



Brooks Acoustics Corporation

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19 November 2018
PJ2018-1269-L01

Subject: Soccer and Tennis Club Acoustical Study – Acoustical Impacts of Zoning Code Changes

Dear Mr. O'Donnell:

As requested, Brooks Acoustics Corporation (BAC) has analyzed the proposed zoning code changes in the City of Stamford with regard soccer clubs, and the potential sound issues related to this use.

The acoustical engineering analysis of the proposed zoning code changes included:

1. A generic analysis of soccer field and tennis court acoustic sound generation.
2. Comparison of data collected at existing and similarly scaled uses
3. Discussion of the current City Code of Ordinances in which sound is limited to 55 dBA/45dBA, day and night, respectively, and the potential for impact on residential neighbors.
4. Identification of site best practices/design.

Based on this acoustical engineering analysis of the proposed zoning code changes, it is the opinion of BAC that, with a reasonable degree of certainty, the proposed changes will have a positive impact on the City of Stamford, will not have a negative impact on residential quality of life, and will not have create a negative or significant acoustical impact surrounding residential properties.

Acoustical engineering analysis

Acoustic sound generation

The sound generated by an outdoor athletic or sports facility depends largely on the people who use the facility, and the manner in which they use it.

For soccer fields, the sound sources may be characterized by primarily three groups:

- 1- Official's whistles
- 2- Players
- 3- Spectators

It is noted that no loudspeakers or concession stands will be allowed at soccer clubs by the proposed zoning code changes.

For tennis courts, the sound is mainly emitted by the sequence of ball stroke impulses.

Research for a German standard document shows that the sound power emitted by a soccer field is somewhat higher than that from a tennis court, primarily due to the official's whistles. The sound power emitted by the players and spectators at the soccer field is in the same range as the sound of the tennis ball stroke impacts and people on the tennis court. ¹

Comparison of existing and similarly scaled uses

Sound projections were made for a typical soccer field use using acoustical engineering calculation methods.

The source sound data used for these projections were obtained during test survey measurements of playing children measured at the former site of the Washington Montessori School (Hinckley Road, New Preston) in June 2001. The sound testing coincided with "Field Day" at the school.

That special event included many outdoor activities for the entire school population, supervised by instructors using whistles, and therefore represents the maximum outdoor sound generation for similar activities. About 100 children, 12 staff members and 10 parents were on the Montessori field at the time of testing. The measured levels near the Montessori field were equivalent to that of a quiet conversation. Moving away from the field, at 165 feet distance, the sound of the children was recognizable, but muffled and mixed with other neighborhood sounds, such as cars and birds. At 560 feet distance the children were not audible at all, with the ambient sound due only to neighborhood sources.

The Montessori School field day sound levels were selected for this analysis as these data represent a "worst case" scenario. It is not expected that there will be as many as 100 children and 22 adults at a typical proposed soccer club use. Further, the voices of the younger Montessori children (K through 8th Grade) are expected to be slightly higher in pitch, and therefore more noticeable, than the voices of older students (9 to 12th Grade), or adults who may occupy the proposed soccer club land use. Also, the measured field day sound levels are consistent with the sound data provided in the aforementioned German standard document. ¹

The playing field source sound data described above was used as input to a computer modeling procedure which calculates the propagation of that sound through the atmosphere to the selected receiver location. The sound propagation calculation procedure accounts for the effects of the source sound and also terrain, distance and atmospheric conditions, in accordance with International Standards Organization document ISO 9613-1. The sound reduction benefits provided by typical terrain contours were included in this analysis. The calculation sheets for several locations are attached.

¹ Characteristic noise emission values of sound sources - Facilities for recreational and sporting activities, published by Verein Deutscher Ingenieure (Association of German Engineers), Düsseldorf 2002, VDI 3770:2002-04.

Sound projection results

The sound measurements made during the activities on the school playing field during the field day activities were projected by acoustical engineering calculation out to several distances of interest for terrain typical of North Stamford.

A sound projection at a distance of 100 feet from the edge of the soccer field was made, as this is the minimum set-back allowed in the proposed zoning code change for soccer club uses.

Also calculated were the sound projections for 300 feet and 500 feet distance from the edge of the soccer field. These are typical distances which can be expected between a proposed soccer field and residences in North Stamford.

Also, included in the calculation is the sound reduction benefit of vegetation. For the minimum proposed code set-back distance of 100 feet, the depth of vegetation was taken as the proposed code minimum depth of 50 feet. For the 300 and 500 foot distance projections greater vegetation depths were calculated as being typical of the terrain in North Stamford.

