

HSR: A Comparison of Two Computer Models with the FRA Methodology

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Outline

- Motivations for study
- Basics of FRA methodology
- Review of software packages
- Description of comparison test
- Test results
- Conclusions



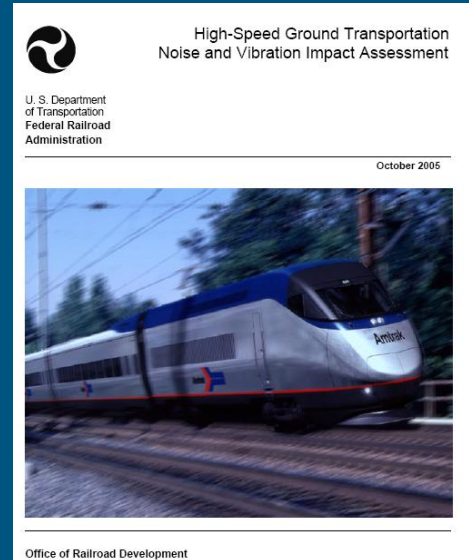
Motivations for the Study

- Spreadsheet-based analyses for large projects become unwieldy and time-consuming
- Increasing availability of electronic data geo-referenced (e.g., GIS)
- Graphical and animated results desirable
- Must compare FRA projections with software packages



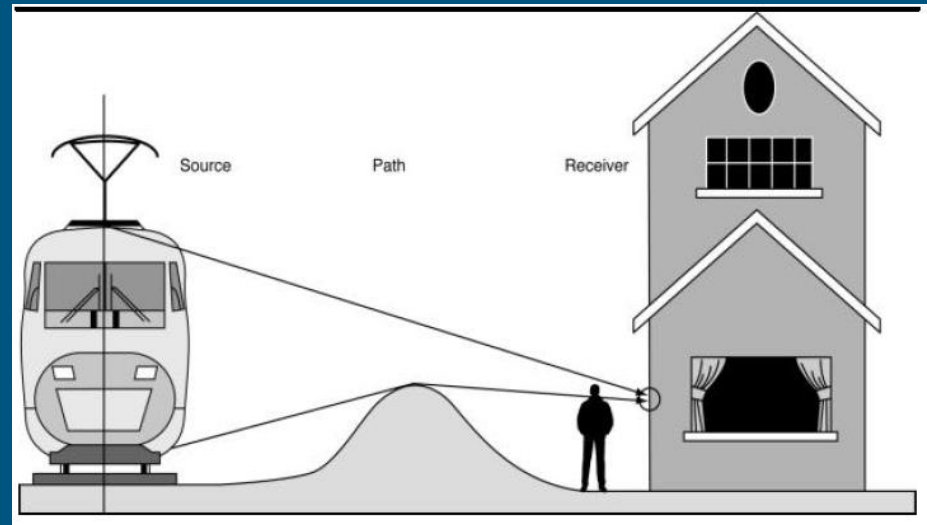
FRA noise model

- FRA guidelines – October 2005
 - Guidelines for projecting wayside noise from high-speed rail sources
- Three level of assessment:
 - Screening, General Assessment (GA) and Detailed Analysis (DA).
- GA and DA assessments based on the day-night metric L_{dn} (cumulative assessment)
- Noise criteria based on the land use category of receivers



FRA noise model

- Projected noise at the location of a single receiver



- Assumes a straight line source and infinite barrier length
- Methods intended for calculation in a spreadsheet



FRA Noise Model Procedure

- Determine Sound Exposure Level (SEL) for each sub-source at 50 ft (15m)
- Operational Conditions for each sub-source (Adjust SEL for train length, speed and operational schedule)
- Propagation of Noise to Receiver each sub-source
 - Geometric spreading
 - Ground attenuation
 - Existing shielding
- Compute Ldn at receiver



