Memorandum

Date: October 17, 2006

To: Mr. Edmund P. Tarallo
Woburn Planning Board

From: Gregory Flaherty, P.E.

Re: Sound Control Report ←
Trade Center Park,
100 Sylvan Road, Woburn

A. Introduction

Trade Center Park, LLC (TCP) is proposing to construct a seven-story office building in two sections joined by a four-level parking garage at Trade Center Park, Woburn. This report will review the acoustic considerations of this project.

B. Existing Noise Sources

The project site is located near the intersection of Interstate 95/Route 128 and Route 38 in Woburn. It is bounded on the south by Sylvan Road, a local feeder street, and I-95/Route 128, a major eight-lane highway. It is bounded on the east by a large retail development including a Super Stop and Shop grocery store, an Applebee's restaurant and other retail stores. It is bounded on the north by the existing two-level commercial building and an adjacent residential development. It is bounded on the west by the Skyworks manufacturing facility. (See Existing Sound Sources - Exhibit A)

Proximity impacts:

1. The extremely heavy, fast moving traffic on the adjacent I-95/Route 128 generates a substantial background noise level.
2. The existing HVAC and process cooling equipment (including cooling towers, chillers and exhaust fans) at the Skyworks manufacturing facility at 20 Sylvan Road generates continuous fan noise 24-hours-a-day.
3. The existing process cooling systems at the Stop & Shop plaza also generate continuous fan noise 24-hours-a-day.
4. The existing 100 Sylvan Road office building also generates fan noise (cooling tower and condenser units) associated with cooling operations during business hours in summer months.

C. Proposed noise sources- New construction (See Exhibit B and C)

The sound generating equipment proposed for the new buildings is the rooftop HVAC equipment. These buildings will be heated and cooled via a water-source heat pump system. The main components of each system include dual gas-fired boilers, pumps and a cooling tower. The building will be served by maximum sized components to limit the number of systems required to condition the whole building. Currently, three separate HVAC systems are proposed, one for the rear (courthouse) structure (150,000 SF) and two systems to serve the main building along I-95/Route 128 (400,000 SF.) The boilers and pumps will be enclosed in rooftop penthouse structures and their noise will be contained. The cooling towers will be addressed as described below.

Additionally, small intake and exhaust fans (4000 cfm) will provide fresh air and exhaust from the various office levels. These fans will be equipped with factory installed isolation equipment and will generate an insignificant decibel contribution to the complex.

D. Building Equipment

Phase 1 - 200 Sylvan Road (courthouse)

Building mechanical equipment will be located at the roof level. Most equipment will be located within an insulated mechanical penthouse. The cooling tower will be positioned on the south side of the penthouse to allow the penthouse to act as an acoustic barrier between the cooling tower and the residential area to the north. The penthouse will be approximately 15' high above the roof. The cooling tower will be 15' high, located 45' from the east roof edge, and 120' from the north roof edge and approximately 345' from the nearest home. (See Exhibit D)

The cooling tower will operate primarily during daylight hours in the spring, summer and fall. The cooling tower works through a combination of evaporation, natural convective airflow, and fan-forced airflow. The airflow sound pressure level is generated by electrically operated cooling fans in each unit. These units will tend to operate only when the natural convective airflow and water spray do not sufficiently cool the circulating water from the building HVAC system. This will tend to be later in the morning and afternoon during warm weather conditions. Hence this sound source has a limited calendar of operation. (See Exhibit E for cooling tower manufacturer's spec.)

Cooling tower noise mitigation- TCP intends to address noise mitigation for the cooling towers as follows:

1) Install vibration isolators on the cooling towers. These large spring and rubber gasket isolators help stop the transfer of vibration noise through and out of the main cooling tower structure.

2) Locate the cooling towers behind or adjacent to penthouse structures.

3) Use manufacturer installed sound-reducing fan blades in the cooling tower (courthouse.) These fan blades reduce the sound generated by the tower by 4-5 decibels.

The cooling tower closest to the residential area is located on the roof of 200 Trade Center Park (the courthouse building). This unit will be more than one football-field distant from the nearest residential home, and more than 80' above grade.

