



Air Quality Permitting Statement of Basis

March 5, 2007

Permit to Construct No. P-060131

**Kellogg Middle School
Kellogg, ID**

Facility ID No. 079-00040

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FINAL

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Acronyms, Units, and Chemical Nomenclatures

acfm	actual cubic feet per minute
AFS	AIRS Facility Subsystem
AIRS	Aerometric Information Retrieval System
AQCR	Air Quality Control Region
Btu	British thermal unit
CO	carbon monoxide
DEQ	Department of Environmental Quality
dscf	dry standard cubic feet
gr	grain (1 lb = 7,000 grains)
IDAPA	a numbering designation for all administrative rules in Idaho promulgated in accordance with the Idaho Administrative Procedures Act
km	kilometer
lb/hr	pound per hour
m	meter(s)
MMBtu	million British thermal units
NO _x	nitrogen oxides
PM	particulate matter
PM ₁₀	particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
PTC	permit to construct
PTE	potential to emit
Rules	Rules for the Control of Air Pollution in Idaho
scf	standard cubic feet
SIC	Standard Industrial Classification
SM	Synthetic Minor
SO ₂	sulfur dioxide
T/yr	tons per year
UTM	Universal Transverse Mercator
VOC	volatile organic compound

1. PURPOSE

The purpose for this memorandum is to satisfy the requirements of IDAPA 58.01.01.200, Rules for the Control of Air Pollution in Idaho, for issuing permits to construct.

2. FACILITY DESCRIPTION

Kellogg Middle School is proposing to install and operate a 2.0 MMBtu/hr wood fired boiler. The combustor is a Messersmith Combustor and the boiler is a Hurst. The boiler is rated for 30 PSI water. The Messersmith Combustor is a sloped grate assembly fed by a stoker auger.

3. FACILITY / AREA CLASSIFICATION

Kellogg Middle School is classified as a minor facility because its potential to emit is less than major source thresholds without requiring limits on potential to emit. The AIRS classification is B.

The facility is located within AQCR 62 and UTM zone 11. The facility is located in Shoshone County in an area that is designated as unclassifiable for all regulated criteria pollutants (PM₁₀, CO, NO_x, SO₂, lead, and ozone).

The AIRS information provided in Appendix A defines the classification for each regulated air pollutant at Kellogg Middle School. This required information is entered into the EPA AIRs database.

4. APPLICATION SCOPE

Kellogg Middle school is proposing to construct a 2.0 MMBtu/hr wood fired boiler to supply heat to the middle school. Kellogg Middle School will be abandoning in place a 4.93 MMBtu/hr natural gas fired boiler.

4.1 *Application Chronology*

October 10, 2006	DEQ received 15-day pre-permit construction application
October 13, 2006	DEQ denied 15-day pre-permit construction application
November 14, 2006	DEQ received new 15-day pre-permit construction application
November 29, 2006	DEQ granted 15-day pre-permit construction approval
December 13, 2006	DEQ determined application complete

5. PERMIT ANALYSIS

This section of the Statement of Basis describes the regulatory requirements for this PTC action.

5.1 *Equipment Listing*

2.0 MMBtu/hr Messersmith Wood Fired Combustor - Dual Combustion Chamber
Hurst Boiler
Hot Water Circulation System

5.2 Emissions Inventory

Emissions from the 2.0 MMBtu/hr Messersmith wood fired combustor were estimated using a combination of EPA AP-42 emission factors and emission factors developed from a source test of a similar Messersmith boiler in Vermont. The emission factors from the Vermont test were obtained from the report titled *Wood-Chip Fired Furnances Testing Project Air Emissions Testing and Public Health Impacts Analysis* prepared by Environmental Risk Limited, April 1996. Emission estimates may be seen in Appendix B. The emission factors developed from the emissions test on the Vermont Messersmith combustion unit may be seen in Appendix D.

Table 5.1 summarizes the criteria air pollutant emission estimates.

Table 5.1 CRITERIA AIR POLLUTANT SUMMARY

Pollutant	lb/hr	T/yr
Carbon Monoxide	4.25	6.88
Nitrogen Oxides	0.29	0.47
PM/PM ₁₀	0.24	0.39
Sulfur Dioxide	0.05	0.08

5.3 Modeling

Air dispersion modeling results show compliance with all applicable standards. Details of the ambient impact analysis, including predicted ambient concentrations may be seen in Appendix C.

5.4 Regulatory Review

This section describes the regulatory analysis of the applicable air quality rules with respect to this PTC.

IDAPA 58.01.01.201.....Permit to Construct Required

The facility’s proposed project does not meet the permit to construct exemption criteria contained in Sections 220 through 223 of the Rules. Therefore, a PTC is required.

IDAPA 58.01.01.203.....Permit Requirements for New and Modified Stationary Sources

The applicant has shown to the satisfaction of DEQ that the facility will comply with all applicable emissions standards, ambient air quality standards, and toxic standards.

IDAPA 58.01.01.210.....Demonstration of Preconstruction Compliance with Toxic Standards

The applicant has demonstrated preconstruction compliance for all TAPs identified in the permit application. Table 5.2 lists those toxic air pollutants that exceeded their respective screening emissions levels listed in Section 585 and 586. All of these toxic air pollutants cause an ambient impact that is acceptable in accordance with IDAPA 58.01.01.161. The ambient impact analysis results may be seen in Appendix C.

Table 5.2 TOXIC AIR POLLUTANTS THAT EXCEED SCREENING LEVELS

Pollutant	Screening Emission Level (lb/hr)	Estimated Emissions (lb/hr)
Arsenic	1.5E-6	5.32E-6
PAH Mixture	2.0E-6	1.45E-5
Cadmium	3.7E-6	3.56E-5
Chromium (VI)	5.6E-7	2.62E-6
PAH Total	9.1E-5	4.78E-4
Formaldehyde	5.1E-4	2.1E-2

IDAPA 58.01.01.677.....Fuel Burning Equipment – Particulate Matter

The applicant has demonstrated compliance with particulate matter emissions standard of 0.200 gr/dscf at 8% oxygen that applies to wood fired boilers with a rated input capacity of less than 10 MMBtu/hr. Particulate matter emissions are estimated to be 0.24 pounds per hour. From the combustion evaluation (see Appendix B) gas flowrate is estimated to be 665 cubic feet per minute (dscf at 8% oxygen). This equals 0.042 gr/dscf at 8% oxygen.

IDAPA 58.01.01.224.....Permit to Construct Application Fee

The applicant satisfied the PTC application fee requirement by submitting a fee of \$1,000.00 on October 2, 2006.

IDAPA 58.01.01.225.....Permit to Construct Processing Fee

The total emissions from the proposed new facility are between 1 and 10 T/yr; therefore, the associated processing fee is \$2,500.00. On March 2, 2007 DEQ received the permit to construct processing fee.

5.5 Permit Conditions Review

The permit was written to be consistent with Permit to Construct (P-050022) issued on September 23, 2005 to the Council School for a similar Messersmith combustor.

