High Efficiency Residential Wood Boiler Modeling Assumptions Based On Monitored Data

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March, 2007

The AERMOD modeling system was used in 2006 to evaluate maximum 1-hour and 24-hour average fine particle ($PM_{2.5}$) ambient air concentrations for several hypothetical residential wood boiler scenarios involving increased setback distances between the wood boiler and a residential structure.

The emission rate and stack parameters used were based on actual monitoring data provided by the Michigan DEQ Air Quality Division Upper Peninsula District and are shown below:

PM 2.5 Emission Rate	=	30 grams/hour
Stack Height	=	5 meters (16.4ft)
Stack Temp	=	250° F
Stack Diameter	=	15 cm
Exit Velocity	=	10 meters/second
House Roof Height	=	7 meters (23 ft)
Dwelling Length & Width	=	9 meters x 18 meters

Three setback distances of 10, 20, and 30 meters were evaluated placing the stack due north of the residential dwelling. Other modeling assumptions pertinent to the analysis are as follows:

Meteorological Data	=	1 Year (2005) from Gaylord Michigan
Grid Receptor Spacing	=	10 meters out to 200 meters
Localize Area Terrain	=	Flat Terrain Assumed

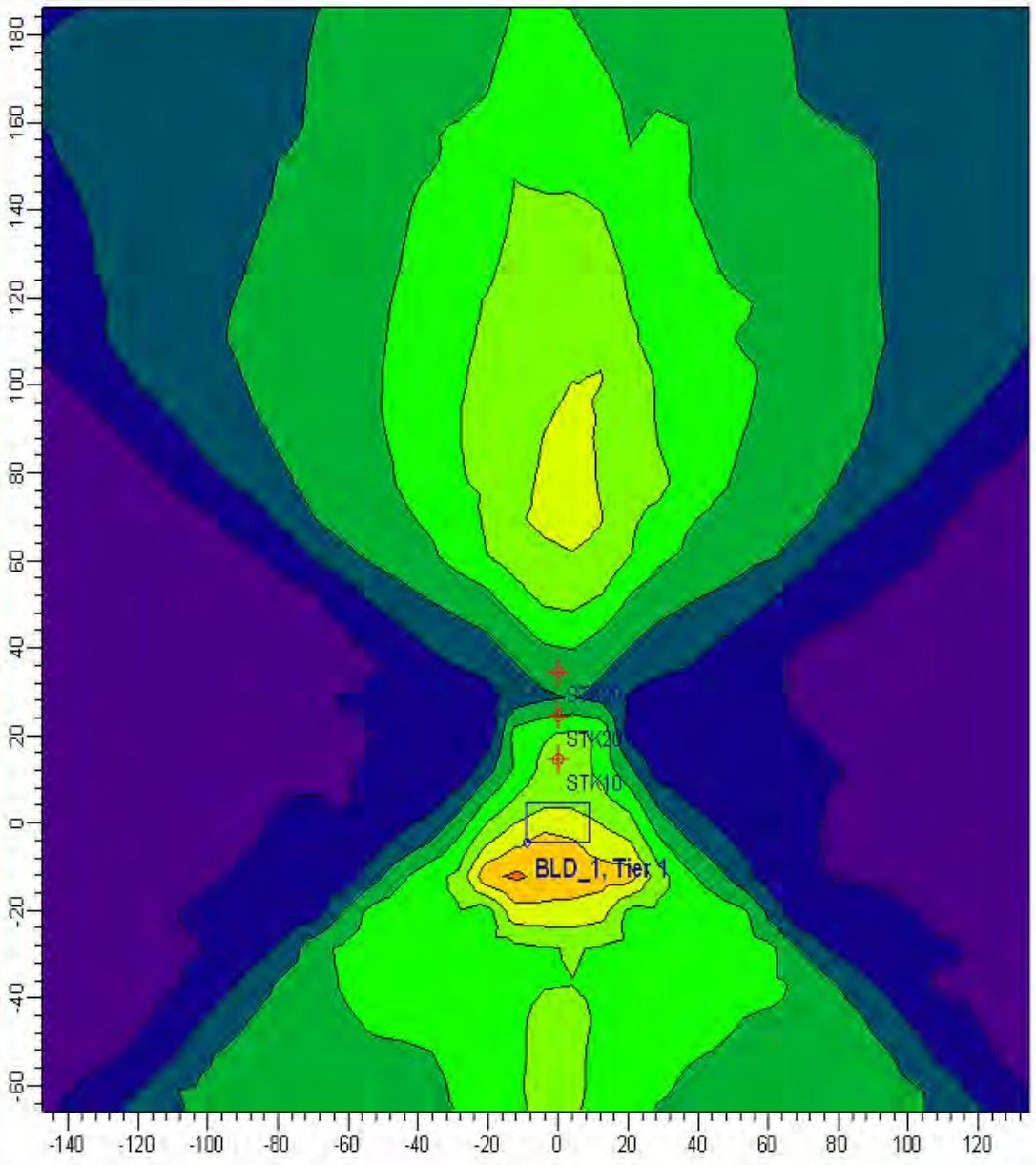
It should be mentioned that any localized terrain in an area could have a significant affect on the maximum predicted impact. The model can produce much higher results if elevated terrain exists downwind of the stack.