Sound Plan

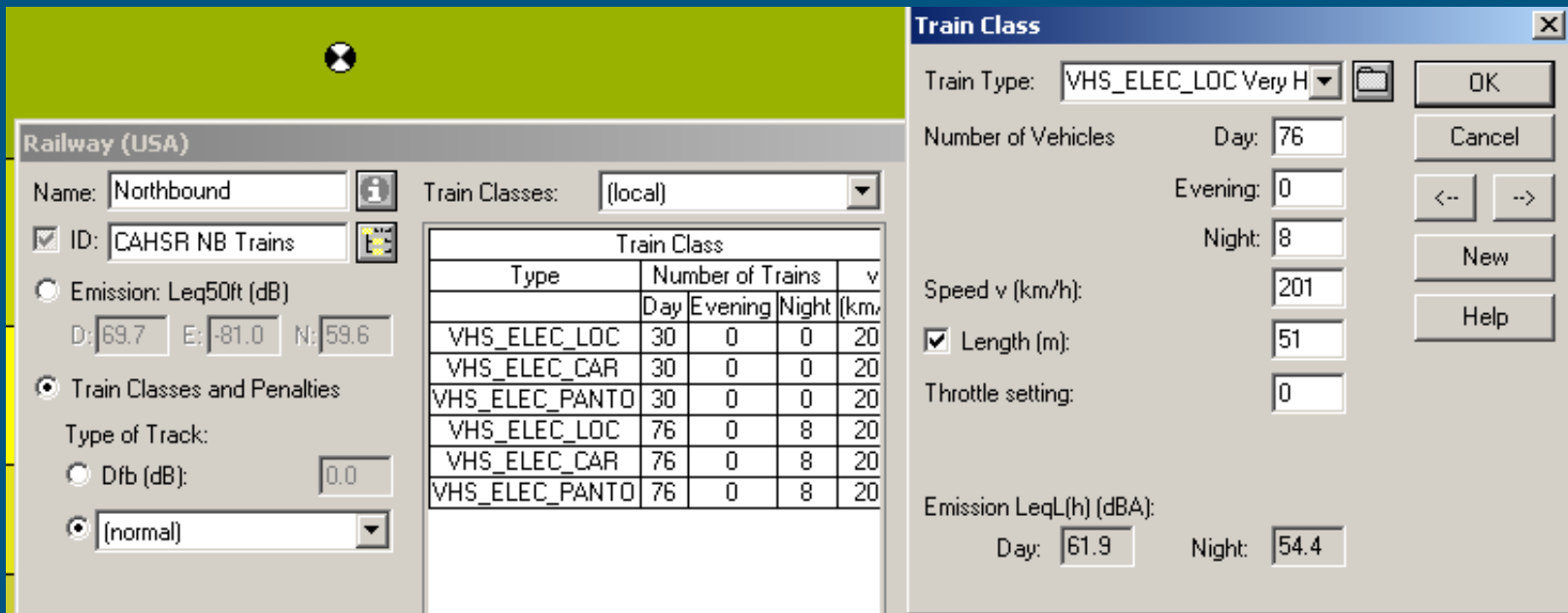


SoundPLAN® 7.0

- Module-based program based on European guidelines or standards
 - E.g.: Schall 03 (Germany), CRN 99 (GB), Nord2000 rail, etc
- **FRA version under development**
- Source based on Level Mean Emission (LME)
- LME at 25 m (82 ft) from library or calculated

$$L_{m,E} = 10 * \log_{10} \left[10^{(0.1 * (51 + D_{Fz} + D_D + D_L + D_V))} + D_{Tt} + D_{Br} + D_{LC} + D_{ra} \right]$$

- Module-based program based on guidelines or standards (same as SP)
- FTA/FRA methods available (preliminary)
- Same train classes as FRA are included



The screenshot displays the 'Railway (USA)' dialog box and the 'Train Class' dialog box.

Railway (USA) Dialog:

- Name: Northbound
- ID: CAHSR NB Trains
- Emission: Leq50ft (dB)
 - D: 69.7
 - E: -81.0
 - N: 59.6
- Train Classes and Penalties
 - Type of Track: Dfb (dB): 0.0
 - [normal]
- Train Classes: (local)

Train Class Dialog:

- Train Type: VHS_ELEC_LOC Very H
- Number of Vehicles
 - Day: 76
 - Evening: 0
 - Night: 8
- Speed v (km/h): 201
- Length (m): 51
- Throttle setting: 0
- Emission LeqL(h) (dBA)
 - Day: 61.9
 - Night: 54.4

Train Class Table:

Type	Number of Trains			v (km/h)
	Day	Evening	Night	
VHS_ELEC_LOC	30	0	0	20
VHS_ELEC_CAR	30	0	0	20
VHS_ELEC_PANTO	30	0	0	20
VHS_ELEC_LOC	76	0	8	20
VHS_ELEC_CAR	76	0	8	20
VHS_ELEC_PANTO	76	0	8	20