Per manufacturer's data, when the cooling tower fans are operating at maximum speed, they generate approximately 65 dB of noise at 50' (horizontal). The adjacent penthouse (15' high) will also reduce the direct sound transfer. Sound dissipation from the source to the residential area will reduce sound another 20 dB. (See Calculations- Exhibit H)

Hence, the projected sound level, as measured at the rear yard of the neighboring houses will be approximately 48 decibels (weighted average), consistent with expected noise levels associated with a "average home or quiet street." (See Exhibit F)

Phase 2 - 500 Sylvan Road

As at 500 Sylvan Road, building mechanical equipment will be located on the roof. Again, most equipment will be located within two insulated penthouses, with the exception of several relatively small exhaust and makeup air fans and two cooling towers. The cooling towers will be positioned on the side of the two penthouse areas. The cooling towers will be approximately 850 feet from the nearest home.

Installing vibration isolators yields a similar level of sound reduction from this equipment. Hence, the sound level due to the more distant cooling towers on the roof at 500 Sylvan Road (more than 850' away from the neighborhood) will be approximately 44 decibels. The distance factor here contributes to a sound level at the northern neighborhood equivalent to that generated from the courthouse system.

E. Buildings as barriers:

For residential abutters north of the site, the new Trade Center Park buildings and garage will act as line-of-sight noise barriers to the highway traffic noise from I-95/Route 128. Additionally, for some residents to the east and northeast, the courthouse building and

garage will act as a line-of-sight barrier to the Skyworks roof equipment noise. (See Exhibit B)

The sound levels in the current residential area, unabated by new building construction, due to both light and heavy traffic volumes on the adjacent Interstate 95 were calculated using the same formula. The sound level due to heavy traffic noise is 54 dB. The sound level due to light traffic is 48.5 dB. (See Exhibit H) These are both higher than the sound levels generated by the cooling towers.

Sound generally travels in a linear fashion, much of the direct sound transmission will be buffered by the new buildings to a significant degree for a portion of the northern neighborhood. According to the Federal Highway Administration, such barriers typically reduce decibel (dB) ratings by 5 dB at 6' high, and an additional 1.5 dB for each additional 3 feet in height. For instance, a 15' high barrier will reduce line-of-sight sound levels by 10 dB, a reduction of one-half in the current perceived sound level. In this case, the buildings are 80' high. (See schematic representation – Exhibit C) Additionally, sound dissipates over distance in a geometric fashion, getting less "noisy" by the square of the distance as opposed to a straight linear reduction.

F. Conclusion

Sound levels will vary by day, time of day, temperature, wind direction, seasonal vegetation, and sound levels of other sources (adjacent buildings, highway traffic speed and volume, etc.) Calculations based on the cooling tower manufacturer's data indicates that the noise generated by the new cooling towers should not be a significant addition to the existing conditions.

This resultant sound levels generated by the cooling towers (48 decibels) is considered "Quiet" on a subjective scale (Architectural Graphic Standards). It is less than the Common Noise Levels (Mechanical and Electrical Equipment for Buildings) for an average home or quiet residential street. (See Exhibit G) It is also significantly less (20 dB) than the Federal Highway Administration (FHA) noise impact criteria for land close to highways (67 dB maximum sound level).

Respectfully submitted,
CUMMINGS PROPERTIES, LLC

Gregory Flaherty, P.E.

Appendix/References

"Mechanical and Electrical Equipment for Buildings"
Benjamin Stein
John S. Reynolds
John Wiley & Sons, 8th ed. 1992