The results of these calculations are shown in the Table below.

Sound projection results for soccer club activities

Projection distance	Soccer Club sound level	Comment
100 feet	48 dBA	Minimum code set-back
300 feet	35 dBA	Typical residence distance
500 feet	28 dBA	Typical residence distance

City Code compliance and the potential for impact on residences

The calculated sound levels shown above may be compared with the applicable sound level standards to determine compliance with those standards.

The City of Stamford Code of Ordinances section 164-5, Noise levels, states that the maximum allowable sound level for a recreational use to a residential use is 55 dBA during daytime hours (7 am to 10 pm), and 45 dBA during nighttime hours (10 pm to 7 am).

The calculated sound level of 48 dBA at the minimum set-back distance of 100 feet is well below the allowable maximum level of 55 dBA for daytime hours, and therefore would be **compliant** with the City of Stamford Code. It is noted that 48 dBA is the sound level of a very quiet conversation.

The calculated sound levels may also be compared with residential background sound levels.

A typical daytime background sound level at a residence in the low density area of North Stamford is expected to range from about 35 to 50 dBA, depending on local road traffic, and natural sources such as birds, insects and wind in the trees.

The soccer club sound levels calculated for distances from 100 feet (48 dBA) to 300 feet (35 dBA) are within the range of typical background sound levels at residences. Therefore, the sounds of a soccer club are likely to range from **faintly noticeable to inaudible** at nearby residences.

The soccer club sound level calculated for the distance of 500 feet (28 dBA) is well below the typical background sound levels expected for North Stamford. Therefore, a soccer club is likely to be **inaudible** at that distance. This result is consistent with the results observed for the Montessori School Field Day activities.

As a soccer club is likely to be only faintly audible, or not audible at all, at nearby residences, it is expected that the sounds emitted by such a use will have **little or no impact** on those residences.

Best practices for site layout and design

In order to minimize the impact of sound from a soccer club, site design best practices would suggest that the indigenous terrain be used to reduce sound projections to nearby residences. Features of the terrain which provide such benefits include elevation changes which can provide barrier-like sound shielding and vegetation which can provide sound attenuation.

It is recommended that playing fields be situated to take advantage of such terrain features. In the absence of elevation changes which may offer sound shielding, artificial earthen berms may be constructed to provide the shielding. Also, best practices would suggest that existing thick vegetation be preserved to the extent possible. If no such vegetation exists on the proposed site and on the surrounding land, then vegetation which can provide significant sound attenuation should be planted.

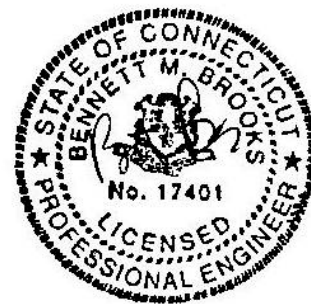
Please contact me if you have any questions concerning these findings.