- 5.5.1 Formaldehyde is limited to be 67.9 pounds per year to ensure that the wood-fired boiler complies with toxic standards in accordance with IDAPA 58.01.01.161. A maximum annual fuel usage of 600 tons per year is established to ensure that the boiler complies with the annual emissions limit. Limiting the annual wood combustion rate also inherently limits the emissions rates of all other TAPs and the criteria pollutants.
- 5.5.2 The wood-fired boiler is subject to 20% opacity limit. Because this is gasifying, multi-chamber biomass combustion boiler, DEQ doesn't foresee an exceedance of the opacity limit under normal operation.
- 5.5.3 The wood-fired boiler is subject to the IDAPA 58.01.01.677 grain loading standard of 0.200 gr/dscf at 8% oxygen. Emission tests on similar units in Vermont assure compliance with this standard.
- 5.5.4 The permittee is required to operate the wood-fired boiler in accordance with manufacturer's recommendations. That document is required to be maintained on site at all times and made available to DEQ representatives upon request. A copy of the document is also required to be submitted to DEQ's Coeur d' Alene Regional Office.
- 5.5.5 The permittee is required to monitor and record the monthly and annual fuel usage, and to keep the record for most recent two years. Fuel usage is determined by multiplying the hours of operation times a coefficient to determine the amount of wood burned. The equation is:

$$(\text{Hours of Operation})(0.185) = \text{Tons of wood burned}$$

The coefficient is derived as follows:

(Rated input capacity of the combustor)/ (lower heating value of wood) or;

$$[(2.0 \text{ MMBtu/hr}/5,400 \text{ Btu/lb})](\text{ton}/2000 \text{ lb}) = 0.185$$

6. PERMIT FEES

The applicant satisfied the PTC application fee requirement by submitting a fee of \$1,000.00 on October 2, 2006. A permit to construct processing fee of \$2,500 was paid by the applicant on March 2, 2007.

Table 6.1 PTC PROCESSING FEE TABLE

Emissions Inventory			
Pollutant	Annual Emissions Increase (T/yr)	Annual Emissions Reduction (T/yr)	Annual Emissions Change (T/yr)
NO _x	0.47	.3	0.17
SO ₂	0.08	0	0.08
CO	6.88	.26	6.62
PM ₁₀	0.39	0.02	0.37
VOC	0.06	0.02	0.04
TAPS/HAPS	<0.3	<0.02	<0.3
Total:	8.2	0	7.3
Fee Due	\$ 2,500		

7. PERMIT REVIEW

7.1 *Regional Review of Draft Permit*

The DEQ Coeur d' Alene Regional office provided comments on the working draft permit. Those comments were incorporated into the permit.

7.2 *Facility Review of Draft Permit*

On February 12, 2007 DEQ issued Kellogg School a facility draft permit for their review. On March 5, 2007 Kellogg School District notified DEQ in writing that did not have any comments to the draft permit.

7.3 *Public Comment*

An opportunity for public comment period on the PTC application was provided from December 22, 2006, to January 24, 2007, in accordance with IDAPA 58.01.01.209.01.c. During this time, there were no comments on the application and no requests for a public comment period on DEQ's proposed action.

8. RECOMMENDATION

Based on review of application materials, and all applicable state and federal rules and regulations, staff recommends that Kellogg Middle School be issued PTC No. 060131 for the wood fired boiler. No public comment period is recommended, no entity has requested a comment period, and the project does not involve PSD requirements.

DP/bf Permit No. P-060131

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Appendix A

AIRS Information

P-060131

AIRS/AFS^a FACILITY-WIDE CLASSIFICATION^b DATA ENTRY FORM

Facility Name: Kellogg Middle School
Facility Location: Kellogg
AIRS Number: 079-00040

AIR PROGRAM POLLUTANT	SIP	PSD	NSPS (Part 60)	NESHAP (Part 61)	MACT (Part 63)	SM80	TITLE V	AREA CLASSIFICATION A-Attainment U-Unclassified N- Nonattainment
SO ₂	B							
NO _x	B							
CO	B							
PM ₁₀	B							
PT (Particulate)	B							
VOC	B							
THAP (Total HAPs)	B							
APPLICABLE SUBPART								

^a Aerometric Information Retrieval System (AIRS) Facility Subsystem (AFS)

^b AIRS/AFS Classification Codes:

- A = Actual or potential emissions of a pollutant are above the applicable major source threshold. For HAPs only, class "A" is applied to each pollutant which is at or above the 10 T/yr threshold, **or** each pollutant that is below the 10 T/yr threshold, but contributes to a plant total in excess of 25 T/yr of all HAPs.
- SM = Potential emissions fall below applicable major source thresholds if and only if the source complies with federally enforceable regulations or limitations.
- B = Actual and potential emissions below all applicable major source thresholds.
- C = Class is unknown.
- ND = Major source thresholds are not defined (e.g., radionuclides).

Appendix B
Emissions Inventory
P-060131

Kellogg Middle School

Project # P-060131

Messersmith Wood Fired Boiler

Boiler Rated input capacity = 2 MMBtu/hr
 Wood Combustion rate = 600 T/yr (wet wood)
 Wood Moisture content = 40 %
 Wood Heat Content= 9000 Btu/lb Higher Heating Value (dry wood)

	lb/MMBtu	Reference	Maximum Estimated Emissions (lb/hr)	EL (lbhr)	Maximum Exceeds EL? (yes/no)	Annual Average Emissions (lb/hr)	Average Exceeds EL ? (yes/no)
Acenaphthene	7.530E-07	2	1.506E-06			5.570E-07	
Acenaphthylene	3.330E-05	2	6.660E-05			2.463E-05	
Acetaldehyde (HAP)	8.300E-04	1	1.660E-03	3.00E-03	no	6.140E-04	no
Acetone	1.900E-04	1	3.800E-04			1.405E-04	
Acetophenone (HAP)	3.200E-09	1	6.400E-09			2.367E-09	
Acrolein (HAP)	4.000E-03	1	8.000E-03	0.017	no	2.959E-03	NA
Anthracene	2.440E-06	2	4.880E-06			1.805E-06	
Antimony(HAP)	7.900E-06	1	1.580E-05	0.033	no	5.844E-06	NA
Arsenic (HAP)	2.66E-06	2	5.320E-06	1.50E-06	yes	1.968E-06	yes
Barium	1.070E-04	2	2.140E-04	0.033	no	7.915E-05	-
Benzaldehyde <	8.500E-07	1	1.700E-06			6.288E-07	
Benzene (HAP)	4.49E-05	2	8.988E-05	8.00E-04	no	3.324E-05	no
PAH Mixture (sum of the following)	7.230E-06		1.446E-05	2.00E-06	yes	5.348E-06	yes
Benzo(a)pyrene	9.910E-07	2	1.982E-06	2.00E-06	no	7.331E-07	no
Benzo(b)fluoranthene	1.000E-07	1					
Benzo(k)fluoranthene	3.600E-08	1					
Chrysene	3.150E-06	2					
Indeno(1,2,3,c,d)pyrene	1.280E-06	2	2.560E-06			9.468E-07	
Benzo(a)anthracene	1.540E-06	2	3.080E-06			1.139E-06	
Dibenzo(a,h)anthracene	1.330E-07	2	2.660E-07			9.838E-08	
Benzo(e)pyrene	2.380E-06	2	4.760E-06			1.761E-06	
Benzo(g,h,i)perylene	1.930E-06	2	3.860E-06			1.428E-06	
Benzo(j,k)fluoranthene	1.600E-07	1	3.200E-07			1.184E-07	
Benzoic acid	4.700E-08	1	9.400E-08			3.477E-08	
bis(2-Ethylhexyl)phthalate (HAP)	4.700E-08	1	9.400E-08	2.80E-02	no	3.477E-08	no