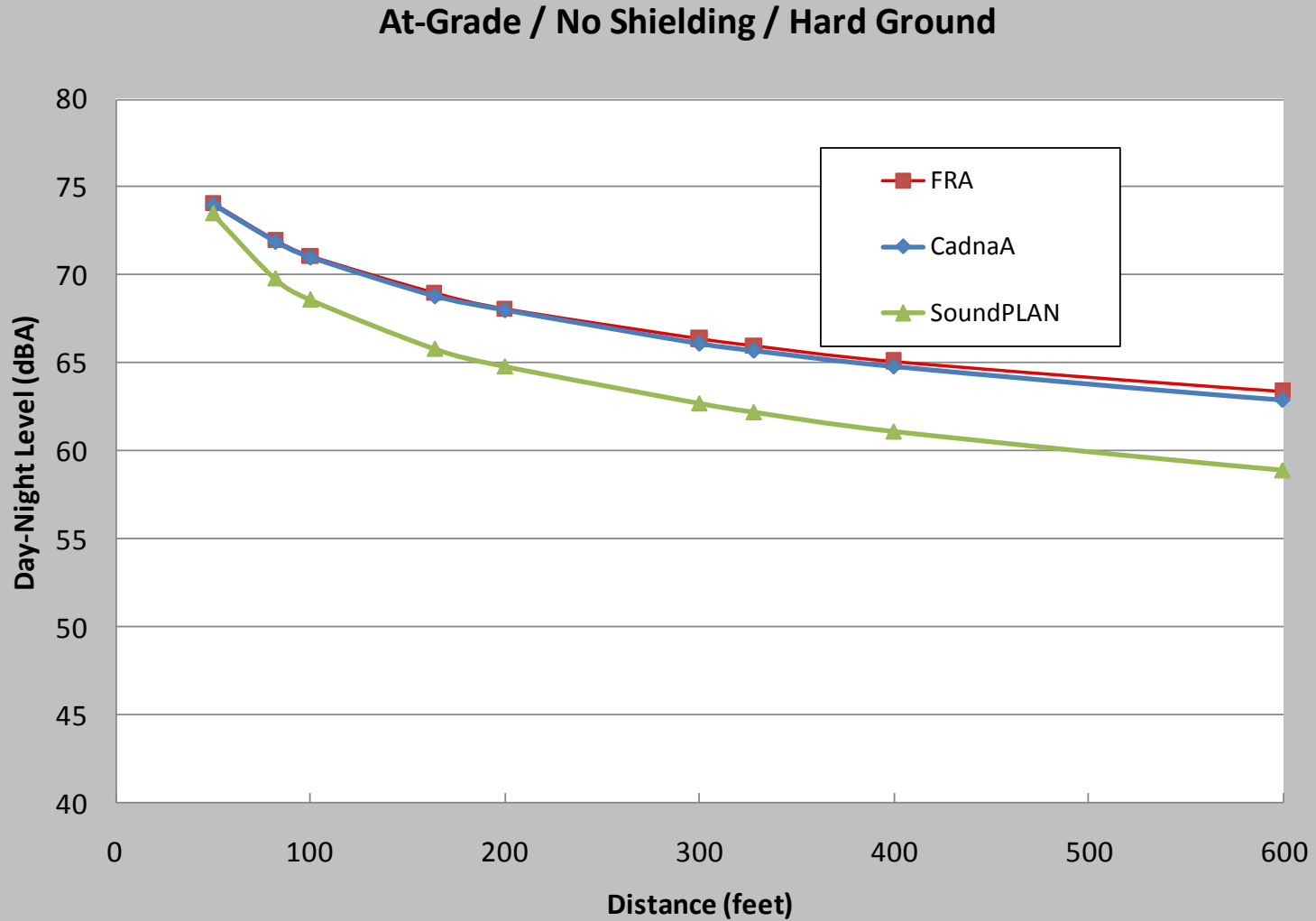
Comparison Test

- Including:
 - Track geometry
 - Shielding effects
 - Ground attenuation
 - Attenuation vs distance
- Assumptions