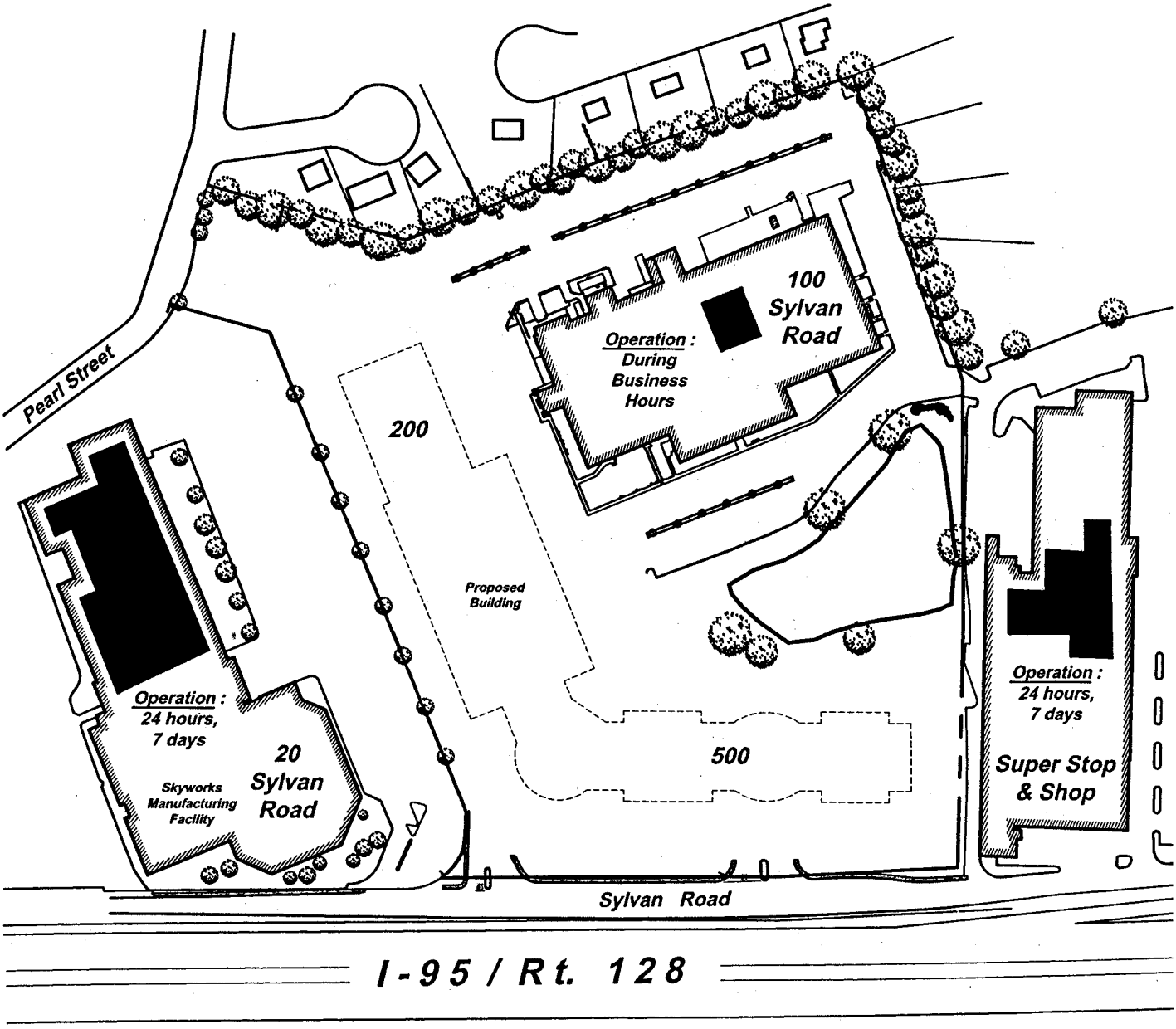
p. 1340 Common Noise Levels

"Architectural Graphic Standards"
Charles Ramsey
Ray Hoke, Jr. editor-in-chief
John Wiley & Sons, 9th ed. 1994

p. 59 Relationship of sound level and subjective loudness

"Highway Traffic Noise"
Pamphlet
United States Department of Transportation
Federal Highway Administration
Edited by Washington State Department of Transportation
Publication Year: 1992
http://www.fhwa.dot.gov/environment/htnoise.htm

"Keeping the Noise Down"
Pamphlet
United States Department of Transportation
Federal Highway Administration
http://www.fhwa.dot.gov/environment/keepdown.htm



