WILLIAMS & ASSOCIATES
ARCHITECTURE, INC.

October 22, 2002

City of Rapid City
Planning & Zoning Department
Attn: Vicky Fisher
300 Sixth Street
Rapid City SD 57701

Re: Black Hills Imaging Center
PCD Amendment Application – HVAC equipment sound evaluation.

Dear Ms. Fisher:

Attached is the sound data that you have requested for the Black Hills Imaging Center. In simple terms we calculated the sound level in decibels (db) at 3 locations on the adjacent properties. By using multiple pieces of unitary equipment (similar to a residential condensing units) we are able to keep the sound levels at "residential" levels according to the standards used by the City of Sioux Falls.

It is also noteworthy that the adjacent properties and distances used in this sound study include space that is not conducive to building or outdoor-use space based on topography and/or land use. This site screens itself well from the neighbors with or without an additional screening fence.

I hope this is helpful to you in evaluating this application. Please let me know if you have any questions or need additional information.

Sincerely,

Jason Roberdeau

JR

cc: Frank Shobe, Black Hills Surgery Center
File

c:\02-31\CityP&Z003

125 E. Colorado Blvd., Suite 2A • Spearfish, South Dakota 5 7 7 8 3
605-642-2009 • Fax 605-642-3339 • E-Mail: skwarcht@rushmore.com

JOHN W. HEY & COMPANY

920 Quincy
Rapid City, SD 57701

Phone (605) 342-3596
Fax (605) 342-0787

May 22, 2002

Williams & Associates Architecture, Inc
125 E Colorado Blvd., Suite 2A
Spearfish, SD 57783

ATTN: Jason

RE: MRI Addition
Rapid City, South Dakota
Mechanical Equipment Sound Analysis

Gentlemen:

The purpose of this letter is to provide information requested by the Rapid City Planning Department with regard to the sound level of the exterior mounted HVAC equipment. Enclosed is sound power data for the largest unitary HVAC unit being located on the ground on the south side of the building.

The existing equipment consists of unitary condensers for the HVAC equipment and remote chillers for the imaging equipment. The condensers do not have compressors while the remote chillers do have multiple 5 ton scroll compressors. These units compare to residential condensing units which have similar compressors.

There are approx four compressors at this time, the future addition will add approx four more compressors. (These are for the imaging equipment only, the HVAC units have compressors located inside the building.)

The overall sound power in db(a) is:

Scroll compressor – 5 ton	83

Dd stands for decibels and is on a logarithmic scale. Each 10 db is 10 times more watts of energy, but to the human ear 10 db is perceived as 2 times the sound.

I have performed an evaluation of the sound levels for three locations for three units based on the 1997 ARI standard 275, Application of Sound Rating Levels of Outdoor Unitary Equipment:

Location #1	Top of Hill
Location #2	Property line North
Location #3	50 FT from building to East

"A" designates the effect of a blocking fence wall with the top 3 to 5 ft above the top of the equipment.

In the absence of a sound ordinance, I am using the sound criteria used by the City of Sioux Falls. They reportedly require systems to comply with the following levels by taking a time weighted reading for 10 minutes at the property line or 50 ft from the building with a hand held meter reading db(a):

Commercial districts	65 db night and day
Residential	60 db day 55 db night

The data compiled on the attached table is first for a single compressor, the additive effect of additional compressors depends on the difference between the sound levels. The additive effect is greater if the sound is of the same level. The worst case difference for ten units of the same level is 8.5 db. The assumed additive effect is 5 db because in reality the units will not be running at the same time and will not be at the same sound level.

It is recommended that a screen fence be constructed on the parking lot retaining wall. A similar fence should be provided to screen to the east.

Please contact me if there are any questions or if additional information is required.

Sincerely,

JOHN W. HEY, P.E.