Very truly yours,
BROOKS ACOUSTICS CORPORATION



Bennett M. Brooks, PE, FASA, INCE
President

Attachments



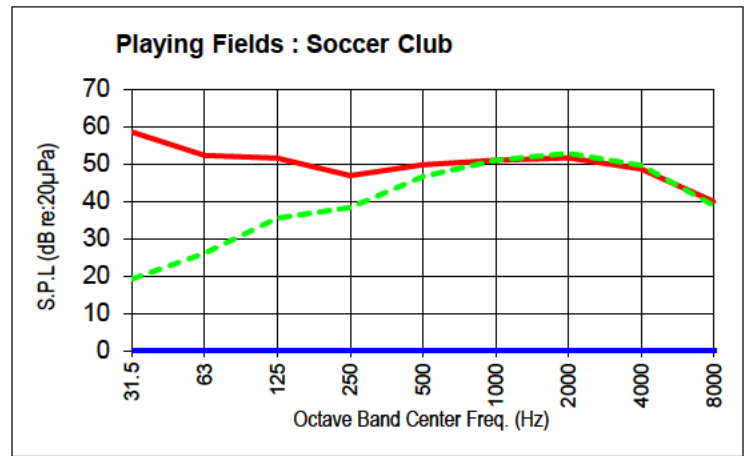
Source Sheet

Source Group: Playing Fields
 Source Name: Soccer Club

Source Data: MFG data Lin
 Source Level: 57 dB(A)
 record distance: 70

Source Type: point

Coordinates: East North Elev.
 0 0 5.3



Frequency	Data	TL	Signature	A-weighted Signature	A-weighting Curve	freq.
31.5 Hz	58.6	0	<u>59</u>	19	-39.4	31.5
63.0 Hz	52.3	0	<u>52</u>	26	-26.2	63
125.0 Hz	51.6	0	<u>52</u>	36	-16.1	125
250.0 Hz	46.9	0	<u>47</u>	38	-8.6	250
500.0 Hz	49.9	0	<u>50</u>	47	-3.2	500
1000.0 Hz	51.0	0	<u>51</u>	51	0.0	1000
2000.0 Hz	51.7	0	<u>52</u>	53	1.2	2000
4000.0 Hz	48.7	0	<u>49</u>	50	1.0	4000
8000.0 Hz	39.9	0	<u>40</u>	39	-1.1	8000

BAC data
 for
 School Playing Field
 Washington Montessori School
 "Field Day" activities
 100 kids, 12 staff, 10 parents

Proposed Soccer Club Zone

Residential Sound Study

Based on BAC data

Sound Projection -- Stamford, CT

Per proposed zoning code change minimum setbacks

Coordinates:

PROJECTED FROM: Playing fields
 PROJECTED TO: Nearby Residence

<u>East</u>	<u>North</u>	<u>Elevation</u>
70.0	70.0	5.3

baseline elev. 400 ft

RELATIVE HUMIDITY: 50%
 TEMPERATURE: 70 deg. F
 ATMOS. PRESS: 760 mm Hg

Total Sound Level 48 dBA
 Noise Criteria Level 55 dBA

Exceedance?
NO

<u>FREQ.</u>	<u>AWT SPL</u>	<u>SOURCE</u>		<u>CONTRIBUTIONS</u>
		<u>#</u>		<u>AWT SPL</u>
31.5 Hz	8.1	1	Playing Fields Soccer Club	47.7 dBA
63 Hz	15.0	2	reserved --	
125 Hz	31.3	3	reserved --	
250 Hz	34.7	4	reserved --	
500 Hz	41.6	5	reserved --	
1000 Hz	42.0	6	reserved --	
2000 Hz	42.6	7	reserved --	
4000 Hz	37.4	8	reserved --	
8000 Hz	22.3	9	reserved --	
RMS:	47.7	10	reserved --	
		11	reserved --	
		12	reserved --	

Atmospheric attenuation: yes
 Excess ground attenuation: yes
 Source region hard, soft, mixed (h,s,m=%s): s
 Receiver region hard, soft, mixed (h,s,m=%s): s
 Middle region hard, soft, mixed (h,s,m=%s): s
 Barrier shadowing: yes
 Vegetation: yes

PATH SHEET

	<u>COORDINATES</u>	
SOURCE 1: Playing Fields	East 0.0	<u>Record Distance</u>
Soccer Club	North 0.0	70.0
TYPE: point	Elevation 5.3	<u>Projection Dist.</u>
		99.0

Freq.	Source	Vegetation	Shadowing	Ground Atten	Net		Distance Atten	Contribution	Awt Contrib.
					Barrier Atten	Atmospheric			
31.5 Hz	58.6	0.3	4.8	-3.0	7.8	0.0	3.0	47.5	8.1
63 Hz	52.3	0.3	4.8	-3.0	7.8	0.0	3.0	41.2	15.0
125 Hz	51.6	0.5	4.9	4.1	0.8	0.0	3.0	47.4	31.3
250 Hz	46.9	0.6	5.0	6.2	0.0	0.0	3.0	43.3	34.7
500 Hz	49.9	0.6	5.2	3.8	1.4	0.1	3.0	44.8	41.6
1000 Hz	51.0	0.8	5.5	0.4	5.1	0.1	3.0	42.0	42.0
2000 Hz	51.7	0.9	6.1	0.0	6.1	0.3	3.0	41.4	42.6
4000 Hz	48.7	1.2	7.2	0.0	7.2	0.9	3.0	36.4	37.4
8000 Hz	39.9	1.8	8.7	0.0	8.7	3.0	3.0	23.4	22.3
								53.2	47.7