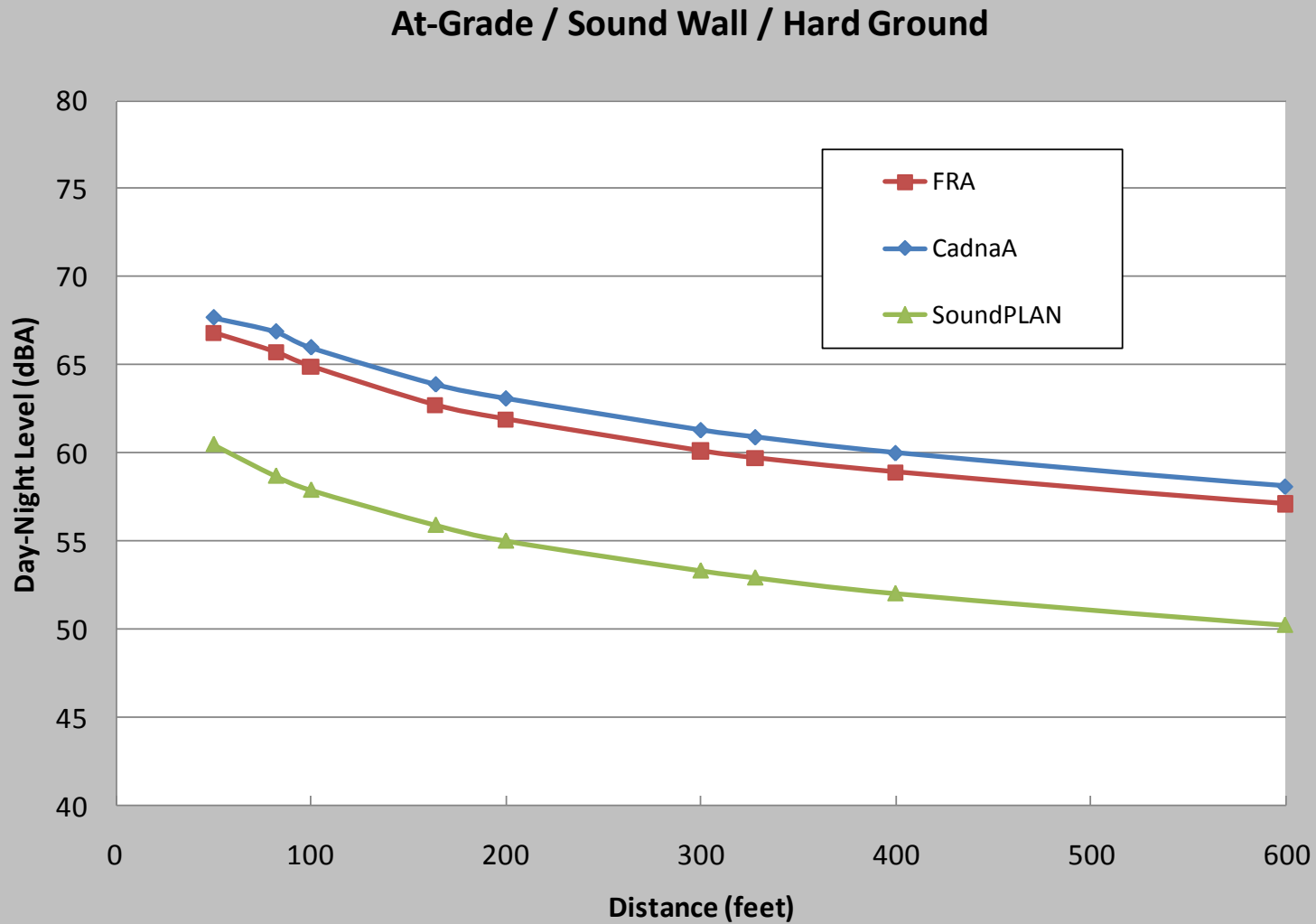
FRA	CadnaA (FTA/FRA)	Sound Plan (Schall 03)
VHS Electric	VHS Electric	Siemens ICE (EMU)
656/1312 ft trains & 114 trains per 24hrs		
12 ft/1 ft source ht	12 ft/1 ft source ht	2 ft source ht
125 mph		