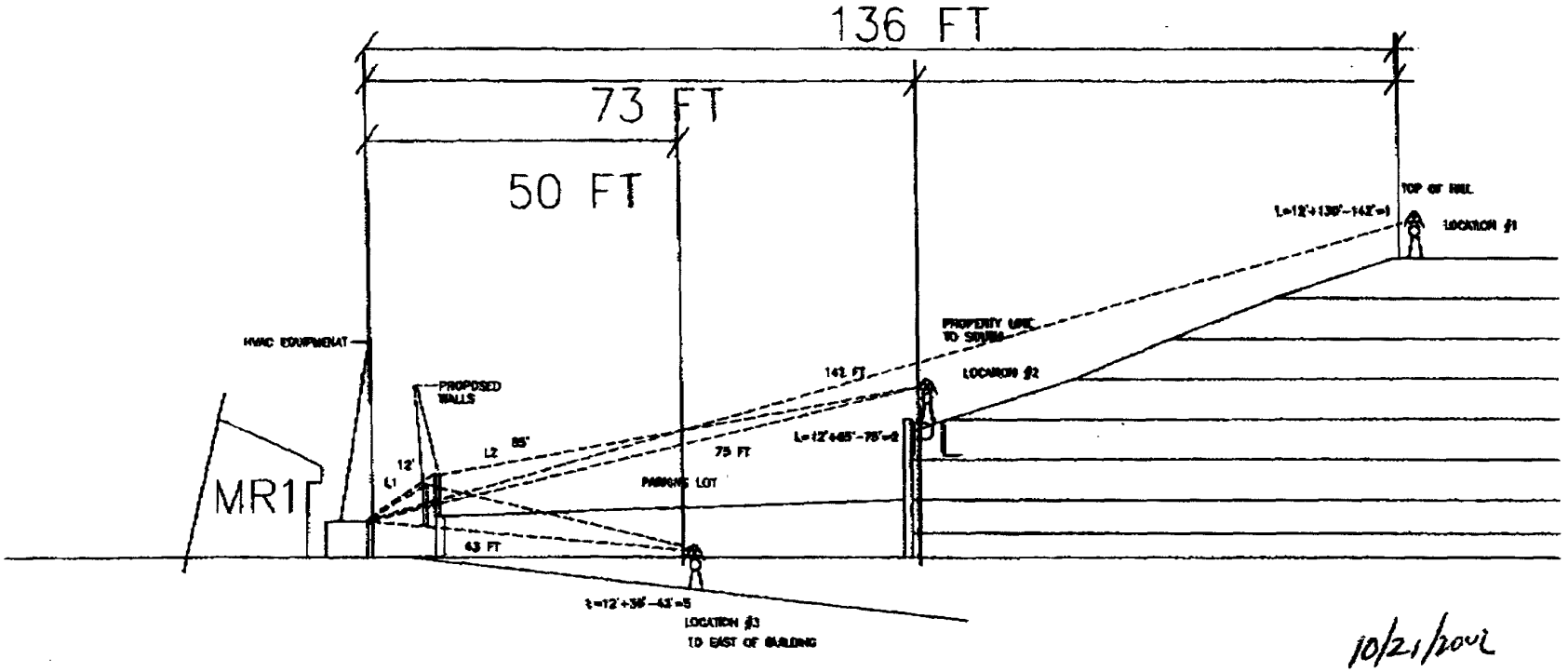
ADOC\WILL\SLINGSBY\soundrec

10/21/2002

SOUND EVALUATION

PROJECT:
MRI PH 2
RAPID CITY, S. DAK

LINE	ITEM	LOCATIONS 1	1A	2	2A	3	3A
	DISTANCE IN FT TO EQUIPMENT FROM EVALUATION POINT	142	142	75	75	43	43
1	UNIT SOUND RATING LEVEL	87	87	87	87	87	87
2	EQUIPMENT LOCATION FACTOR (TABLE 1.1)	3	3	3	3	3	3
3	ADD LINE 1 AND 2	90	90	90	90	90	90
4	BARRIER SHIELDING FACTOR (TABLE 1, ITEM 2)	0	7	0	10	0	13
5	SOUND PATH FACTOR (TABLE 1, ITEM 3)	0	0	0	0	0	0
6	DISTANCE FACTOR (TABLE 2)	40	40	35	35	30	30
7	ADD LINES 4,5,&6	40	47	35	45	30	43
8	ESTIMATED WEIGHTED SOUND PRESSURE LEVEL SUBTRACT LINE 7 FROM LINE 3	50	43	55	45	60	47
	ADDITIVE EFFECT OF MULTIPULE UNITS	5	5	5	5	5	5
	TOTAL SOUND PRESSURE LEVEL	55	48	60	50	65	52
	RESIDENTIAL LEVEL AT NIGHT	55	55	55	55	55	55