	lb/MMBtu	Reference	Maximum Estimated Emissions (lb/hr)	EL (lbhr)	Maximum Exceeds EL? (yes/no)	Annual Average Emissions (lb/hr)	Average Exceeds EL ? (yes/no)
Bromomethane	1.500E-05	1	3.000E-05			1.110E-05	
Butanone, 2 - (MEK)	5.400E-06	1	1.080E-05	39.3	no	3.995E-06	-
Cadmium(HAP)	1.78E-05	2	3.560E-05	3.70E-06	yes	1.317E-05	yes
Carbazole	1.800E-06	1	3.600E-06			1.332E-06	
Carbon tetrachloride (HAP)	4.500E-05	1	9.000E-05	4.40E-04	no	3.329E-05	no
Chlorine (HAP)	7.900E-04	1	1.580E-03	0.2	no	5.844E-04	-
Chlorobenzene (HAP)	3.300E-05	1	6.600E-05	23.3	no	2.441E-05	-
Chloroform (HAP)	2.800E-05	1	5.600E-05	2.80E-04	no	2.071E-05	no
Chloromethane	2.300E-05	1	4.600E-05			1.701E-05	
Chloronaphthalene, 2-	5.180E-09	2	1.036E-08			3.832E-09	
Chlorophenol,2-	2.400E-08	1	4.800E-08	0.033	no	1.775E-08	NA
Chromium - All/Total (HAP)	2.640E-05	2	5.280E-05			1.953E-05	
Chromium (VI) (T)	1.311E-06	2	2.622E-06	5.60E-07	yes	9.698E-07	yes
Cobalt (HAP)	6.500E-06	1	1.300E-05	0.0033	no	4.808E-06	NA
Copper	6.390E-05	2	1.278E-04	0.013	no	4.727E-05	NA
Crotonaldehyde	9.900E-06	1	1.980E-05	0.38	no	7.323E-06	NA
Decachlorobiphenyl	2.700E-10	1	5.400E-10			1.997E-10	
Dibromoethene, 1,2 -	5.500E-05	1	1.100E-04			4.068E-05	
Dichlorobiphenyl	7.400E-10	1	1.480E-09			5.474E-10	
Dichloroethane , 1,2-	2.900E-05	1	5.800E-05	2.50E-04	no	2.145E-05	NA
Dichloromethane	2.900E-04	1	5.800E-04	1.60E-03	no	2.145E-04	no
Dichloropropane 1,2-	3.300E-05	1	6.600E-05	23.133	no	2.441E-05	NA
Dinitrophenol, 2,4- (HAP)	1.800E-07	1	3.600E-07			1.332E-07	
Ethyl benzene (HAP)	3.100E-05	1	6.200E-05	29	no	2.293E-05	NA
Fluoranthene	1.080E-05	2	2.160E-05			7.989E-06	
Fluorene	6.220E-07	2	1.244E-06			4.601E-07	
Formaldehyde (HAP)	1.047E-02	2	2.094E-02	5.10E-04	yes	7.745E-03	yes
Heptachlorobiphenyl	6.600E-11	1	1.320E-10			4.882E-11	

	lb/MMBtu	Reference	Maximum Estimated Emissions (lb/hr)	EL (lb/hr)	Maximum Exceeds EL? (yes/no)	Annual Average Emissions (lb/hr)	Average Exceeds EL? (yes/no)
Hexachlorobiphenyl	5.500E-10	1	1.100E-09			4.068E-10	
Hexanal	7.000E-06	1	1.400E-05			5.178E-06	
Hydrogen chloride (TH)	1.900E-02	1	3.800E-02	0.05	no	1.405E-02	NA
Indeno(1,2,3,c,d)pyrene	1.280E-06	2	2.560E-06			9.468E-07	
Iron	9.900E-04	1	1.980E-03	0.053	no	7.323E-04	NA
Isobutyraldehyde	1.200E-05	1	2.400E-05			8.877E-06	
Lead (H)	5.160E-05	2	1.032E-04			3.817E-05	
Methane	2.100E-02	1	4.200E-02			1.553E-02	
Methylnaphthalene,2-	1.320E-05	2	2.640E-05			9.764E-06	
Monochlorobiphenyl	2.200E-10	1	4.400E-10			1.627E-10	
Manganese (HAP)	5.570E-04	2	1.114E-03	0.067	no	4.120E-04	NA
Mercury (HAP)	3.500E-06	1	7.000E-06	0.001	no	2.589E-06	NA
Molybdenum	2.100E-06	1	4.200E-06	0.333	no	1.553E-06	NA
Naphthalene (HAP)	1.260E-04	2	2.520E-04	3.33	no	9.321E-05	NA
Nickel (HAP)	2.110E-05	2	4.220E-05	2.70E-05	yes	1.561E-05	no
Nitrophenol, 4- (HAP)	1.100E-07	1	2.200E-07			8.137E-08	
Nitrophenol, 2- (H)	2.400E-07	1	4.800E-07			1.775E-07	
Polyaromatic Hydrocarbons (PAH), total (HAP)	2.393E-04	2	4.785E-04	9.10E-05	yes	1.770E-04	yes
Naphthalene (HAP)	1.260E-04	2	2.520E-04	3.33	no	9.321E-05	NA
Methylnaphthalene,2-	1.320E-05	2	2.640E-05			9.764E-06	
Acenaphthene	7.530E-07	2	1.506E-06			5.570E-07	
Chloronaphthalene, 2-	5.180E-09	2	1.036E-08			3.832E-09	
Acenaphthylene	3.330E-05	2	6.660E-05			2.463E-05	
Fluorene	6.220E-07	2	1.244E-06			4.601E-07	
Phenanthrene	2.670E-05	2	5.340E-05			1.975E-05	
Anthracene	2.440E-06	2	4.880E-06			1.805E-06	
Fluoranthene	1.080E-05	2	2.160E-05			7.989E-06	
Pyrene	9.380E-06	2	1.876E-05			6.939E-06	
Benzo(a)anthracene	1.540E-06	2	3.080E-06			1.139E-06	
Chrysene	3.150E-06	2	6.300E-06			2.330E-06	
Perylene	2.080E-07	2	4.160E-07			1.539E-07	
Benzo(b)fluoranthene	3.660E-06	2	7.320E-06			2.707E-06	