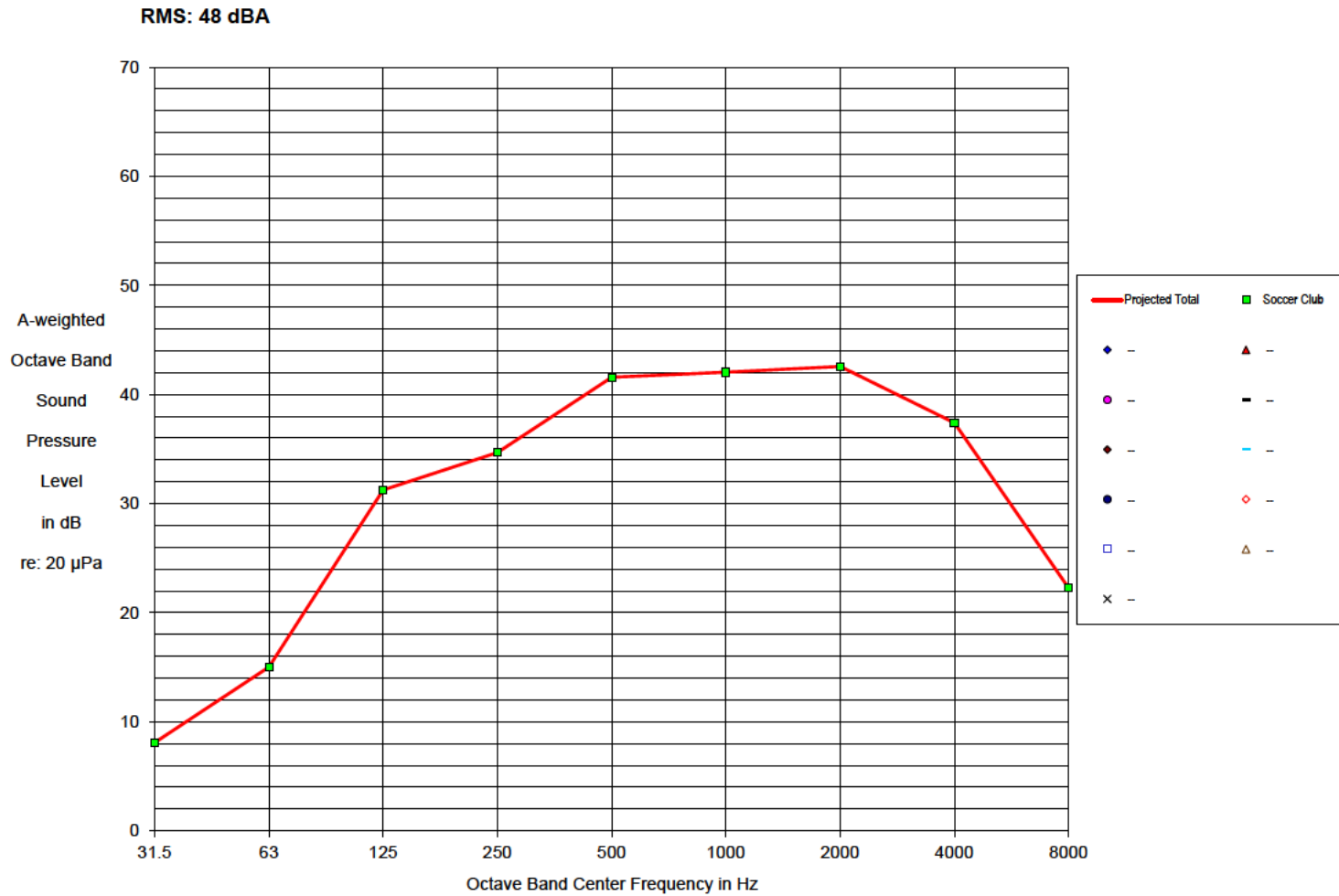
PATH SHEET

	<u>COORDINATES</u>	
SOURCE 2: reserved	East 0.0	<u>Record Distance</u>
--	North 0.0	1.0
TYPE: point	Elevation 1.0	<u>Projection Dist.</u>
		99.1

Freq.	Source	Vegetation	Shadowing	Ground Atten	Net		Distance Atten	Contribution	Awt Contrib.
					Barrier Atten	Atmospheric			
31.5 Hz	0.0	0.0	0.0	-3.0	-3.0	0.0	39.9	-36.9	-76.3
63 Hz	0.0	0.0	0.0	-3.0	-3.0	0.0	39.9	-36.9	-63.1
125 Hz	0.0	0.0	0.0	4.5	4.5	0.0	39.9	-44.4	-60.5
250 Hz	0.0	0.0	0.0	6.9	6.9	0.0	39.9	-46.9	-55.5
500 Hz	0.0	0.0	0.0	8.0	8.0	0.1	39.9	-48.0	-51.2
1000 Hz	0.0	0.0	0.0	2.3	2.3	0.1	39.9	-42.4	-42.4
2000 Hz	0.0	0.0	0.0	0.0	0.0	0.3	39.9	-40.2	-39.0
4000 Hz	0.0	0.0	0.0	0.0	0.0	0.9	39.9	-40.8	-39.8
8000 Hz	0.0	0.0	0.0	0.0	0.0	3.0	39.9	-43.0	-44.1
								-31.2	-34.7