10/21/2002
MRI 2

York Unitary Products Group

YORK INTERNATIONAL

5-10-2002

To: Lance – O'Connor Co. @ Fax 605-348-9215

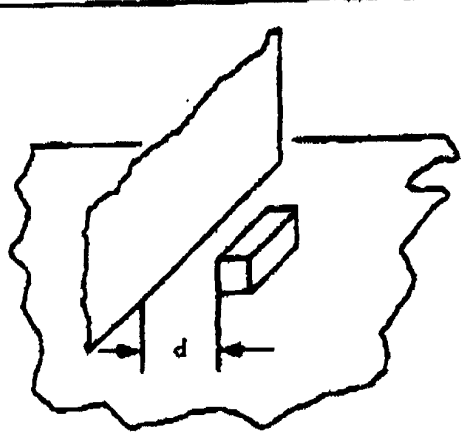
Subj: **Outdoor Sound Power Ratings**

The following outdoor sound power ratings are based on nominal full load operation at a 95 F ambient.

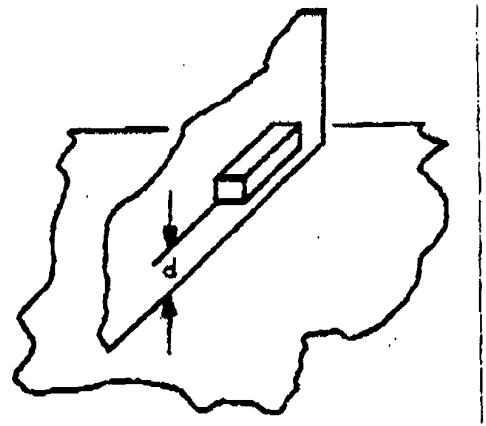
Model	Octave Band Centerline Frequency, Hertz								db(A)
	65	125	250	500	1,000	2,000	4,000	8,000	
	Sound Power Level, db(10)-12 Watts								
Res Cond H4CR090	82	83	81	80	79	74	71	66	85

Table 1. Application Factors for Estimating A-Weighted Sound Pressure Levels

	Factor Value
1. Equipment Location Factor	
a. Equipment on ground or roof or in side of building wall with *no* adjacent reflective surface within 10 ft. [3 m] (d greater than 10 ft. [3 m])	0 dB
b. Equipment on ground or roof or in side of building wall with a *single* adjacent reflective surface within 10 ft. [3 m] (d less than 10 ft. [3 m])	3 dB

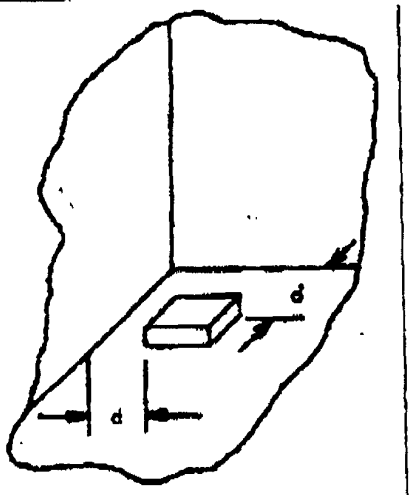


On Ground or Roof
Single Reflective Surface

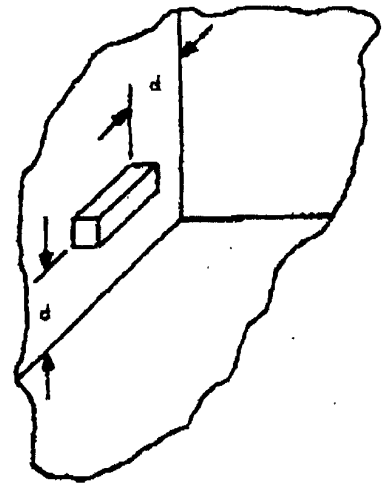


In Side of Building
Single Reflective Surface

c. Equipment on ground or roof or in side of building wall within 10 ft. [3 m] of *two* adjacent walls forming an inside corner (d less than 10 ft. [3 m] to both surfaces)	6 dB