Trade Center Park
Woburn, MA

Existing Sound Sources

Exhibit

A

10/16/06
NOT TO SCALE

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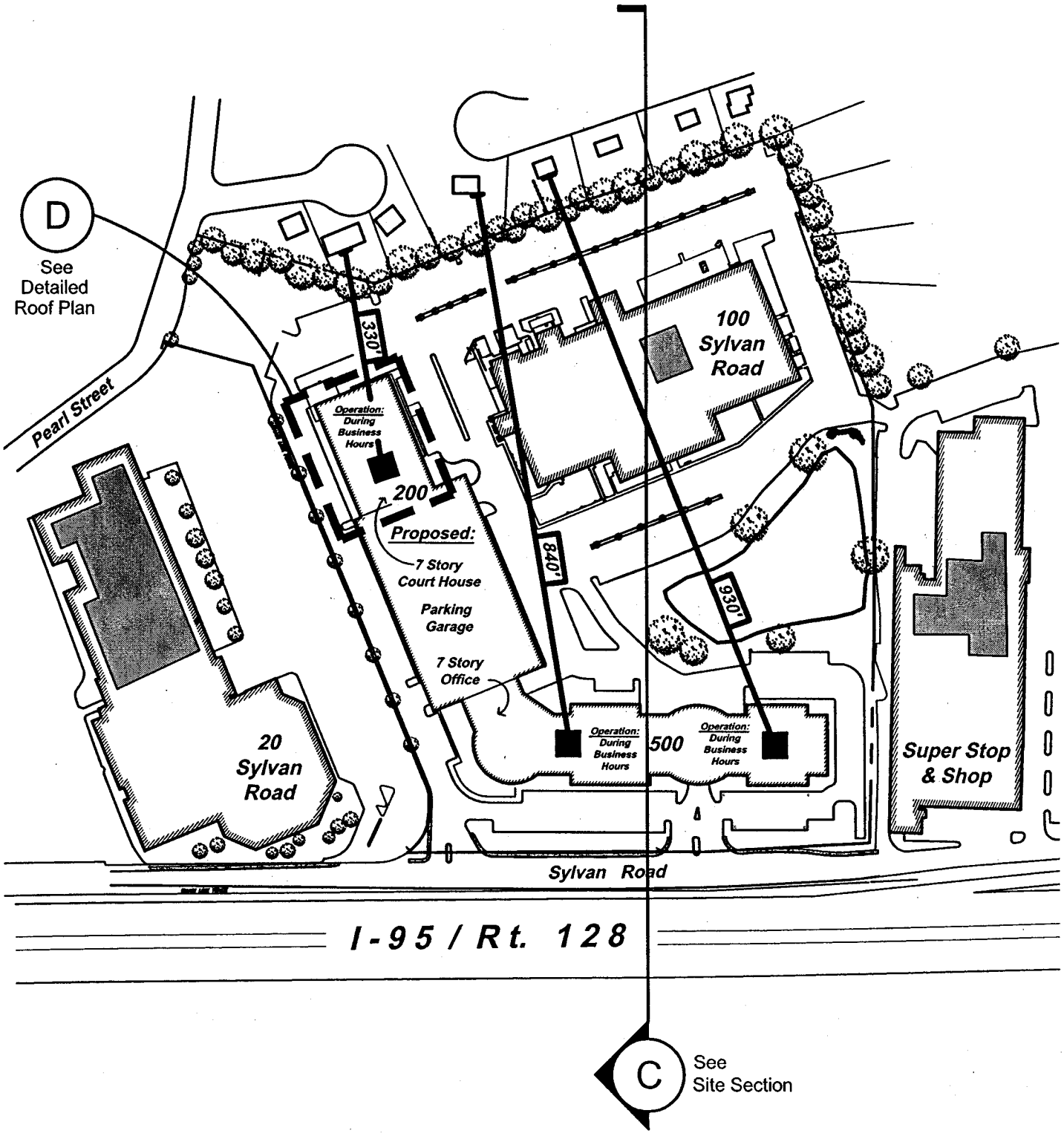
Cummings Properties
200 West Cummings Park, Woburn, MA. 781-935-8000



Trade Center Park
Woburn, MA

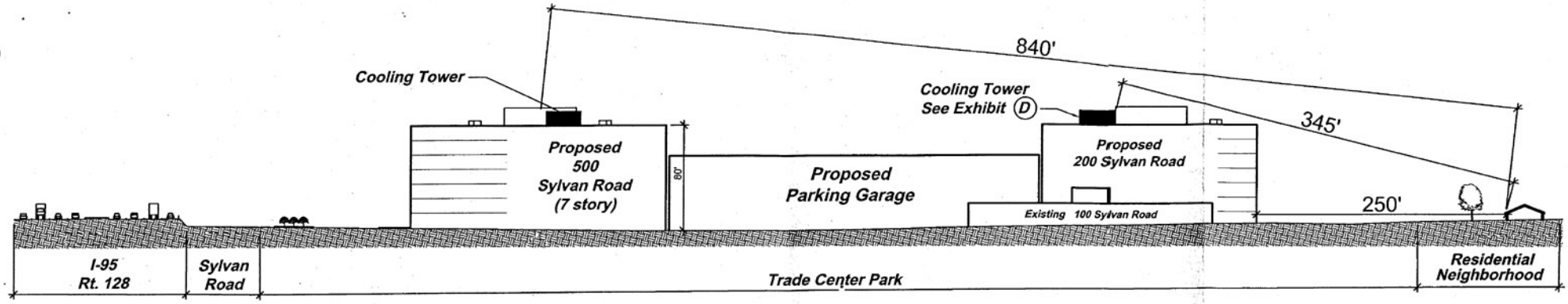
Cummings Properties
200 West Cummings Park, Woburn, MA. 781-935-8000