	lb/MMBtu	Reference	Maximum Estimated Emissions (lb/hr)	EL (lb/hr)	Maximum Exceeds EL? (yes/no)	Annual Average Emissions (lb/hr)	Average Exceeds EL? (yes/no)
Benzo(k)fluoranthene	7.790E-07	2	1.558E-06			5.762E-07	
Benzo(a)pyrene (T)	9.910E-07	2	1.982E-06	2.00E-06	no	7.331E-07	no
Benzo(e)pyrene	2.380E-06	2	4.760E-06			1.761E-06	
Benzo(g,h,i)perylene	1.930E-06	2	3.860E-06			1.428E-06	
Indeno(1,2,3,c,d)pyrene	1.280E-06	2	2.560E-06			9.468E-07	
Dibenzo(a,h)anthracene	1.330E-07	2	2.660E-07			9.838E-08	
Pentachlorobiphenyl	1.200E-09	1	2.400E-09			8.877E-10	
Pentachlorophenol (HAP)	5.100E-08	1	1.020E-07	0.033	no	3.773E-08	NA
Perylene	2.080E-07	2	4.160E-07			1.539E-07	
Phenanthrene	2.670E-05	2	5.340E-05			1.975E-05	
Phenol (HAP)	5.100E-05	1	1.020E-04	1.27	no	3.773E-05	NA
Phosphorus (HAP)	2.700E-05	1	5.400E-05	0.007	no	1.997E-05	NA
Potassium	3.900E-02	1	7.800E-02			2.885E-02	
Propanal	3.200E-06	1	6.400E-06			2.367E-06	
Propionaldehyde (HAP)	6.100E-05	1	1.220E-04	0.0287	no	4.512E-05	NA
Pyrene	9.380E-06	2	1.876E-05			6.939E-06	
Selenium(HAP)	3.12E-06	2	6.240E-06	0.013	no	2.308E-06	NA
Silver	2.68E-06	2	5.360E-06	0.001	no	1.982E-06	NA
Strontium	1.000E-05	1	2.000E-05			7.397E-06	
Styrene (HAP)	1.900E-03	1	3.800E-03	6.67	no	1.405E-03	NA
Total Dioxin/Furan	1.130E-11	2	2.260E-11	1.50E-10	no	8.359E-12	no
Tetrachlorobiphenyl	2.500E-09	1	5.000E-09			1.849E-09	
Tetrachloroethene	3.800E-05	1	7.600E-05			2.811E-05	
Tin	2.300E-05	1	4.600E-05	0.007	no	1.701E-05	NA
Titanium	2.000E-05	1	4.000E-05			1.479E-05	
Tolualdehyde o,-	7.200E-06	1	1.440E-05			5.326E-06	
Tolualdehyde p,-	1.100E-05	1	2.200E-05			8.137E-06	
Toluene (HAP)	9.200E-04	1	1.840E-03	25	no	6.805E-04	NA
Trichlorobiphenyl	2.600E-09	1	5.200E-09			1.923E-09	
Trichloroethane 1,1,1-	3.100E-05	1	6.200E-05			2.293E-05	
Trichloroethylene (HAP)	3.000E-05	1	6.000E-05	1.79E+01	no	2.219E-05	no
Trichlorofluoromethane (CFC 111) (T)	4.100E-05	1	8.200E-05			3.033E-05	

	lb/MMBtu	Reference	Maximum Estimated Emissions (lb/hr)	EL (lbhr)	Maximum Exceeds EL? (yes/no)	Annual Average Emissions (lb/hr)	Average Exceeds EL ? (yes/no)
Trichlorophenol, 2,4,6- (HAP) <	2.200E-08	1	4.400E-08	1.20E-03	no	1.627E-08	no
Vanadium as V2O5, respirable dust & fume	9.800E-07	1	1.960E-06	0.003	no	7.249E-07	-
Vinyl chloride (HAP)	1.800E-05	1	3.600E-05	9.40E-04	no	1.332E-05	no
Xylene, o- (HAP)	2.500E-05		5.000E-05			1.849E-05	
Xylene, (o, m,p- isomers) (H)				29	no		NA
Yttrium	3.000E-07	1	6.000E-07	0.067	no	2.219E-07	NA
Zinc	6.130E-04	2	1.226E-03	0.667	no	4.535E-04	NA
CO	2.123	2	4.25		-	1.570E+00	-
NOx	0.146	2	0.29		-	1.080E-01	-
PM/PM10	0.12	2	0.24		-	8.877E-02	-
VOC	0.017	1	0.03		-	1.258E-02	-
SO2	0.025	1	0.05			1.849E-02	

1) EPA AP-42, Table 1.63, 9/03

2) Emissions test results on a 2.2 MMBtu/hr Messersmith Boiler, Wood - Chip Fired Furnances Testing Project, Environmental Risk Limited, April 1996

Combustion Evaluation

Wood Fired Boiler - Kellogg Middle School

Wood = 9000 BTU/lb dry

Boiler 2.00E+06 Btu/hr

Fuel Data (% by weight)⁽¹⁾

S	0
N ₂	0
C	31.38
H ₂	3.78
H ₂ O	40
O ₂	24.3

Fuel burned (lb/hr)	370
Excess air (%) ⁽⁴⁾	5
Stk temp (F)	350
Stack press (atm)	0.92
Elevation (ft)	2310

Combustion Air Required

	O ₂ lb.mole	N ₂ lb.mole
S	0.00	0.00
N ₂	0.00	0
C	9.67	36.36
H ₂	3.47	13.06
O ₂	-2.81	
	<hr/>	<hr/>
	10.33	49.42

Flue Products

	lb.mole	lb/hr
SO ₂	0.00	0.00
N ₂	51.89	1452.96
CO ₂	9.67	425.33
H ₂ O(comb)	6.99	125.87
O ₂	0.52	16.52
H ₂ O(fuel)	8.22	148.00
	<hr/>	<hr/>
dry	62.07	
wet	77.29	

stioc. comb air = 74.30241923 lb.mole/hr
 stoic. dry comb air = 59.087197 lb.mole/hr

Flow⁽²⁾ IDAPA Flow⁽³⁾

Volume of flue gas (acfm)	828.2	
Volume of flue gas (dscfm)	398.9	
Volume of flue gas (dscfm@7%O ₂)	569.5	617.2
Volume of flue gas (dscfm@15%O ₂)	1328.9	1440.1
Volume of flue gas (dscfm@8%O ₂)	613.3	664.6
Volume of flue gas (dscfm@3%O ₂)	443.0	480.0
Volume of flue gas (dscfm@10%O ₂)	724.8	785.5

1) Data from EPA, Combustion Evaluation in Air Pollution Control, Student Manual, March 1994, Table 15-2 (Douglas Fir assumed to be typical for wood combusted)

2) Standard conditions based on a pressure of 1.0 atmospheres (760 mm Hg) and 68 F °

3) Standard conditions corrected for altitude per IDAPA 58.01.01.680

4 Data from EPA, Combustion Evaluation in Air Pollution Control, Student Manual, March 1994, page 227

Appendix C
Modeling Review
P-060131

MEMORANDUM

DATE: March 6, 2007

TO: Dan Pitman, Air Quality Senior Engineer, Air Program

FROM: Kevin Schilling, Stationary Source Modeling Coordinator, Air Program

PROJECT NUMBER: P-060131

SUBJECT: Modeling Review for the Kellogg School District Permit to Construct Application for a Wood Fired Boiler at the Middle School in Kellogg, Idaho

1.0 Summary

Siemens Building Technologies, Inc. (Siemens), submitted a Permit to Construct (PTC) application on behalf of Kellogg School District No. 391 (Kellogg School) for a wood fired Hurst boiler and Messersmith Combustor at the middle school in Kellogg, Idaho. Air quality analyses involving atmospheric dispersion modeling of emissions associated operations of the boiler were submitted to demonstrate that the modification would not cause or significantly contribute to a violation of any ambient air quality standard (IDAPA 58.01.01.203.02). Spidell and Associates (Spidell), Kellogg School’s consultant, conducted the ambient air quality analyses.

A technical review of the submitted air quality analyses and independent impact analyses were conducted by DEQ. The submitted modeling analyses, combined with DEQ’s analyses: 1) utilized appropriate methods and models; 2) was conducted using reasonably accurate or conservative model parameters and input data; 3) adhered to established DEQ guidelines for new source review dispersion modeling; 4) showed either a) that predicted pollutant concentrations from emissions associated with the proposed boiler were below significant contribution levels (SCLs); or b) that predicted pollutant concentrations from emissions associated with all sources at the school, when appropriately combined with background concentrations, were below applicable air quality standards at all receptor locations. Table 1 presents key assumptions and results that should be considered in the development of the permit.