Proposed Soccer Club Zone
Residential Sound Study
Stamford, CT

Sound Source Contribution Plot Nearby Residence



BAC Noise Projection Graph Sound Calculation -- Typical Case 1

Proposed Soccer Club Zone

Residential Sound Study

Based on BAC data

Sound Projection -- Stamford, CT

Typical installation features - distance 300 ft

Coordinates:

PROJECTED FROM: Playing fields
 PROJECTED TO: Nearby Residence

East	North	Elevation
210.0	210.0	5.3

baseline elev. 400 ft

RELATIVE HUMIDITY: 50%
 TEMPERATURE: 70 deg. F
 ATMOS. PRESS: 760 mm Hg

Total Sound Level 35 dBA
 Noise Criteria Level 55 dBA

Exceedance?
NO

<u>FREQ.</u>	<u>AWT SPL</u>		<u>SOURCE</u>	<u>CONTRIBUTIONS</u>
		<u>#</u>		<u>AWT SPL</u>
31.5 Hz	-2.7			
63 Hz	4.2	1	Playing Fields Soccer Club	35.0 dBA
125 Hz	20.5	2	reserved --	
250 Hz	22.5	3	reserved --	
500 Hz	30.6	4	reserved --	
1000 Hz	29.3	5	reserved --	
2000 Hz	28.5	6	reserved --	
4000 Hz	20.9	7	reserved --	
8000 Hz	-1.1	8	reserved --	
		9	reserved --	
RMS:	35.0	10	reserved --	
		11	reserved --	
		12	reserved --	

Atmospheric attenuation: yes
 Excess ground attenuation: yes
 Source region hard, soft, mixed (h,s,m=%s): s
 Receiver region hard, soft, mixed (h,s,m=%s): s
 Middle region hard, soft, mixed (h,s,m=%s): s
 Barrier shadowing: yes
 Vegetation: yes

PATH SHEET

	<u>COORDINATES</u>	
SOURCE 1: Playing Fields	East 0.0	<u>Record Distance</u>
Soccer Club	North 0.0	70.0
TYPE: point	Elevation 5.3	<u>Projection Dist.</u>
		297.0

Freq.	Source	Vegetation	Shadowing	Ground Atten	Net		Distance Atten	Contribution	Awt Contrib.
					Barrier Atten	Atmospheric			
31.5 Hz	58.6	1.6	4.8	-3.0	7.8	0.0	12.6	36.7	-2.7
63 Hz	52.3	1.6	4.8	-3.0	7.8	0.0	12.6	30.4	4.2
125 Hz	51.6	2.4	4.9	7.7	0.0	0.0	12.6	36.6	20.5
250 Hz	46.9	3.2	5.0	11.4	0.0	0.1	12.6	31.1	22.5
500 Hz	49.9	3.2	5.2	7.1	0.0	0.3	12.6	33.8	30.6
1000 Hz	51.0	4.0	5.5	0.8	4.7	0.4	12.6	29.3	29.3
2000 Hz	51.7	4.8	6.1	0.0	6.1	0.9	12.6	27.3	28.5
4000 Hz	48.7	6.4	7.2	0.0	7.2	2.6	12.6	19.9	20.9
8000 Hz	39.9	9.6	8.7	0.0	8.7	9.1	12.6	0.0	-1.1
								41.9	35.0