Proposed HVAC
System Locations

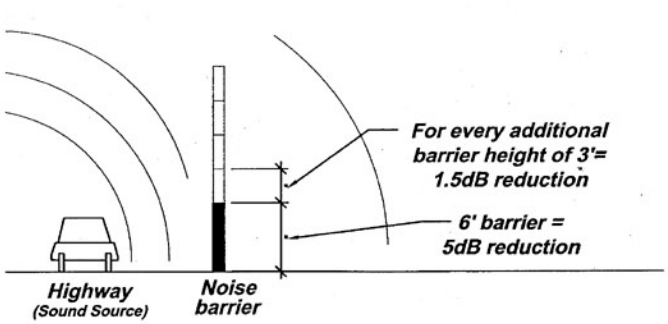
10/16/06
NOT TO SCALE

Exhibit

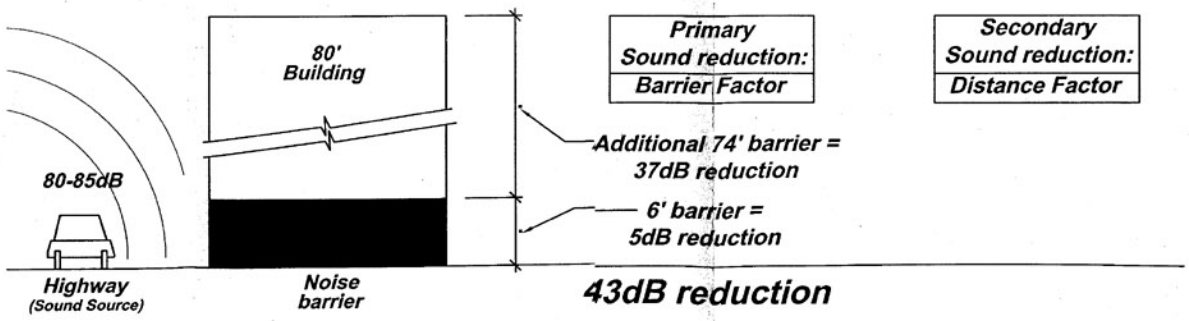
B



1 Site Section Looking West
NOT TO SCALE



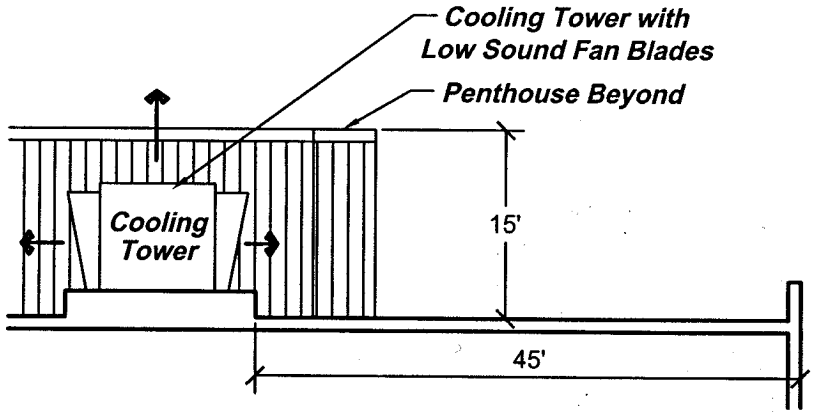
Federal Highway Association
2 Highway Barrier Effectiveness Schematic
NOT TO SCALE