Criteria/Assumption/Result	Explanation/Consideration
The existing natural gas fired boilers at the school will only be operated in emergency situations.	The existing boilers were not included in the modeling analyses submitted with the application.
Operations must be limited to 600 tons of wood waste per year.	This limit is needed to control formaldehyde emissions such that impact are within acceptable levels.

2.0 Background Information

2.1 Applicable Air Quality Impact Limits and Modeling Requirements

This section identifies applicable ambient air quality limits and analyses used to demonstrate compliance.

2.1.1 Area Classification

The Kellogg School is located in Kellogg, Idaho. This area is designated as an attainment or unclassifiable for all criteria pollutants. Kellogg is several miles from Pinehurst, Idaho, which is a PM₁₀ non-attainment area.

2.1.2 Significant and Full Impact Analyses

If estimated maximum pollutant impacts to ambient air from the emissions sources associated with the proposed boiler exceed the significant contribution levels (SCLs) of IDAPA 58.01.01.006.90, then a full impact analysis is necessary to demonstrate compliance with IDAPA 58.01.01.203.02. A full impact analysis for attainment area pollutants involves adding ambient impacts from facility-wide emissions to DEQ-approved background concentration values that are appropriate for the criteria pollutant/averaging-time at the facility location and the area of significant impact. The resulting maximum pollutant concentrations in ambient air are then compared to the National Ambient Air Quality Standards (NAAQS) listed in Table 2. Table 2 also lists SCLs and specifies the modeled value that must be used for comparison to the NAAQS.

Pollutant	Averaging Period	Significant Contribution Levels ^a (µg/m ³) ^b	Regulatory Limit ^c (µg/m ³)	Modeled Value Used ^d
PM ₁₀ ^e	Annual	1.0	50 ^f	Maximum 1 st highest ^g
	24-hour	5.0	150 ^h	Maximum 6 th highest ⁱ
Carbon monoxide (CO)	8-hour	500	10,000 ^j	Maximum 2 nd highest ^g
	1-hour	2,000	40,000 ^j	Maximum 2 nd highest ^g
Sulfur Dioxide (SO ₂)	Annual	1.0	80 ^f	Maximum 1 st highest ^g
	24-hour	5	365 ^j	Maximum 2 nd highest ^g
	3-hour	25	1,300 ^j	Maximum 2 nd highest ^g
Nitrogen Dioxide (NO ₂)	Annual	1.0	100 ^f	Maximum 1 st highest ^g
Lead (Pb)	Quarterly	NA	1.5 ^h	Maximum 1 st highest ^g

^aIDAPA 58.01.01.006.90

^bMicrograms per cubic meter

^cIDAPA 58.01.01.577 for criteria pollutants

^dThe maximum 1st highest modeled value is always used for significant impact analyses

^eParticulate matter with an aerodynamic diameter less than or equal to a nominal ten micrometers

^fNever expected to be exceeded for any calendar year

^gConcentration at any modeled receptor

^hNever expected to be exceeded more than once in any calendar year

ⁱConcentration at any modeled receptor when using five years of meteorological data

^jNot to be exceeded more than once per year

2.1.3 Toxic Air Pollutant Analyses

IDAPA 58.01.01.161 states, “Any contaminant which is by its nature toxic to human or animal life or vegetation shall not be emitted in such quantities or concentrations as to alone, or in combination with other contaminants, injure or unreasonably affect human or animal life or vegetation.” Specific Toxic Air Pollutant (TAP) analysis requirements for PTCs are then specified in IDAPA 58.01.01.210. IDAPA 58.01.01.210 provides that in accordance with subsection 203.03, the applicant must demonstrate compliance with section 161 to the satisfaction of the Department. Methods in section 210 require an ambient impact analysis if the emissions increase associated with a new source or modification exceeds screening emission levels (ELs) of IDAPA 58.01.01.585 or 586. If ambient impacts are less than applicable Acceptable Ambient Concentrations (AACs) for non-carcinogens of IDAPA 58.01.01.585 and Acceptable Ambient Concentrations for Carcinogens (AACCs) of IDAPA 58.01.01.586, then compliance with TAP requirements has been demonstrated.

TAPs compliance methods provided in section 210 were used for all TAPs emitted from the boiler except formaldehyde. A more refined risk-based analysis was used by DEQ to demonstrate requirements of section 161 are satisfied with regard to formaldehyde emissions. These refined methods are evaluated on a case-by-case basis considering the contaminant emitted, potentially exposed individuals, and the type of source.

2.2 Background Concentrations

Background concentrations were revised for all areas of Idaho by DEQ in March 2003¹. Background concentrations in areas where no monitoring data are available were based on monitoring data from areas with similar population density, meteorology, and emissions sources. Default small town/suburban background concentrations were used for all criteria pollutants except PM₁₀. PM₁₀ background concentrations were based on monitoring data collected from Pinehurst. Table 3 lists applicable background concentrations.

Pollutant	Averaging Period	Background Concentration (µg/m ³) ^a
PM ₁₀ ^b	24-hour	94
	Annual	23
Carbon monoxide (CO)	1-hour	10,200
	8-hour	3,400
Sulfur dioxide (SO ₂)	3-hour	42
	24-hour	26
	Annual	8
Nitrogen dioxide (NO ₂)	Annual	32
Lead (Pb)	Quarterly	0.08

^a Micrograms per cubic meter

^b Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers

3.0 Modeling Impact Assessment

3.1 Modeling Methodology

Table 4 lists the modeling parameters used in the submitted analyses and DEQ's verification analyses, except for DEQ's formaldehyde analysis to demonstrate compliance with IDAPA 58.01.01.161. Section 3.1.9 describes methods and data used for the formaldehyde analysis.

Parameter	Description/Values	Documentation/Addition Description ^a
Model	ISCST3-PRIME	ISCST3 with the PRIME downwash algorithm, version 04269
Meteorological data	1987-1991	Spokane, Washington surface and upper air data
Terrain	Considered	Receptor, building, and emissions source elevations were determined using Digital Elevation Model (DEM) files
Building downwash	Considered	The building profile input program (BPIP) was used
Receptor Grid	Grid 1	10-meter out to 100 meters (25-meter spacing out 200 meters from the stack)
	Grid 2	25-meter out to 200 meters (50-meter spacing out to 500 meters)
	Grid 3	50-meter out to 500 meters (100-meter spacing out to 1,500 meters)

^a Parameters listed in parentheses are those used in the submitted analyses, where those values differed from what was used in DEQs verification analyses

1 Hardy, Rick and Schilling, Kevin. *Background Concentrations for Use in New Source Review Dispersion Modeling*. Memorandum to Mary Anderson, March 14, 2003.

3.1.1 Modeling protocol and Methodology

The submitted air impact analyses were conducted by Spidell. A modeling protocol was submitted to DEQ prior to the application. Modeling was generally conducted using methods and data presented in the protocol and the *State of Idaho Air Quality Modeling Guideline*.

DEQ revised estimated formaldehyde emissions rates during review of the application. Compliance with the formaldehyde AACC could not be demonstrated by using the methods presented in IDAPA 58.01.01.210 when revised emissions were used in the dispersion modeling analyses. DEQ then conducted refined independent analyses to evaluate compliance with IDAPA 58.01.01.161 for formaldehyde.