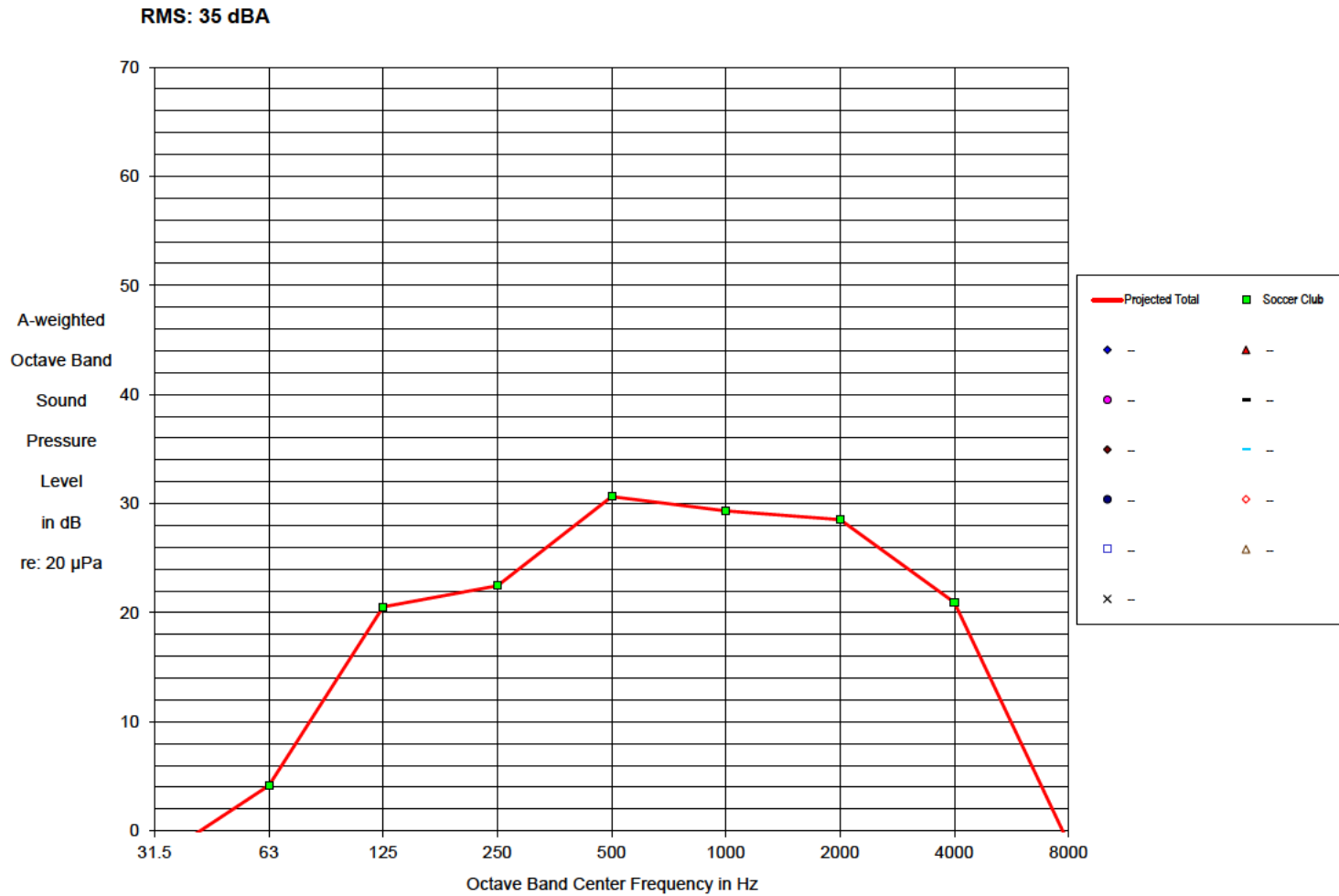
PATH SHEET

	<u>COORDINATES</u>	
SOURCE 2: reserved	East 0.0	<u>Record Distance</u>
--	North 0.0	1.0
TYPE: point	Elevation 1.0	<u>Projection Dist.</u>
		297.0

Freq.	Source	Vegetation	Shadowing	Ground Atten	Net		Distance Atten	Contribution	Awt Contrib.
					Barrier Atten	Atmospheric			
31.5 Hz	0.0	0.0	0.0	-1.9	-1.9	0.0	49.5	-47.5	-86.9
63 Hz	0.0	0.0	0.0	-1.9	-1.9	0.0	49.5	-47.6	-73.8
125 Hz	0.0	0.0	0.0	8.4	8.4	0.0	49.5	-57.9	-74.0
250 Hz	0.0	0.0	0.0	12.8	12.8	0.1	49.5	-62.4	-71.0
500 Hz	0.0	0.0	0.0	14.7	14.7	0.3	49.5	-64.5	-67.7
1000 Hz	0.0	0.0	0.0	4.2	4.2	0.4	49.5	-54.1	-54.1
2000 Hz	0.0	0.0	0.0	0.0	0.0	0.9	49.5	-50.3	-49.1
4000 Hz	0.0	0.0	0.0	0.0	0.0	2.6	49.5	-52.0	-51.0
8000 Hz	0.0	0.0	0.0	0.0	0.0	9.1	49.5	-58.6	-59.7
								-42.3	-46.0