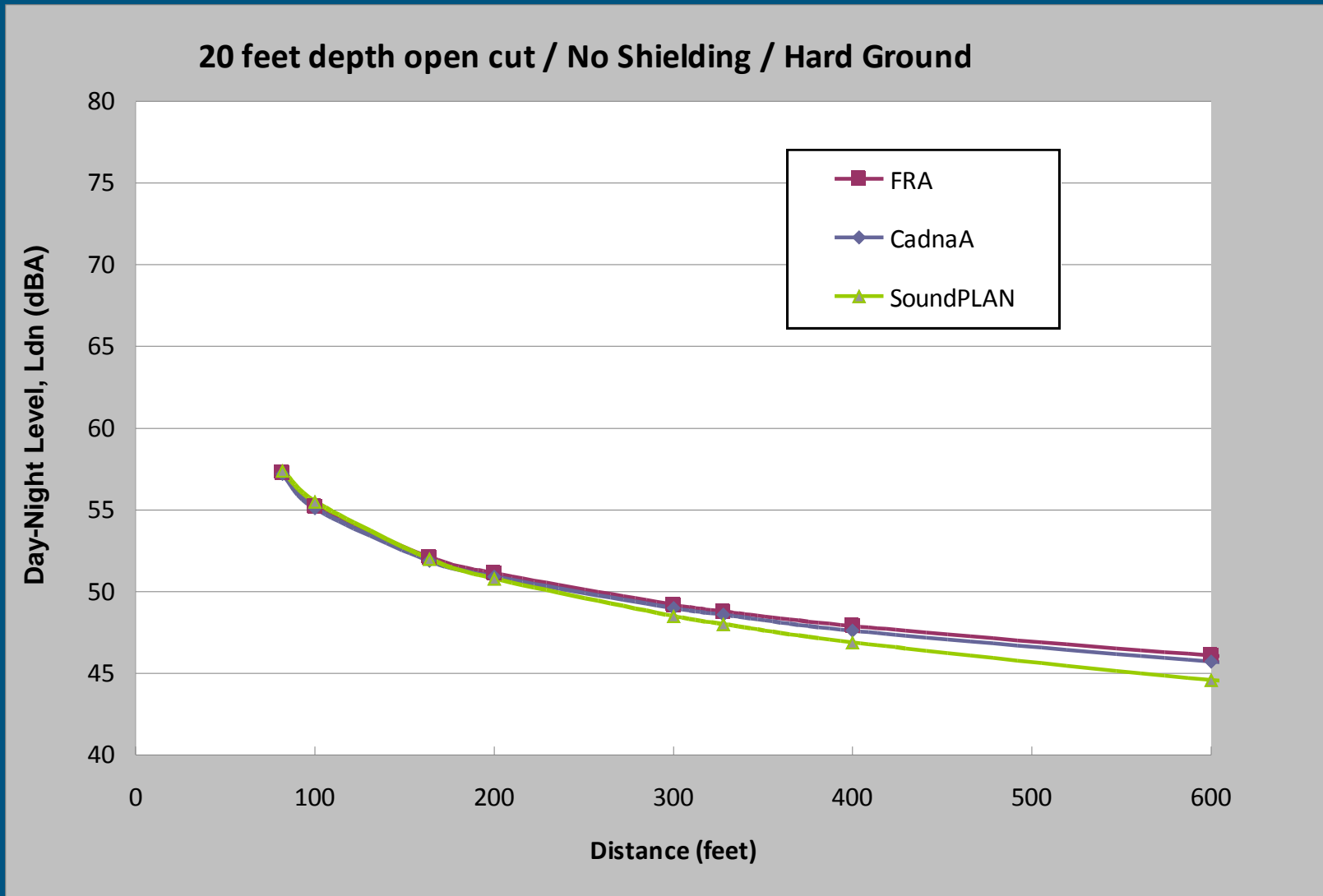
Results At-grade tracks



Results At-Grade Tracks (cont.)