3.1.2 Model Selection

ISCST3 with the PRIME downwash algorithm was used for the modeling analyses. The PRIME downwash algorithm was necessary because of the close proximity of buildings to ambient air receptors. ISCST3, without the PRIME downwash algorithm, does not calculate concentrations within building recirculation cavities. Concentrations within recirculation cavities are handled by ISCST3 with the PRIME downwash algorithm.

3.1.3 Meteorological Data

Surface and upper air meteorological data monitored from 1987 through 1991 at Spokane, Washington, were used for the modeling analyses. DEQ determined these were the most representative data reasonably available for use in the model.

3.1.4 Terrain Effects

Terrain effects on dispersion were considered in the analyses. Receptor elevations were obtained by Spidell using Digital Elevation Model (DEM) 7.5-minute files for Kellogg West and Kellogg East.

3.1.5 Facility Layout

The facility layout used in the modeling analyses, including the ambient air boundary, buildings, and emissions units, were checked against the proposed layout provided in the application. The layout used in the model was sufficiently representative of the proposed site layout.

3.1.6 Building Downwash

Downwash effects potentially caused by structures at the facility were accounted for in the dispersion modeling analyses. Building heights were adjusted in DEQ's analyses based on conversations with the applicant. The southeast section of the school was assigned an elevation of 31.44 feet in the submitted analyses. The applicant indicated the northern two thirds of the building has a roof height of only 14 feet; therefore, DEQ modified the building in the BPIP input file to reflect the lower roof height of the northern two thirds of the building.

3.1.7 Ambient Air Boundary

Ambient air was considered as all areas external to buildings at the middle school because students are considered members of the public.

3.1.8 Receptor Network

The receptor grid met the minimum recommendations specified in the *State of Idaho Air Quality Modeling Guideline*. However, DEQ modeling staff were not confident the receptor grid was adequate to resolve the maximum modeled concentrations. DEQ revised the receptor grid to increase receptor spacing in the area next to the buildings, where maximum concentrations were modeled.

3.1.9 DEQ Formaldehyde Analysis

IDAPA 58.01.01.210 was used to demonstrate preconstruction compliance with IDAPA 58.01.01.161 for all TAPs except for formaldehyde. DEQ determined the applicant-estimated formaldehyde emissions rate may not be reasonably representative of the boiler design. DEQ modeling staff reassessed the ambient impacts after DEQ permitting staff revised the formaldehyde emissions estimates to more reasonably represent emissions from the boiler design. Modeled formaldehyde concentrations exceeded the AACC when the revised emissions rate was used. DEQ then used the methods described below to evaluate compliance with IDAPA 58.01.01.161 for potential formaldehyde impacts.

Maximum modeled concentrations were located within the building recirculation cavities, indicating the emissions stack is not sufficiently high to prevent plume downwash. DEQ used a more refined analysis to assess the potential health risk from exposures to formaldehyde emitted from the boiler. Since maximum modeled concentrations were located within building recirculation cavities at the school, the refined assessment focused on the potential exposure to students. DEQ's air toxics staff developed the refined risk calculation method, and Attachment 1 provides a summary of that method. The modeled formaldehyde concentration used to generate final risk estimates presented in Attachment 1 is somewhat different than the final modeling result presented in this memorandum. The final risk calculations provided in Section 3.5 of this memorandum, based on the methods and toxicological data presented in Attachment 1 and revised modeled concentrations, should be used rather than the final values presented in Attachment 1. Attachment 1 provides documentation of the method with regard to assumptions used in the exposure assessment and toxicological data. The revised analysis used the following assumptions and parameters:

- 30 year exposure (70 years were conservatively assumed for methods associated with Section 210)
- 12 hours per day exposure for 350 days each year
- Breathing rate of 581 liters per kilogram-day, based on the average maximum breathing rate for children.
- Cancer potency factor of $4.55 \text{ E-}2 \text{ (mg/kg-day)}^{-1}$

DEQ also modified the modeling analyses for the more refined assessment of formaldehyde. DEQ used AERMOD, the replacement model for ISCST3, for a refined analysis. DEQ also used concentrations at two meters, representative of breathing height, rather than ground-level modeled concentrations. The AERMOD analysis also used 1987 through 1991 meteorological data from Spokane, as processed by AERMET. Using reasonably representative meteorological data is more critical when using AERMOD than when using ISCST3; therefore, as a conservative measure the modeled concentrations were increased by 20 percent.

The potential formaldehyde dose was calculated by the following:

$$Dose = \frac{(Conc)(BR)(EF)(ED)(1E - 6)}{AT}$$

Where:

- Dose* = Dose of contaminant (mg/kg-day) to a maximum exposed individual
- Conc* = Maximum modeled concentration ($\mu\text{g}/\text{m}^3$)
- BR* = Breathing rate (liters/kg-day) of exposed individual
- EF* = Exposure frequency (day/year)
- ED* = Exposure duration (years)
- 1E-6* = Conversion factor for $\mu\text{g}/\text{m}^3$ to mg/liter

A 70 year cancer risk was then calculated by multiplying the formaldehyde dose by the $4.55 \text{ E-}2$ (mg/kg-day)⁻¹ cancer potency factor. There is general agreement that a cancer risk of less than $1.0 \text{ E-}6$ is acceptable.

3.2 Emission Rates

Emissions rates used in the permit application and the modeling analyses were based on source test data for similar wood waste combustion units.

3.2.1 Criteria Pollutant Emissions Rates

Table 5 provides criteria pollutant emissions rates used in the modeling analyses for both long-term and short-term averaging periods. Discussions with the DEQ permit writer indicated the maximum PM_{10} emissions rate is 0.24 pounds per hour, not the submitted value of 1.00 pounds per hour. The PM_{10} modeling analysis was not corrected since compliance with PM_{10} standards could be demonstrated with a 1.00 pound per hour emissions rate. Compliance with annual criteria pollutant standards was conservatively demonstrated by using maximum hourly emissions rather than emissions based on annual allowable operations.

Emissions Point	Description	Emissions Rates ^a (lb/hr)			
		PM_{10} ^b	SO_2 ^c	CO ^d	NOx ^e
BLRSTK	Boiler Stack	1.00	0.05	4.25	0.29

^a Long term rates assume 8760 hours/year of operation

^b Particulate matter with an aerodynamic diameter less than or equal to a nominal ten micrometers

^c Sulfur dioxide

^d Carbon monoxide

^e Oxides of nitrogen

3.2.2 TAP Emissions Rates

Table 6 lists applicable TAP emissions associated with the proposed facility that were in excess of the screening emissions level (EL). The Dryer Cyclone Stack was the only point of TAP emissions. Emissions of all other TAPs were below applicable ELs and modeling was not required. DEQ-generated TAP emissions rates used in the modeling analyses were based on combustion of 600 tons per year of wood waste, evenly distributed over 8,760 hours per year.

Pollutant	Averaging Period	Source-Specific Emissions Rates ^a (lb/hr) ^b	
		BLRSTK	EL
Arsenic	Annual	1.97 E-6 (2.86 E-6)	1.5 E-6
Cadmium	Annual	1.32 E-5 (1.92 E-5)	3.7 E-6
Chromium 6+	Annual	9.69 E-7 (1.41E-6)	5.6 E-7
Formaldehyde	Annual	7.73 E-3 (6.38 E-3)	5.1 E-4
POM ^c	Annual	5.37 E-6 (1.24 E-5)	2.0 E-6
Total PAH	Annual	1.77 E-4 (2.58 E-4)	9.1 E-5

^{a.} Values for TAPs with an annual averaging period are annual values divided by 8760 hour/year. Values in parentheses are those submitted with the application where those values differ from DEQ's verification analyses.