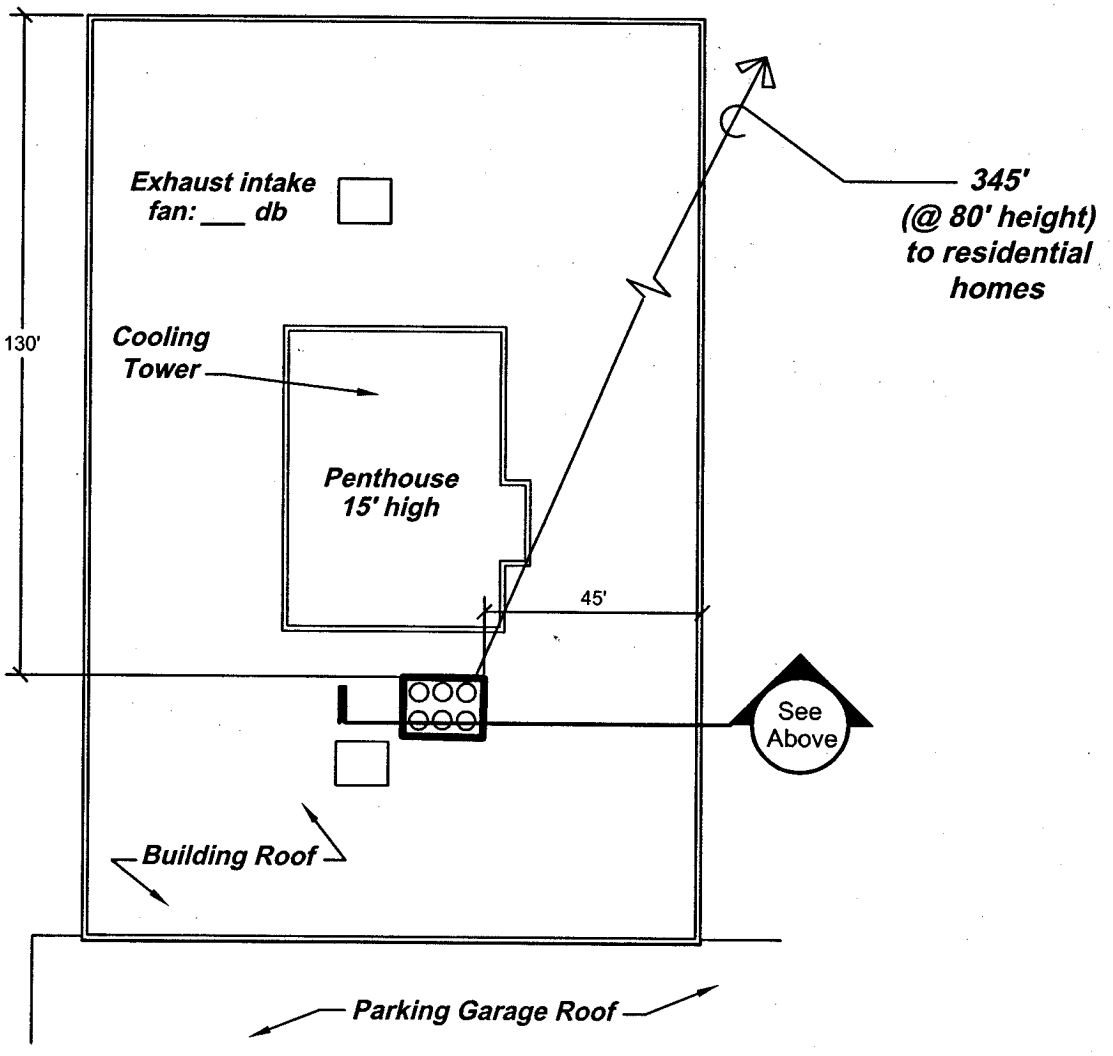
3 Actual Building Schematic
NOT TO SCALE

Trade Center Park Woburn, MA Cummings Properties 200 West Cummings Park, Woburn, MA 781-935-8000	Site Section(s) 10/16/06 NOT TO SCALE	Exhibit C

CMPI-CAD\SUBURBAN\WOBUTN\new-Tcp\0_jen\SO\\Section Through Site.dwg



Section



Plan

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Woburn, MA

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Detailed Roof Plan
and Section

10/16/06
NOT TO SCALE

Exhibit

D

Baltimore Aircoil Company

Sound Rating Program, 5/26/2006 Release

FXV Closed Circuit Cooling Tower

Model: FXV-Q660-OM
No. of Fans: (3) 5.5 ft. Diameter Fan Per Cell
Fan Type: Low Sound Fan
Motor HP: 15 HP per fan

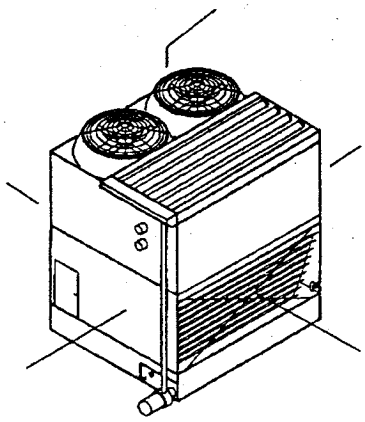
Octave band and A-weighted sound pressure levels (Lp) are expressed in decibels (dB) reference 0.0002 microbar. Sound power levels (Lw) are expressed in decibels (dB) reference one picowatt. Octave band 1 has a center frequency of 63 Hertz.

