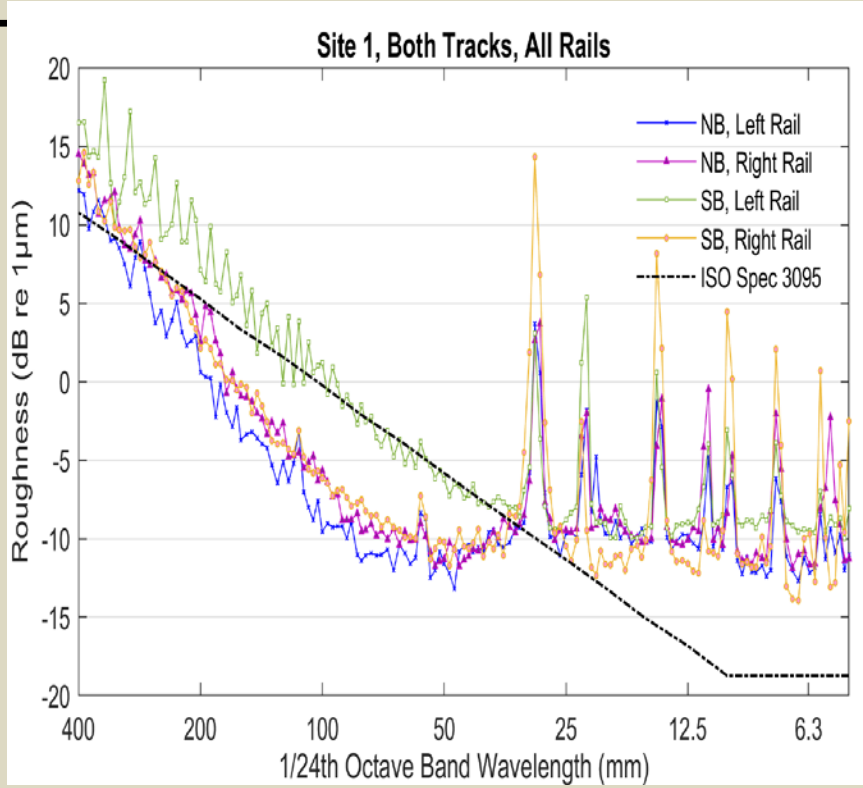




ATSConsulting
acoustics, transportation + strategy

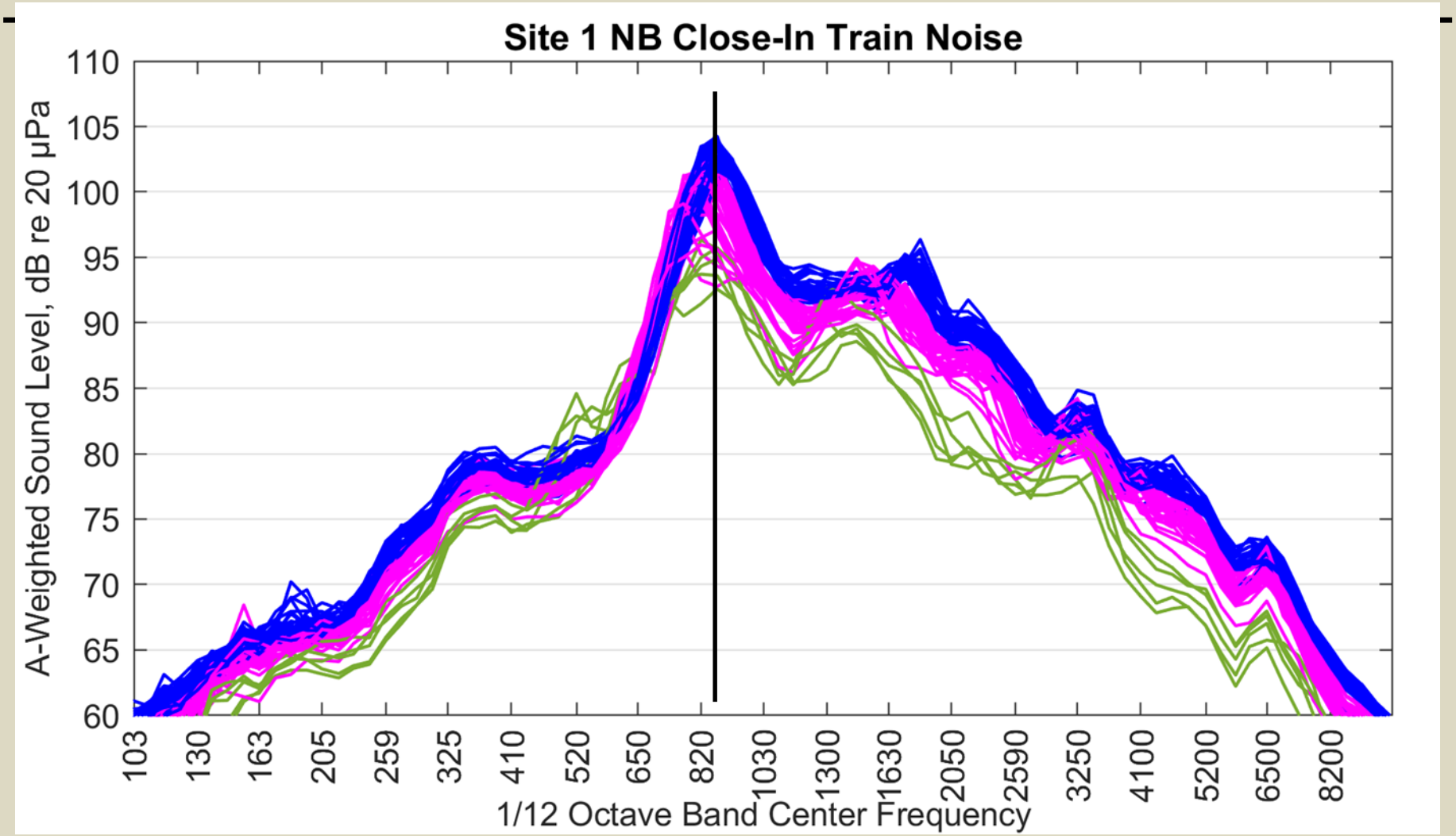
Rail Rough Spectrums



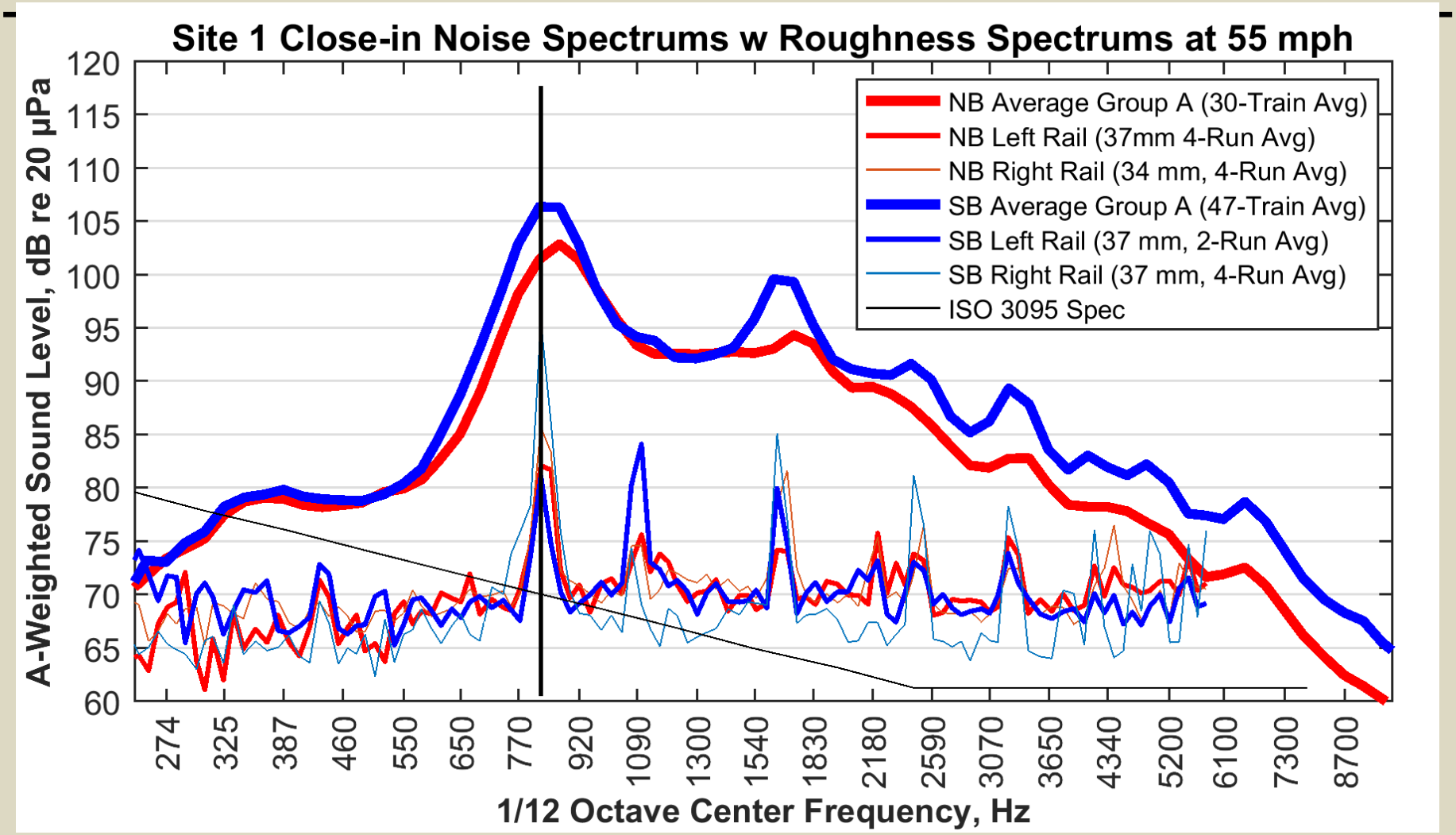


ATSConsulting
acoustics, transportation + strategy

Safety Walk Noise, Tunnel



Safety Walk Noise and Roughness

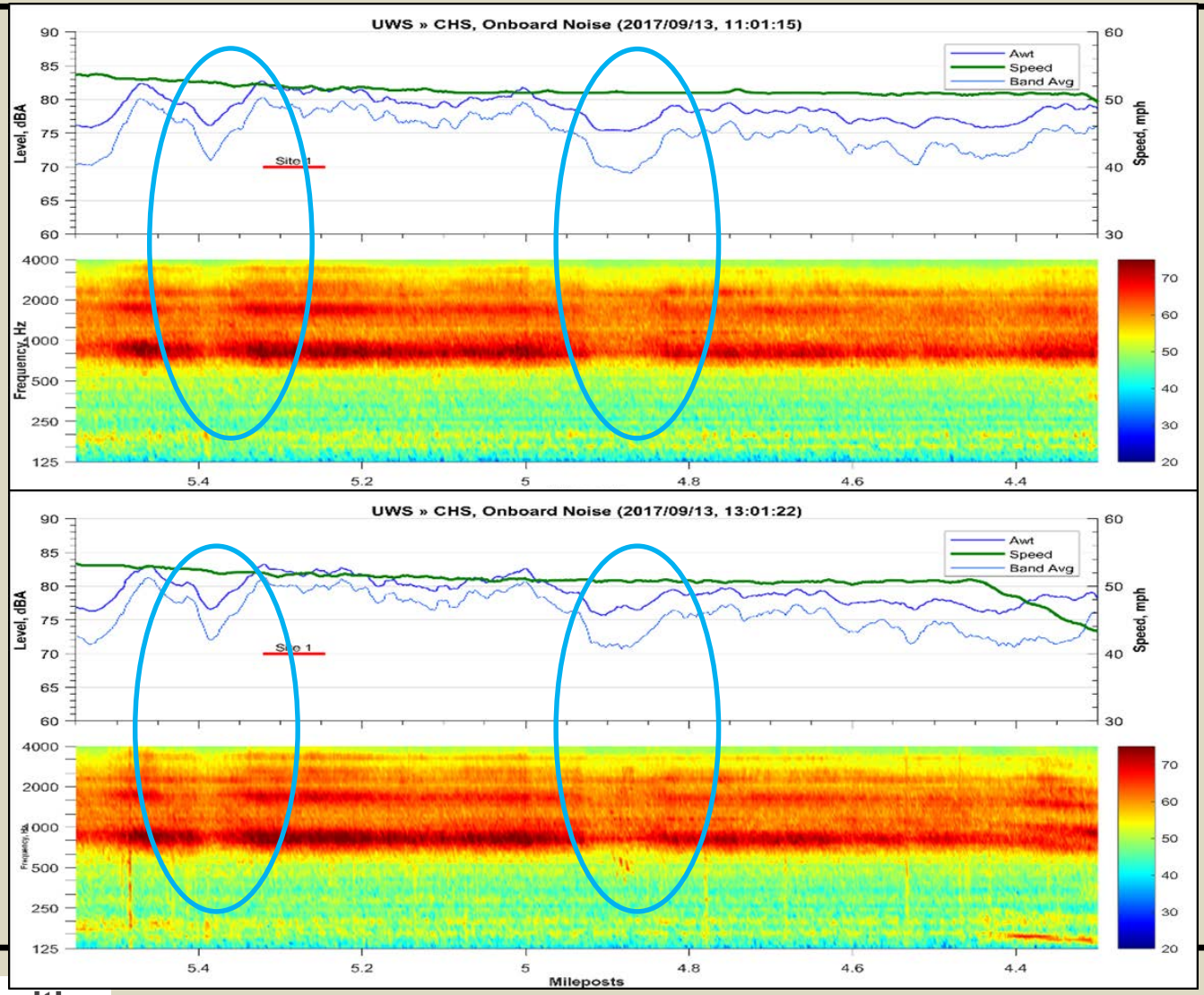


ATSConsulting
acoustics, transportation + strategy

Proposed Solutions

- Replace clips with heavier duty clips
- New specification for rail grinding/polishing
- Careful oversight of rail grinding
- Investigation of different grinding wheels
- Check of rail grinding quality with Corrugation Analysis Trolley (CAT) and onboard noise measurements (CorrTracker)
- Initial collaborative evaluation program with Rail Grinder, ARM and ATS to verify that new spec can be achieved

Onboard Noise, UWS to CHS



ATSConsulting
acoustics, transportation + strategy

Conclusions

- Rail grinding left ~1.1” wavelength.
- At 55 mph, 1.1” wavelength causes vibration at 848 Hz.
- There are short segments where this wavelength disappears.
- Resonance of rail fastener system is 850 Hz.
- Most rail clip failures correlate with locations where the 800 to 900 Hz rail roughness peak is strongest.

General Observations

- Future rail grinding should require measurements to verify compliance with specification before rail grinding company leaves system.
- Onboard measurements (CorrTracker) can be a valuable tool for identifying problem areas.
- Rail grinding/polishing specifications should be updated to address this issue.
- Sound Transit is working with rail grinding company to investigate various approaches.

Thank You!

Questions?