^{b.} Pounds per hour

^{c.} Polycyclic Organic Matter as defined by IDAPA 58.01.01.586.

^{d.} Summation of all PAH HAPs

3.3 Emission Release Parameters

Table 7 provides emissions release parameters for the analyses, including stack height, stack diameter, exhaust temperature, and exhaust velocity.

Release Point /Location	Source Type	Stack Height (m) ^a	Modeled Diameter (m)	Stack Gas Temp (K) ^b	Stack Gas Flow Velocity (m/sec) ^c
BLRSTK	Point	15.2	0.38	450	4.0

^{a.} Meters

^{b.} Kelvin

^{c.} Meters per second

3.4 Results for Significant and Full Impact Analyses

Results significant impact analyses are shown in Table 8. Full impact analyses were required for PM₁₀ and NO₂. Results in parentheses are those submitted with the application. Higher modeled concentrations were obtained by DEQ's verification analyses because DEQ used a tighter receptor grid in the area where maximum concentrations were predicted.

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m ³) ^a	Significant Impact Level (µg/m ³)	Full Impact Analysis Required
PM ₁₀ ^b	24-hour	51.2 (41.0)	5.0	Yes
	Annual	16.8 (10.9)	1.0	Yes
Sulfur Dioxide (SO ₂)	3-hour	5.1 (4.4)	25	No
	24-hour	2.6 (2.1)	5	No
	Annual	0.84 (0.54)	1.0	No
Carbon Monoxide (CO)	1-hour	552 (483)	2,000	No
	8-hour	321 (277)	500	No
Nitrogen Dioxide (NO ₂)	Annual	4.9 (3.2)	1.0	Yes

^{a.} Micrograms per cubic meter. Values in parentheses are those submitted by the applicant.

^{b.} Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers

Table 9 provides a summary of the full impact analyses. All impacts are well below applicable standards.

Pollutant	Averaging Period	Modeled Design Concentration ($\mu\text{g}/\text{m}^3$)^a	Background Concentration ($\mu\text{g}/\text{m}^3$)	Total Impact ($\mu\text{g}/\text{m}^3$)	NAAQS^b ($\mu\text{g}/\text{m}^3$)	Percent of NAAQS
PM ₁₀ ^c	24-hour	42.7 (32.6)	94	136.7 (126.6)	150	91 (84)
	Annual	16.8 (10.9)	23	39.8 (33.9)	50	80 (68)
Nitrogen Dioxide (NO ₂)	Annual	4.9 (3.2)	32	36.9 (35.2)	100	37 (35)

^a Micrograms per cubic meter. Values in parentheses are those submitted by the applicant.

^b National Ambient Air Quality Standards

^c Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers

^d Maximum 6th highest modeled concentration using a five-year data set

^e Maximum annual impact from modeling five separate years

3.5 Results for TAPs Analyses

IDAPA 58.01.01.210 was used to demonstrate compliance for all TAPs emitted from the boiler except formaldehyde. Table 10 summarizes the modeling results for these TAPs.

A maximum formaldehyde annual average concentration of 0.127 $\mu\text{g}/\text{m}^3$ was modeled by AERMOD (including the 20 percent increase) for impacts associated with burning 600 tons of wood waste per year. Results using ISCST3 indicated a concentration of 0.127 $\mu\text{g}/\text{m}^3$, essentially identical to the AERMOD result plus 20 percent.

For a concentration of 0.127 $\mu\text{g}/\text{m}^3$, a dose of 1.52 E-5 mg/kg-day was calculated. A potential cancer risk of 6.91 E-7 for a 70 year lifetime was calculated by multiplying the dose by the 4.55 E-2 (mg/kg-day)⁻¹ cancer potency factor. DEQ air toxics staff determined a risk of 1.00 E-6 or less from formaldehyde was acceptable for this project.

TAP	Averaging Period	Maximum Modeled Concentration ($\mu\text{g}/\text{m}^3$)^a	AAC or AACC ($\mu\text{g}/\text{m}^3$)	Percent of AAC or AACC
Arsenic	Annual	3.23 E-5	2.3E-4	14
Cadmium	Annual	2.17 E-4	5.6E-4	38
Chromium 6+	Annual	1.59 E-5	8.3E-5	19
POM ^d	Annual	8.81 E-5	3.0E-4	29
Total PAH	Annual	2.90 E-3	1.4E-2	21

^a Micrograms per cubic meter

^b Acceptable Ambient Concentration or Acceptable Ambient Concentration for a Carcinogen

4.0 Conclusions

The ambient air impact analyses demonstrated to DEQ's satisfaction that emissions from the facility will not cause or significantly contribute to a violation of any air quality standard.

ATTACHMENT 1

REFINED FORMALDEHYDE RISK ASSESSMENT FOR KELLOGG MIDDLE SCHOOL

MEMORANDUM

TO: Dan Pitman, Kevin Schilling

FROM: Carl Brown, Air Toxics Analyst

DATE: February 6, 2007

SUBJECT: Risk Assessment for Formaldehyde at Kellogg Middle School

Background:

As part of the Fuels for Schools program, the middle school in Kellogg Idaho has obtained funding to put in a wood-fired boiler for use in heating. The toxic air pollutant emission levels of this boiler have been estimated, and the estimated air concentrations for formaldehyde at the Kellogg Middle school exceed the AACC screening level used by the DEQ for permitting. Other estimated air pollutant concentrations from the boiler are below DEQ screening levels. The AACC for formaldehyde listed in IDAPA.58.01.586 is based on the EPA recommended unit risk value for formaldehyde (from EPA's IRIS, Integrated Risk Information System, database). Concentrations below the AACC should yield less than 1 in 1,000,000 chance of developing cancer.

Inherent in the unit risk number is the assumption of lifetime exposure which is probably unrealistic for middle school students. This document calculates risk levels assuming less than lifetime exposures using estimated maximum formaldehyde concentrations from the wood boiler operation.

Method:

The methods and equations used in this analysis were adapted from CAL/EPA's Air Toxics Hot Spots Program Risk Assessment Guidelines (1999).

In the CAL/EPA guidelines, in order to calculate inhalation risk for less than lifetime exposure, the unit risk value is converted to a cancer potency factor (CPF) or slope factor. The following equation was used:

$$CPF = \frac{UR * 70kg * (1000 \mu g / mg)}{20m^3}$$

CPF is in units of $(mg / kg - day)^{-1}$

UR (unit risk factor) is in units of $(\mu g / m^3)^{-1}$

70 kg is the reference human body weight

20 m^3 is the reference human inspiration rate/day

1000 $\mu g / mg$ is the conversion factor from mg to μg

Based on the Unit Risk factor from IDAPA.58.01.586 of $1.3 * 10^{-5}$ for formaldehyde, a CPF of $4.55 * 10^{-2} (mg / kg - day)^{-1}$ was determined.

A cancer risk can then be determined by multiplying the estimated dose by the CPF.