Top Lp
Sound Pressure (dB)

Octave Band	Distance 5 ft	Distance 50 ft
1	87	75
2	86	73
3	84	71
4	82	70
5	78	65
6	76	60
7	74	59
8	65	52
A-wgtd	84	71

Back Lp
Sound Pressure (dB)

Octave Band	Distance 5 ft	Distance 50 ft
1	78	73
2	77	68
3	74	63
4	68	62
5	60	54
6	53	49
7	47	45
8	39	35
A-wgtd	70	62



End Lp
Sound Pressure (dB)

Octave Band	Distance 5 ft	Distance 50 ft
1	77	74
2	74	66
3	71	63
4	65	60
5	57	53
6	50	48
7	44	44
8	36	34
A-wgtd	67	61

Connection End Lp
Sound Pressure (dB)

Octave Band	Distance 5 ft	Distance 50 ft
1	77	74
2	74	66
3	71	63
4	65	60
5	57	53
6	50	48
7	44	44
8	36	34
A-wgtd	67	61

Air Inlet Lp
Sound Pressure (dB)

Octave Band	Distance 5 ft	Distance 50 ft
1	85	79
2	84	72
3	81	65
4	77	64
5	71	59
6	65	53
7	58	47
8	51	38
A-wgtd	78	65

Sound Power (dB)

Octave Band	Center Frequency (Hertz)	Lw
1	63	108
2	125	102
3	250	98
4	500	97
5	1000	92
6	2000	86
7	4000	85
8	8000	77

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Equipment Specifications

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NOT TO SCALE

Exhibit

E

TABLE 26.4 **Common Noise Levels**

Sound Pressure Level, SPL (dbA)	*Typical Sound*	*Subjective Impression*
150		(Short exposure can cause hearing loss)
140	Jet plane takeoff	
130	Artillery fire, riveting, machine gun	(Threshold of pain)
120	Siren at 100 ft, jet plane (passenger ramp), thunder, sonic boom	Deafening
110	Woodworking shop, hard-rock band, accelerating motorcycle	Sound can be felt (Threshold of discomfort)
100	Subway (steel wheels), loud street noise, power lawnmower, outboard motor	Very loud, conversation difficult; ear protection required for sustained occupancy
90	Noisy factory, truck unmuffled, train whistle, machine shop, kitchen blender, pneumatic jackhammer	
80	Printing press, subway (rubber wheels), noisy office, supermarket, average factory	(Intolerable for phone use)
70	Average street noise, quiet typewriter, freight train at 100 ft, average radio, department store	Loud, noisy; voice must be raised to be understood
60	Noisy home, hotel lobby, average office, restaurant, normal conversation	Usual background; normal conversation easily understood
50	General office, hospital, quiet radio, average home, bank, quiet street	
40	Private office, quiet home	Noticeably quiet
30	Quiet conversation, broadcast studio	
20	Empty auditorium, whisper	Very quiet
10	Rustling leaves, soundproof room, human breathing	
0 db		Intolerably quiet Threshold of audibility