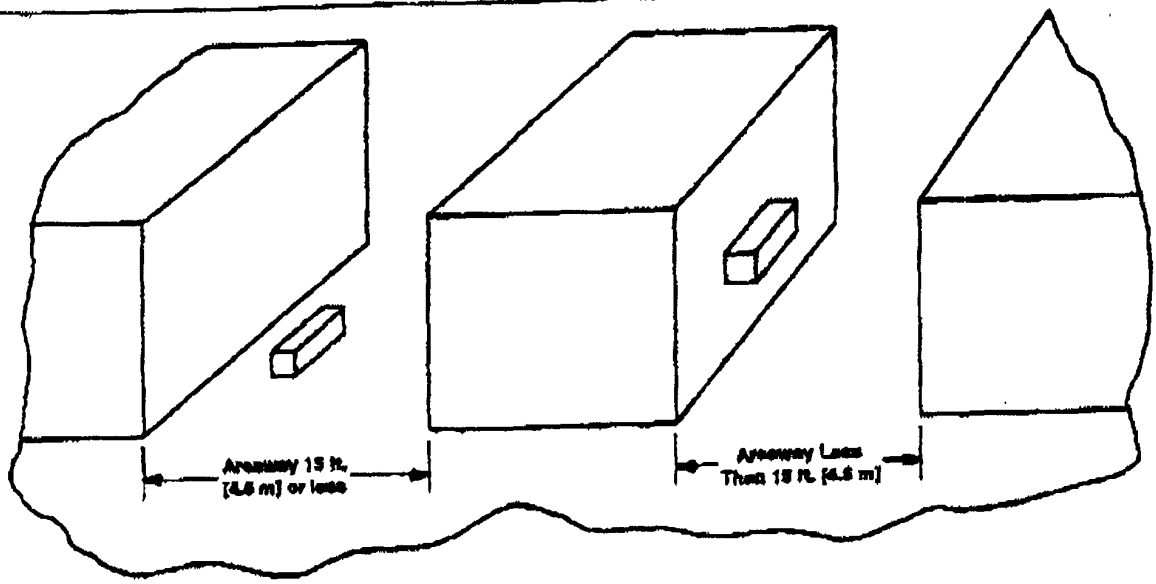


On Ground or Roof
Two Adjacent Reflecting Surfaces



In Side of Building
Two Adjacent Reflecting Surfaces

Table 1. Application Factors for Estimating A-Weighted Sound Pressure Levels (Continued)	
	Factor Value
1. Equipment Location Factor (continued)	
d. Equipment on ground or roof or in side of building wall and between two opposite reflecting surface less than 15 ft. [4.6 m] apart	6 dB