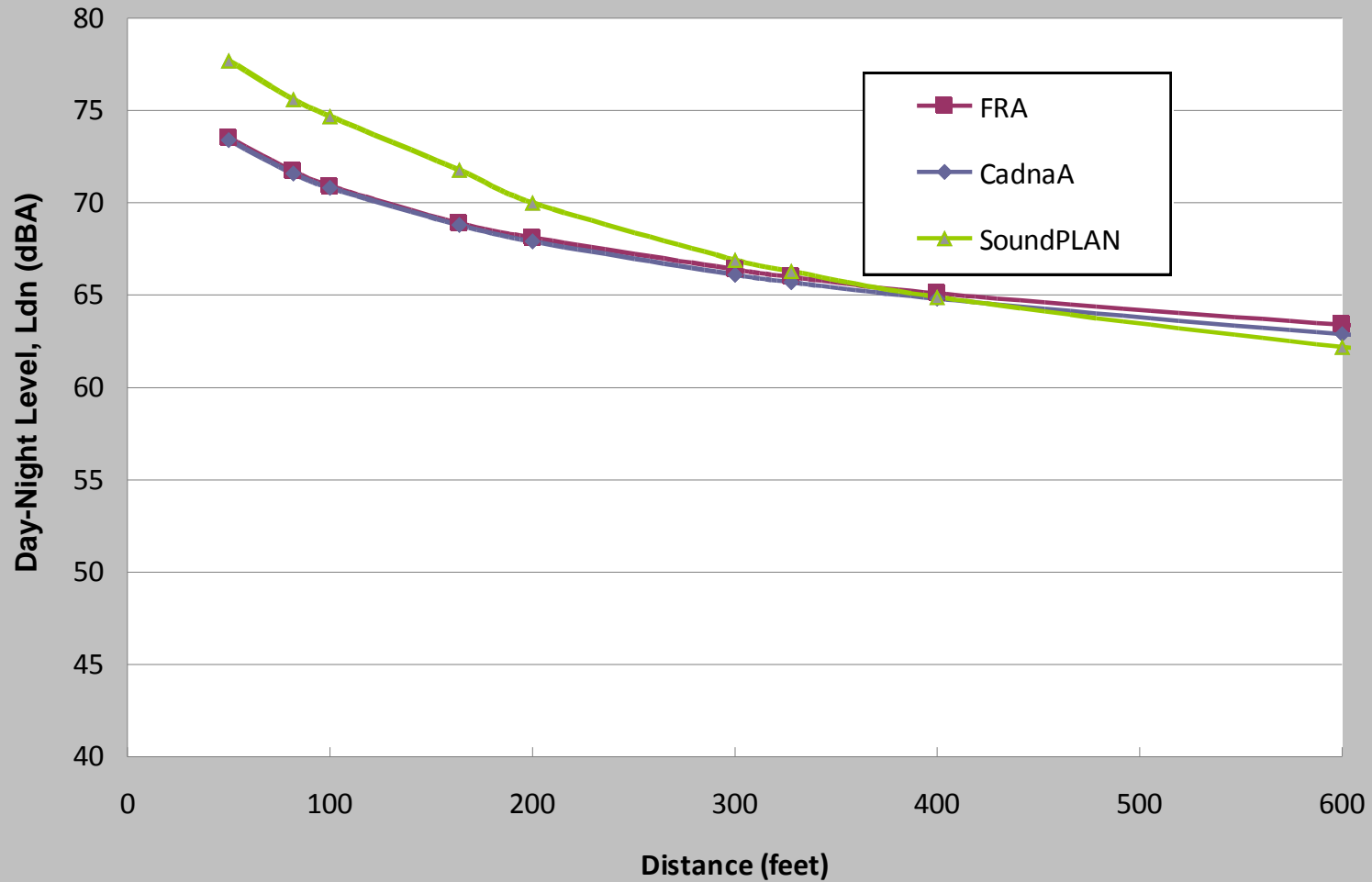


Results Open Cut

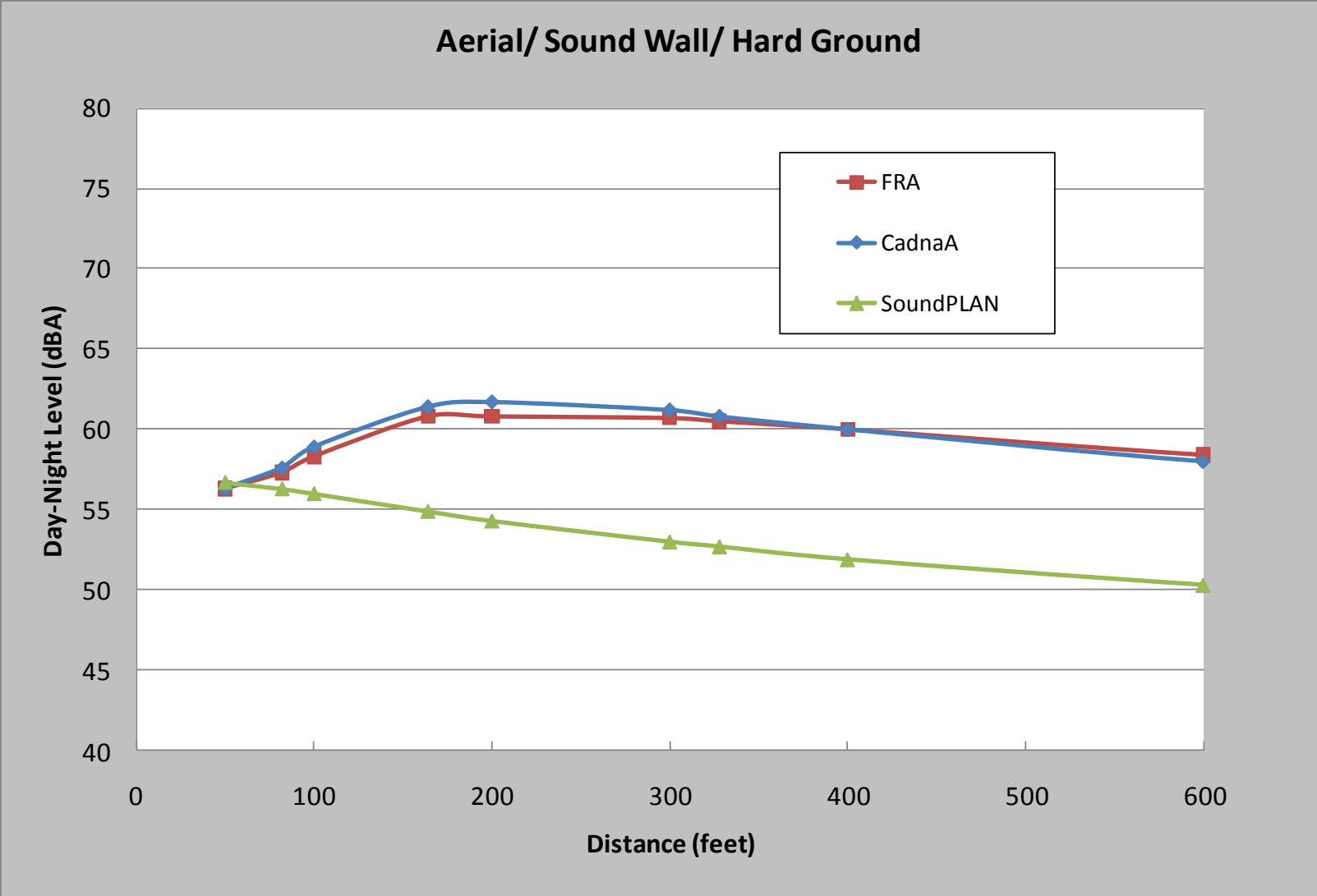


Results Aerial Tracks