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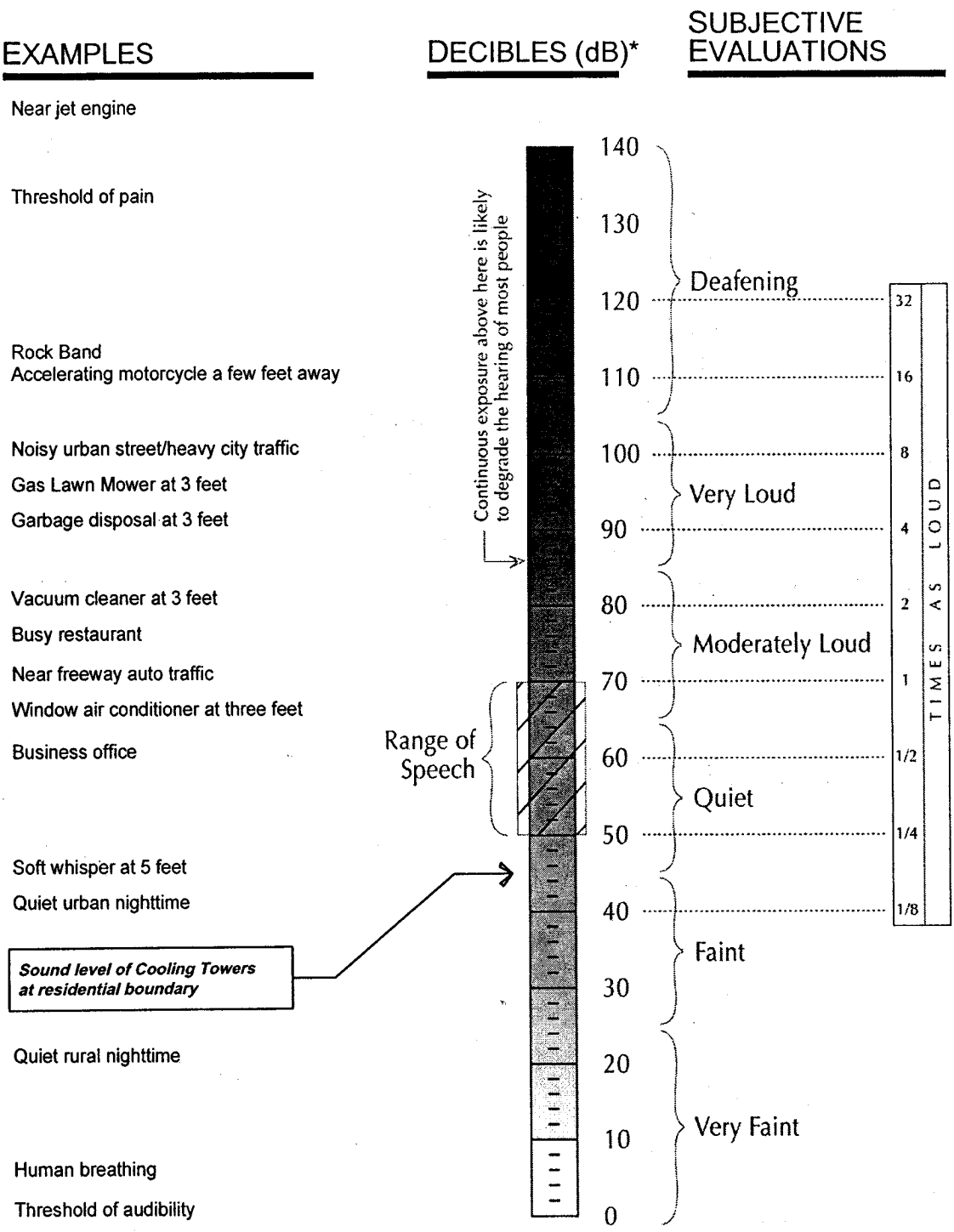
Acoustical Levels
Chart I

10/16/06
NOT TO SCALE

Exhibit
F



* dB are ìaverageî values as measured on the A-scale of a sound-level meter.
From Concepts in Architectural Acoustics: M.David Egan, McGraw Hill, 1972 and U.S. Department of Housing and Urban Development, Office of Community Planning and Development iThe Noise Guidebookî.

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Acoustical Levels
Chart II

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NOT TO SCALE

Exhibit
G

Noise Analysis Calculations

Noise levels, also known as Intensity Levels, are measured in decibels (dB). In order to determine the reduction in decibels over distance, we must do the following:

1) Establish a known Intensity Level at a known distance.
2) Convert the Intensity Level into Intensity (W/cm^2).
3) Calculate the reduced Intensity at the defined distance.
4) Convert the new Intensity into the new Intensity Level.

Data Inputs:

r = distance (ft)
I = Intensity (W/cm^2)
I_0 = Base Intensity (10^{-16} W/cm^2)
IL = Intensity Level (dB)

Formulas:

- Converting intensity levels (dB) into intensity $I = (10^{IL/10}) I_0$
- Relationship between intensity and distance $I_2 = I_1 (r_1^2 / r_2^2)$
- Converting intensity into intensity levels (dB) $IL = 10 \log (I / I_0)$

Courthouse Cooling Tower

Data Inputs: Source sound pressure level: 65 dB @ 50'
Distance from source = 345'

dB rating at 345 feet from the source - **48.0 dB**

Building 500 TCP Cooling Towers

Data Inputs: Source sound pressure level: 69 dB @ 50'
Distance from source = 850'

dB rating at 850 feet from the source - **44.3 dB**

Highway Traffic (Unabated by Sound Barrier)

Heavy Traffic Data Inputs: Source sound pressure level: 80 dB @ 50'
Distance from source = 1000'

dB rating at 1000 feet from the source - **54 dB**

Light Traffic Data Inputs: Source sound pressure level: 85 dB @ 15'
Distance from source = 1000'

dB rating at 1000 feet from the source - **48.5 dB**

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Sound Distance Calculation

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