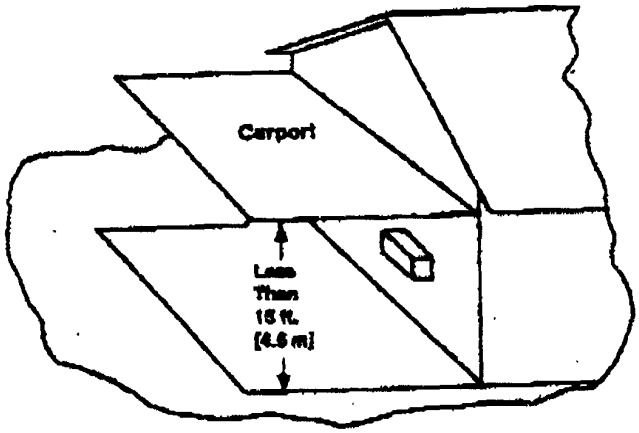
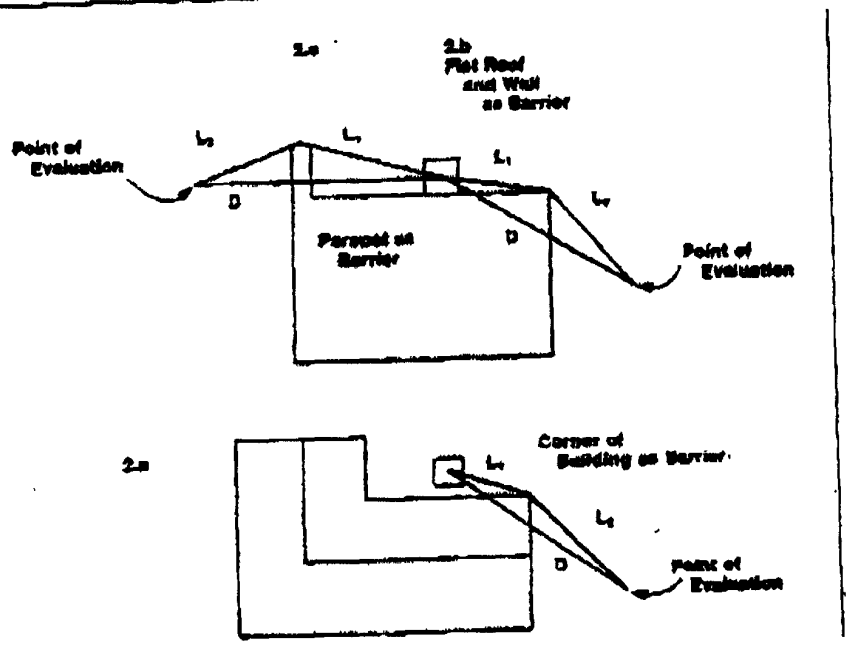


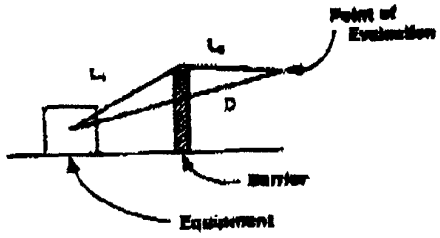
Table 1. Application Factors for Estimating A-Weighted Sound Pressure Levels (Continued)

2. Barrier Shielding Factor (see sketches below). Sound reduction benefits can be gained when a solid structure obstructs the sound path. These structures could be:

a. Corner of building
b. Corner of flat roof and wall
c. Parapet around flat roof
d. Heavy continuous wall



$L = L_1 + L_2 - D$, where:



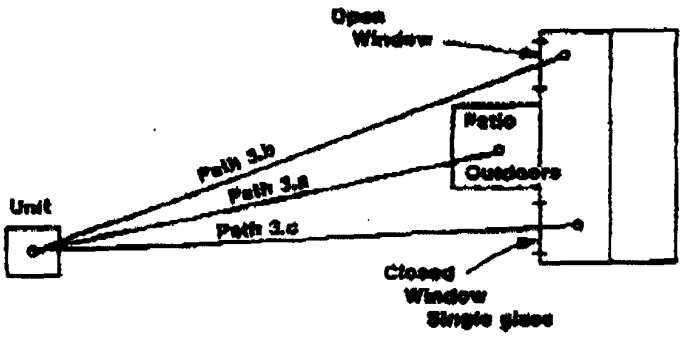
$L_1 + L_2$ = Distance from equipment point of evaluation around barrier (Use minimum $L_1 + L_2$ value.)

D = Direct distance from equipment to point of evaluation with no barrier. Determine D by layout sketch.