Important note: These modeled plots represent actual emissions that were measured during the lab test on a "clean-burning" high efficiency Garn outdoor wood boiler unit. They also represent levels at which Michigan thinks mandatory performance standards should be set.

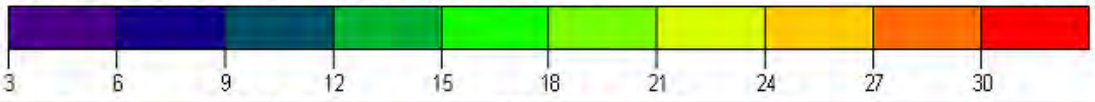
In order to compare these high efficiency wood boiler plot models to existing conventional outdoor wood boilers, the models would be re-run with very different assumptions – <u>much</u> higher emissions (150 grams/hr), shorter stacks (8'), and lower exit velocities (1.5 m/s).

PROJECT TITLE:

Residential Woodburning Maximum PM2.5 Impacts
AERMOD Model, 2005 Gaylord Met Data, Maximum 1-hr avg Impacts



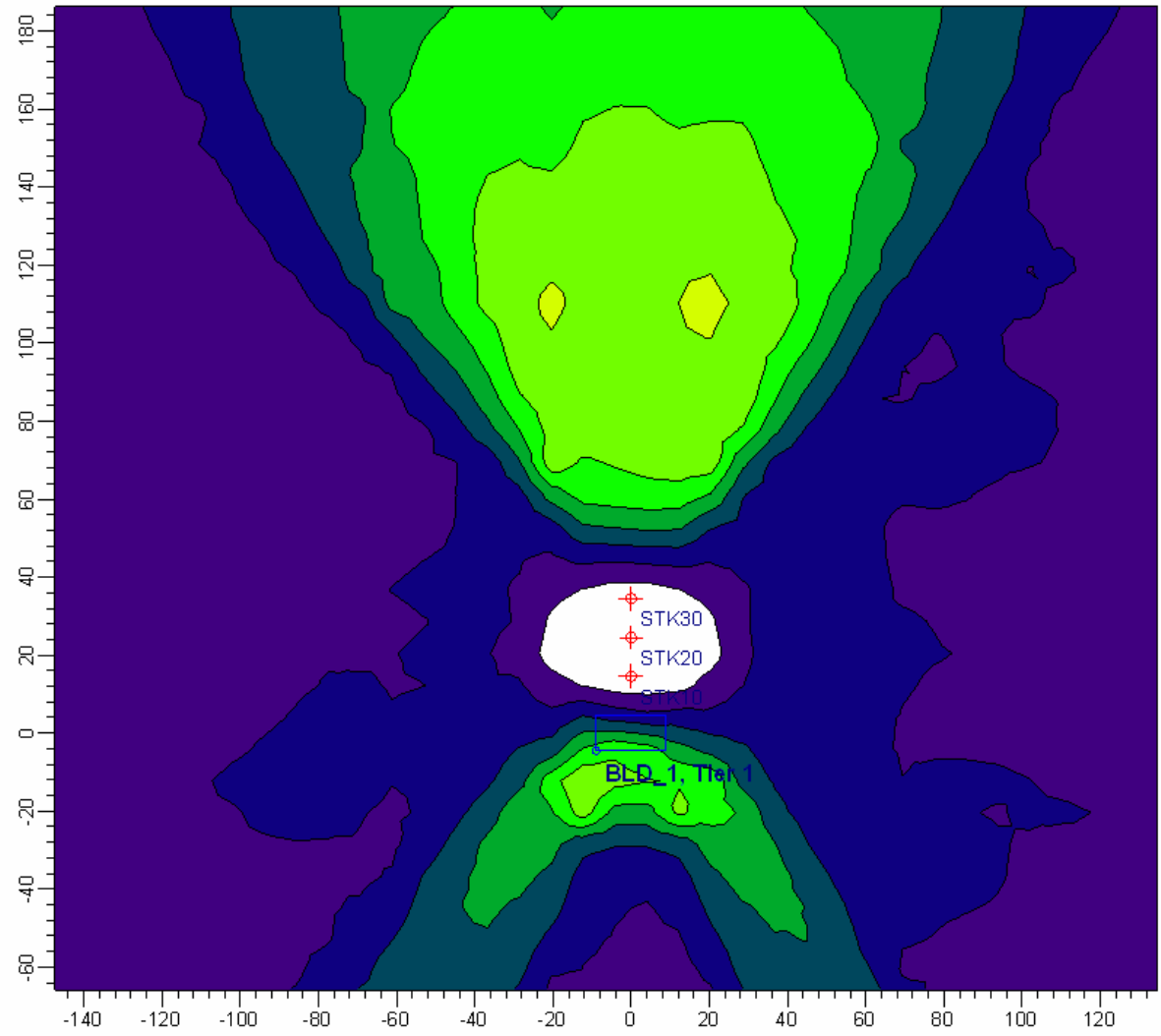
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: STK10 ug/m^3



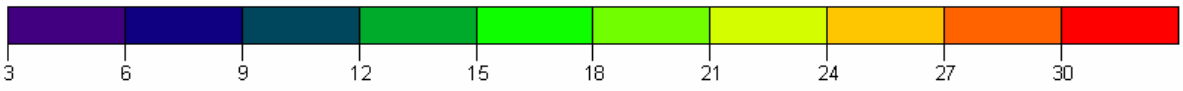
COMMENTS:	SOURCES:	COMPANY NAME:	
House Roof Ht = 7m Stack Ht = 5m Diam = 15 cm Vel = 10 m/s Temp = 250 F Emis Rate = 30 grams/hr	3		
	RECEPTORS: 1680	MODELER:	
	OUTPUT TYPE: CONC	SCALE: 1:1,720 0 0.05 km	
	MAX: 30.19534 ug/m^3	DATE: 11/21/2006	PROJECT NO: **10 M Set Back**

PROJECT TITLE:

Residential Woodburning Maximum PM2.5 Impacts
AERMOD Model, 2005 Gaylord Met Data, Maximum 1-hr avg Impacts