Aerial/ No shielding/ Hard Ground

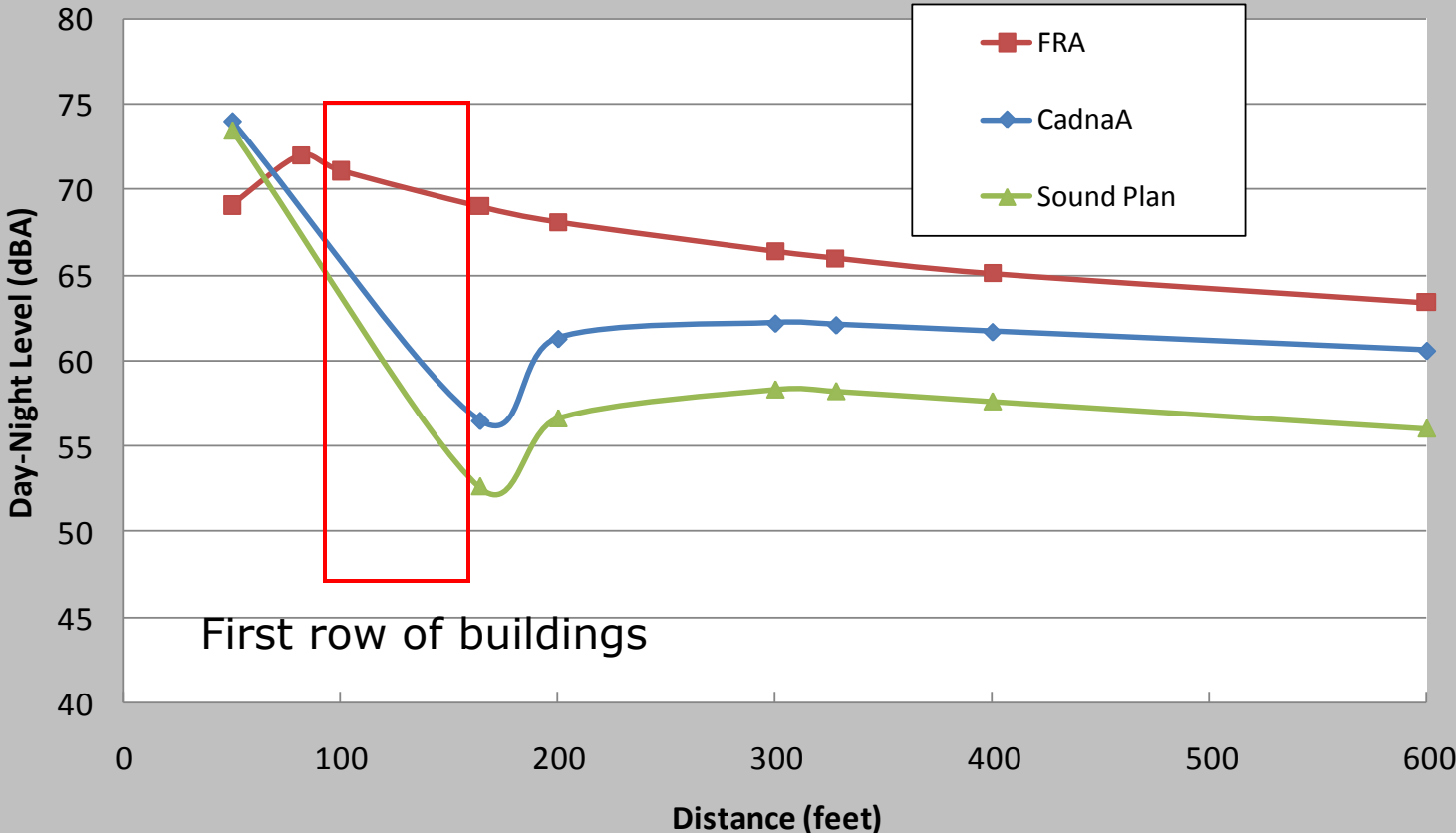


Results Aerial Tracks (cont.)