Proposed Soccer Club Zone
Residential Sound Study
Stamford, CT

Sound Source Contribution Plot Nearby Residence



BAC Noise Projection Graph Sound Calculation -- Typical Case 2

Proposed Soccer Club Zone

Residential Sound Study

Based on BAC data

Sound Projection -- Stamford, CT

Typical installation features - distance 500 ft

Coordinates:

PROJECTED FROM: Playing fields
 PROJECTED TO: Nearby Residence

East	North	Elevation
350.0	350.0	5.3

baseline elev. 400 ft

RELATIVE HUMIDITY: 50%
 TEMPERATURE: 70 deg. F
 ATMOS. PRESS: 760 mm Hg

Total Sound Level 28 dBA
 Noise Criteria Level 55 dBA

Exceedance?
NO

<u>FREQ.</u>	<u>AWT SPL</u>		<u>SOURCE</u>	<u>CONTRIBUTIONS</u>
		<u>#</u>		<u>AWT SPL</u>
31.5 Hz	-7.1			
63 Hz	-0.2	1	Playing Fields Soccer Club	27.9 dBA
125 Hz	14.6	2	reserved --	
250 Hz	16.0	3	reserved --	
500 Hz	24.0	4	reserved --	
1000 Hz	22.2	5	reserved --	
2000 Hz	20.5	6	reserved --	
4000 Hz	10.8	7	reserved --	
8000 Hz	-17.7	8	reserved --	
		9	reserved --	
RMS:	27.9	10	reserved --	
		11	reserved --	
		12	reserved --	

Atmospheric attenuation: yes
 Excess ground attenuation: yes
 Source region hard, soft, mixed (h,s,m=%s): s
 Receiver region hard, soft, mixed (h,s,m=%s): s
 Middle region hard, soft, mixed (h,s,m=%s): s
 Barrier shadowing: yes
 Vegetation: yes

PATH SHEET

	<u>COORDINATES</u>	
SOURCE 1: Playing Fields	East 0.0	<u>Record Distance</u>
Soccer Club	North 0.0	70.0
TYPE: point	Elevation 5.3	<u>Projection Dist.</u>
		495.0

Freq.	Source	Vegetation	Shadowing	Ground Atten	Net		Distance Atten	Contribution	Awt Contrib.
					Barrier Atten	Atmospheric			
31.5 Hz	58.6	2.6	4.8	-1.9	6.7	0.0	17.0	32.3	-7.1
63 Hz	52.3	2.6	4.8	-1.9	6.7	0.0	17.0	26.0	-0.2
125 Hz	51.6	3.9	4.9	9.1	0.0	0.1	17.0	30.7	14.6
250 Hz	46.9	5.2	5.0	12.9	0.0	0.2	17.0	24.6	16.0
500 Hz	49.9	5.2	5.2	8.0	0.0	0.4	17.0	27.2	24.0
1000 Hz	51.0	6.5	5.5	0.9	4.6	0.7	17.0	22.2	22.2
2000 Hz	51.7	7.8	6.1	0.0	6.1	1.5	17.0	19.3	20.5
4000 Hz	48.7	10.4	7.2	0.0	7.2	4.3	17.0	9.8	10.8
8000 Hz	39.9	15.6	8.7	0.0	8.7	15.2	17.0	-16.6	-17.7
								36.4	27.9