L ft. [m]	Factor Value
0.5 [0.15]	4 dB
1 [0.3]	7 dB
2 [0.6]	10 dB
3 [0.9]	12 dB
6 [1.8]	15 dB
12 [3.7]	17 dB

Table 1. Application Factors for Estimating A-Weighted Sound Pressure Levels (Continued)

3. Sound Path Factor	Factor Value
a. To a point of evaluation outdoors	0 dB
b. To room through open window(s) or open door(s)	10 dB
c. To room through closed single glass window(s) or door	17 dB
d. To room through closed double glass window(s) or solid wall (not illustrated)	23 dB



4.1.2 *Barrier Shielding Factor.* This factor accounts for the sound reduction benefit of any solid structure that obstructs the line of sight (or sound) from the equipment location to the point of evaluation. Such a barrier may be the corner of a building, the edge of a roof, or a heavy wall of masonry, etc., built for the specific purpose of shielding noise from a unit to an area of concern. See Item 2, Table 1, for sketches and the normal barrier factors.

4.1.3 *Sound Path Factor.* This factor adjusts for the path of sound from the unit to the point of evaluation, which may be to the outdoors only, to a room through open windows, to a room through closed windows, or through a wall. See Item 3, Table 1.

4.1.4 *Distance Factor.* The direct distance, D, from the equipment location to the point of evaluation is a very significant application factor in determining the estimated A-Weighted sound pressure levels resulting from the operation of outdoor equipment in any installation. The distance factor is obtained from Table 2.

Table 2. Distance Factor

ft.	[m]	Factor Value (dB)
4	1.2	9.5
5	1.5	11.5
6	1.8	13.0
7	2.1	14.5
8	2.4	15.5
9	2.7	16.5
10	3.0	17.5
15	4.6	21.0
20	6.1	23.5
25	7.6	25.5
30	9.1	27.0
40	12.2	29.5
50	15.2	31.0
60	18.3	33.0
70	21.3	34.5
80	24.4	35.5
90	27.4	36.5
100	30.5	37.5
125	38.1	39.5
150	45.7	41.0
175	53.3	42.5
200	61.0	43.5
400	122.0	49.5

4.2 *Procedure for Estimating Sound Pressure Levels - Single Unit Installation.* The basic procedure for estimating A-Weighted sound pressure levels at a given point of evaluation consists of combining the sum of the application and evaluation factors with the Sound Rating Level for the equipment:

Sound Rating Level from ARI 270	_____
+ Equipment Location Factor	_____
− Barrier Shielding Factor	_____
− Sound Path Factor	_____
− Distance Factor	_____
Estimated A-Weighted Sound Pressure Level	_____ dB*

4.3 *Procedure for Estimating Sound Levels-Multiple Unit Installation.* Estimated sound levels for multiple unit installations at any point of interest can be determined by combining the effects of each unit at the point of interest. The procedure for multi-unit installations follows that used for single units except for the additional procedure used to combine numbers.

4.3.1 The combined level for all units is determined as follows:

1. Determine the numerical difference between the largest and next largest levels.
2. Using Table 3, find the proper value and add it to the larger number. This combines the two largest numbers.
3. Determine the numerical difference between this combined number and the third largest level. Again, using Table 3, find the proper value and add it to the combined number.
4. Continue this combining procedure until the value to be added from Table 3 becomes 0.0 or until all numbers have been combined.
5. The resulting single number represents the effect of all units at the point of evaluation. (See Example 4.5.4)

Table 3. Values Used for Combining Numbers for Multi-Unit Installations

Difference Between Numbers (dB)	Value to be Added to Larger Number (dB)
0.0 to 0.5	3.0
1.0 to 1.5	2.5
2.0 to 3.0	2.0
3.5 to 5.0	1.5
5.5 to 7.0	1.0
greater than 7.0	0.0

4.4 *Points of Evaluation.* The calculation procedures described in 4.2 and 4.3 should be made for each area of concern to evaluate the installation from an acoustic standpoint (see 4.5, Examples). Measured A-Weighted sound pressure levels shall be within ± 5 dB of estimated levels when background levels are at least 5 dB below measured values. This estimation error accounts for the effect of the tone adjustment applied during the rating procedure of ARI Standard 270, as well as inaccuracies in the estimation procedure itself. To obtain the background level, readings shall be made with the unit not operating. The effects of environmental conditons on estmated sound levels are not included in this procedure.

* Rounded to the nearest whole dB value.