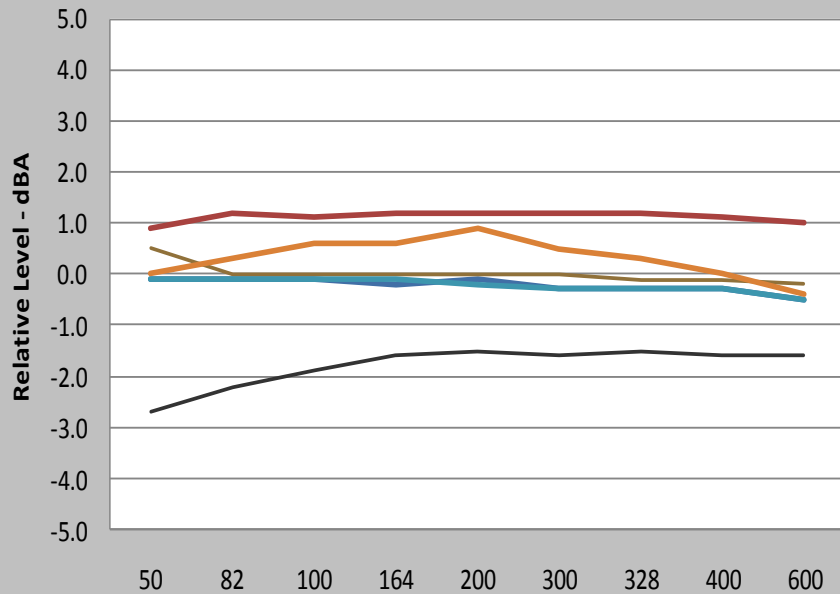
Shielding Effect on 2nd Row Receivers

Comparison Projected Ldn due to Shielding from First-Row Buildings

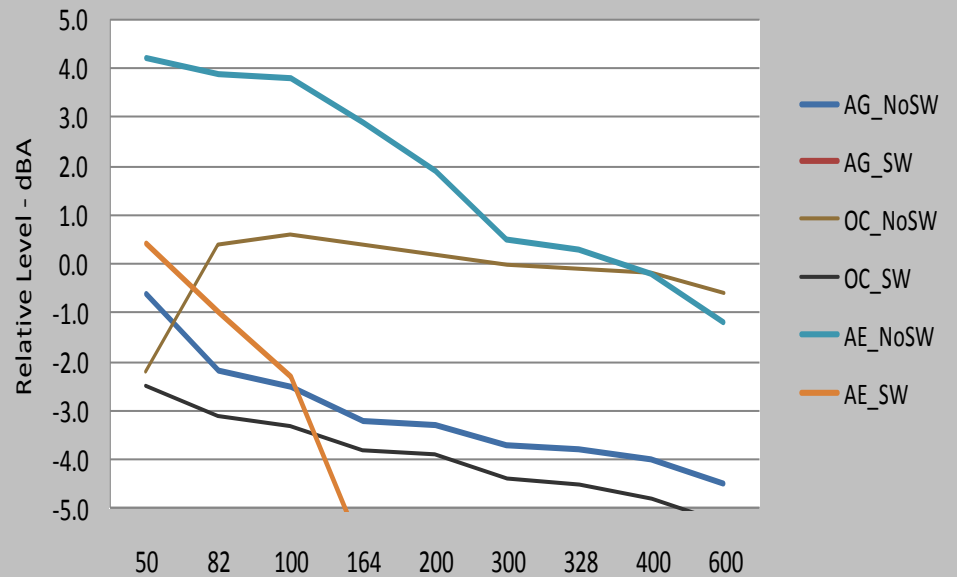


Results (cont.)

Difference CadnaA - FRA



Difference Sound Plan - FRA



Conclusions

- Source height has significant effect
- Good agreement between FRA and SoundPlan for open cut
- Better agreement between FRA & CadnaA
- SoundPlan and CadnaA more realistic beyond first row of buildings
- Until FRA is included in SoundPlan, don't try to force it



Advantages of 3D Software packages

- Reduced computing time for long alignments
- Able to import electronic data from ACAD, GIS, etc
- Able to better project noise levels on second row of buildings and beyond
- Capable of projecting noise contours and animation for enhanced presentations



Animation Lmax EMU with SoundPlan