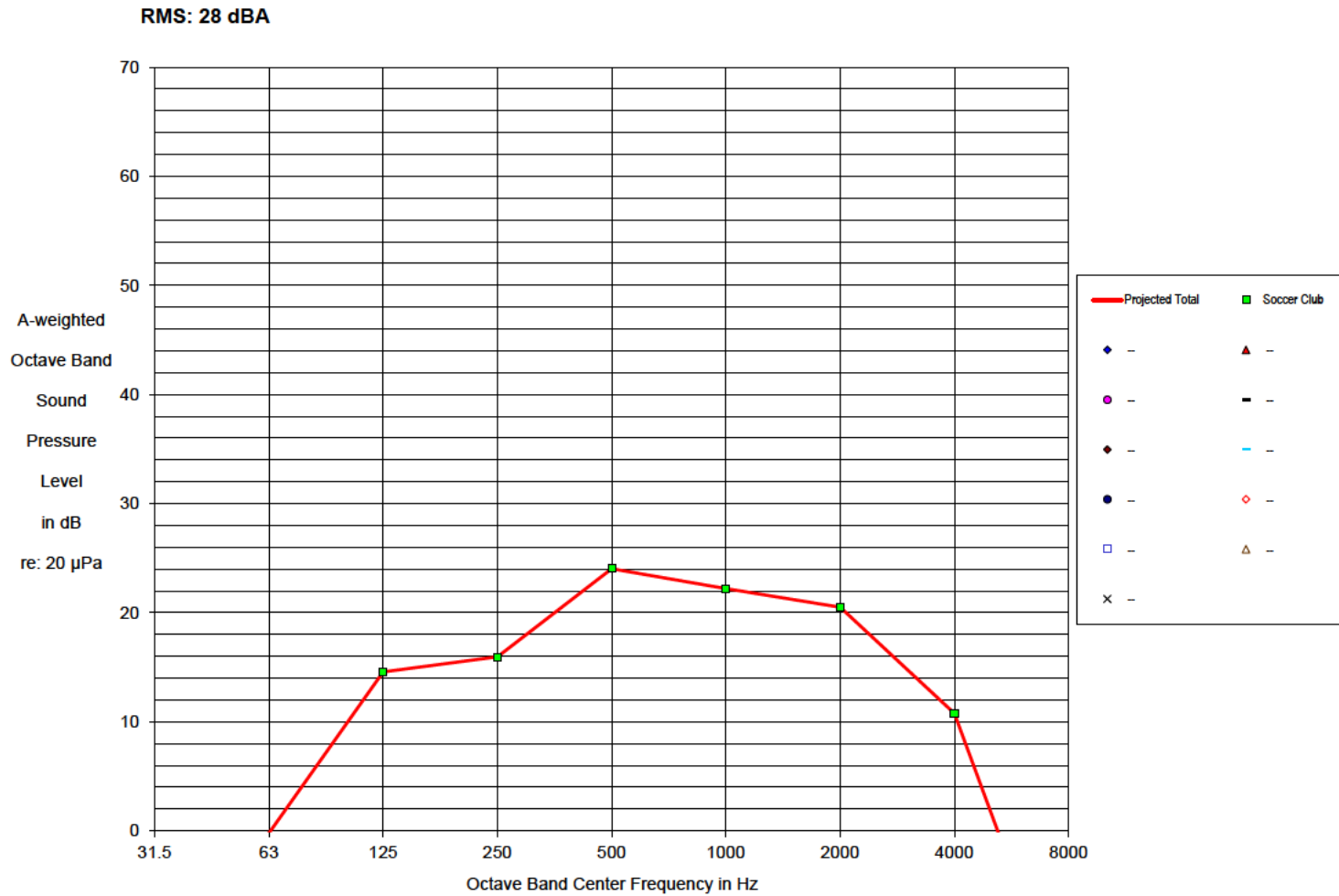
PATH SHEET

	<u>COORDINATES</u>	
SOURCE 2: reserved	East 0.0	<u>Record Distance</u>
--	North 0.0	1.0
TYPE: point	Elevation 1.0	<u>Projection Dist.</u>
		495.0

Freq.	Source	Vegetation	Shadowing	Ground Atten	Net		Distance Atten	Contribution	Awt Contrib.
					Barrier Atten	Atmospheric			
31.5 Hz	0.0	0.0	0.0	-1.1	-1.1	0.0	53.9	-52.8	-92.2
63 Hz	0.0	0.0	0.0	-1.1	-1.1	0.0	53.9	-52.8	-79.0
125 Hz	0.0	0.0	0.0	9.9	9.9	0.1	53.9	-63.9	-80.0
250 Hz	0.0	0.0	0.0	14.6	14.6	0.2	53.9	-68.7	-77.3
500 Hz	0.0	0.0	0.0	16.8	16.8	0.4	53.9	-71.1	-74.3
1000 Hz	0.0	0.0	0.0	4.8	4.8	0.7	53.9	-59.5	-59.5
2000 Hz	0.0	0.0	0.0	0.0	0.0	1.5	53.9	-55.4	-54.2
4000 Hz	0.0	0.0	0.0	0.0	0.0	4.3	53.9	-58.2	-57.2
8000 Hz	0.0	0.0	0.0	0.0	0.0	15.2	53.9	-69.1	-70.2
								-47.7	-51.5

Proposed Soccer Club Zone
Residential Sound Study
Stamford, CT

Sound Source Contribution Plot Nearby Residence



BAC Noise Projection Graph Sound Calculation -- Typical Case 3