An equation for calculating dose that can be used for a less than lifetime exposure is shown below:

$$DOSE = \frac{C(\text{air}) * BR * EF * ED * (1 * 10^{-6})}{AT}$$

- Dose = inhalation dose [(mg/kg body weight)/day]
- C(air) = average annual air concentration ($\mu\text{g} / \text{m}^3$)
- BR = Average daily breathing rate
- EF = Exposure frequency (days/years), can also accommodate less than daily exposure (e.g. 12hrs)
- ED = Exposure duration, in years
- $1 * 10^{-6}$ = conversion factor ($\mu\text{g} / \text{m}^3$) to (mg/L)
- AT = averaging time (for carcinogenic effects is 70 years = 25500 days)

In this estimate three major assumptions were made. First the exposure duration was limited to 30 years instead of 70. The 30 year exposure duration is a default value assumed in some EPA calculations to represent an average length of stay in one location (before moving). This value is higher than expected for the students, who will only spend at most a couple of years at a middle school, but is more applicable for the teachers at the school. Second, the exposure frequency is kept at a default value of 350 days, but with only a 12 hour exposure (vs. 24 hours). This assumption should be adequate to cover school attendance and after school activities. Last, the average breathing rate was assumed to be the average maximum breathing rate for children (581 L/kg-day). The rate is assumed to be constant over the entire 30 years. This assumption is unrealistic but serves as an additional safeguard to err on the side of caution when considering health effects of toxic air pollutants on children (see conclusion). The average maximum daily breathing rate for adults is 393 L/kg-day (less than that for children), so conditions determined to have minimal risk levels for children will be suitable for adults as well.

Based on DEQ modeled concentrations for the maximum and desired throughput for the boiler shown below:

- 873 T/yr of wood = 0.158 micrograms per cubic meter
- 600 T/yr of wood = 0.109 micrograms per cubic meter

the dose can be calculated using the following equation:

$$DOSE = \frac{C(\text{air}) * 581 * 350 * 12 / 24 * 30 * (1 * 10^{-6})}{25500}$$

For the $0.158 \mu\text{g}/\text{m}^3$ concentration, this yields a dose of $1.89 * 10^{-5}$ mg/kg-day, and for the $0.109 \mu\text{g}/\text{m}^3$ concentration, this yields a dose of $1.30 * 10^{-5}$ mg/kg-day.

To determine risk, these dose values can be multiplied by the CPF of $4.55 * 10^{-2}$:

$$1.89 * 10^{-5} * 4.55 * 10^{-2} = 9 * 10^{-7}$$

$$1.30 * 10^{-5} * 4.55 * 10^{-2} = 6 * 10^{-7}$$

In both cases the cancer risk is less than 1 in a million for formaldehyde exposure which is the default standard used by the DEQ for carcinogens.

Conclusion:

The above analysis was by design intended to “err” on the side of caution when possible. There are concerns among regulatory agencies concerning childhood exposures to toxic air pollutants and that they may be worse than adult exposures. The assumption of 30 year exposure and the use of a child inhalation over that period are attempts to be more cautious when estimating risk for children. One final measure to insure the most conservative approach is applied would be to limit the use of the boiler to 600 T/yr.

In the future, the use of boilers that have lower emission rates for toxic air pollutants is recommended. This would prevent the need to undergo additional risk characterization.

Appendix D

Messersmith Combustor Emission Test Results

P-060131

**Table 3--2
Summary of Emission Test Results
CONEG/Green Acres Housing
Barrettown, Vermont**

Method/Component	Units	Run 1	Run 2	Run 3	Average
Method 3A – O ₂	%	13.1	11.8	13.1	12.7
Method 3A – CO ₂	%	8.0	9.1	7.3	8.1
Method 7E – NO _x	lb/MMBtu	0.156	0.142	0.139	0.146
Method 10 – CO	lb/MMBtu	1.989	2.114	2.267	2.123
Method 5 – Particulate	lb/MMBtu	1.151E-01	1.444E-01	1.005E-01	1.200E-01
Method 29 – Multiple Metals	lb/MMBtu				
Silver		2.97E-06	< 1.96E-06	3.12E-06	< 2.68E-06
Barium		1.25E-04	1.12E-04	8.40E-05	1.07E-04
Beryllium		< 3.77E-07	2.59E-07	< 1.17E-07	< 2.51E-07
Cadmium		< 3.02E-05	< 1.23E-05	< 1.09E-05	< 1.78E-05
Chromium		3.61E-05	< 2.49E-05	1.81E-05	< 2.64E-05
Copper		9.36E-05	4.83E-05	4.96E-05	6.39E-05
Manganese		5.19E-04	7.25E-04	4.28E-04	5.57E-04
Zinc		5.92E-04	7.49E-04	4.98E-04	6.13E-04
Arsenic		< 2.28E-06	< 3.27E-06	< 2.42E-06	< 2.66E-06
Nickel		3.02E-05	1.49E-05	1.83E-05	2.11E-05
Lead		6.73E-05	4.76E-05	4.00E-05	5.16E-05
Selenium		5.07E-06	< 1.15E-06	< 3.14E-06	< 3.12E-06
Method 425 – Hex Chrome	lb/MMBtu	1.362E-06	1.988E-06	5.815E-07	1.311E-06
Method 429 – PAH	lb/MMBtu				
Naphthalene		1.36E-04	1.15E-04	1.27E-04	1.26E-04
2-Methylnaphthalene		1.23E-05	1.21E-05	1.52E-05	1.32E-05
Acenaphthene		7.85E-07	4.68E-07	1.01E-06	7.53E-07
2-Chloronaphthalene		5.71E-09	3.93E-09	5.91E-09	5.18E-09
Acenaphthylene		2.61E-05	4.20E-05	3.17E-05	3.33E-05
Fluorene		6.24E-07	3.93E-07	8.51E-07	6.22E-07
Phenanthrene		2.10E-05	2.97E-05	2.94E-05	2.67E-05
Anthracene		1.31E-06	3.23E-06	2.78E-06	2.44E-06
Fluoranthene		8.04E-06	1.41E-05	1.03E-05	1.08E-05
Pyrene		7.06E-06	1.22E-05	8.90E-06	9.38E-06
Benzo(A)anthracene		7.43E-07	2.77E-06	1.09E-06	1.54E-06
Chrysene		2.53E-06	3.74E-06	3.18E-06	3.15E-06
Perylene		6.94E-08	3.79E-07	1.77E-07	2.08E-07
Benzo(B)fluoranthene		2.59E-06	4.68E-06	3.70E-06	3.66E-06
Benzo(K)fluoranthene		5.89E-07	8.69E-07	8.79E-07	7.79E-07
Benzo(A)pyrene		4.63E-07	1.78E-06	7.27E-07	9.91E-07
Benzo(E)pyrene		1.53E-06	3.16E-06	2.45E-06	2.38E-06
Benzo(g,h,i)perylene		8.48E-07	2.65E-06	2.29E-06	1.93E-06
Indeno(1,2,3,cd)pyrene		6.38E-07	1.62E-06	1.57E-06	1.28E-06
Dibenz(a,h)anthracene		6.94E-08	1.74E-07	1.55E-07	1.33E-07
Method 430 – Formaldehyde	lb/MMBtu	9.449E-03	1.204E-02	9.915E-03	1.047E-02
Method 18 – Benzene	lb/MMBtu	1.287E-04	< 3.037E-06	< 3.037E-06	< 4.494E-05
Method 23 – Total Dioxin/Furan	lb/MMBtu	< 2.16E-11	< 8.10E-12	< 4.15E-12	< 1.13E-11
Method 2 – Volumetric Flow	dscfm	619	640	621	627
Method 4 – Moisture	%	7.29	8.35	7.77	7.80
Method 19 – F-Factor	dscf/MMBtu	9891	9891	9891	9891