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: STK20 ug/m^3

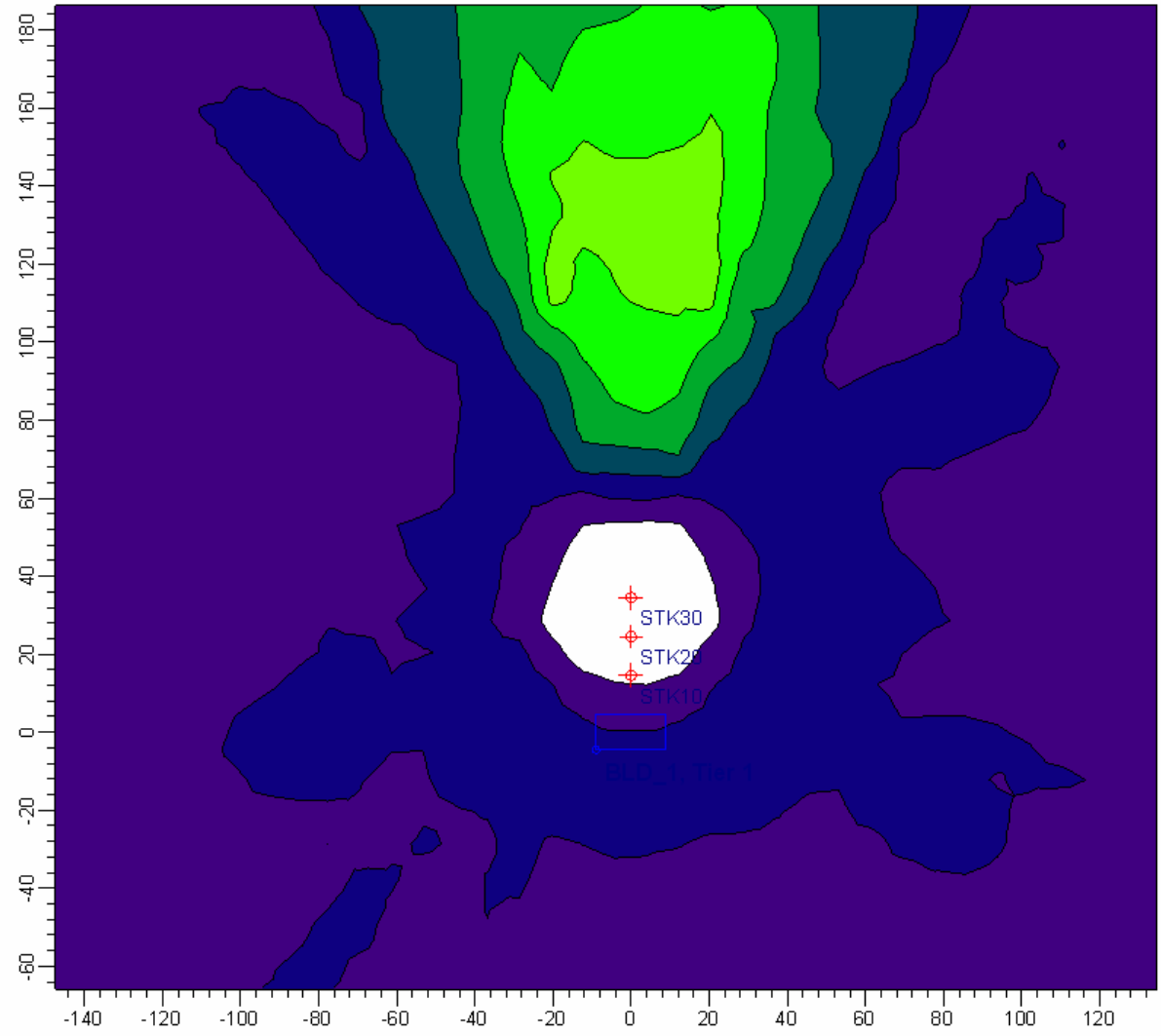


COMMENTS: House Roof Ht = 7m Stack Ht = 5m Diam = 15 cm Vel = 10 m/s Temp = 250 F Emis Rate = 30 grams/hr	SOURCES: **3**	COMPANY NAME:	
	RECEPTORS: **1680**	MODELER:	
	OUTPUT TYPE: **CONC**	SCALE: 1:1,720 0 0.05 km	
	MAX: **23.11056 ug/m^3**	DATE: **11/21/2006**	PROJECT NO.: **20 M Set Back**

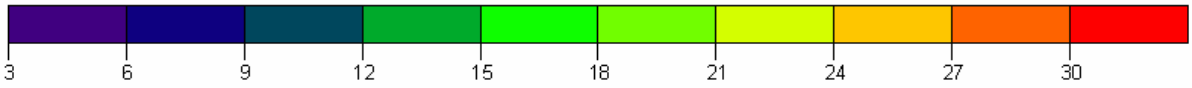
ISC-AERMOD View - Lakes Environmental Software C:\ISCView4\WOODSTV2.isc

PROJECT TITLE:

Residential Woodburning Maximum PM2.5 Impacts
AERMOD Model, 2005 Gaylord Met Data, Maximum 1-hr avg Impacts



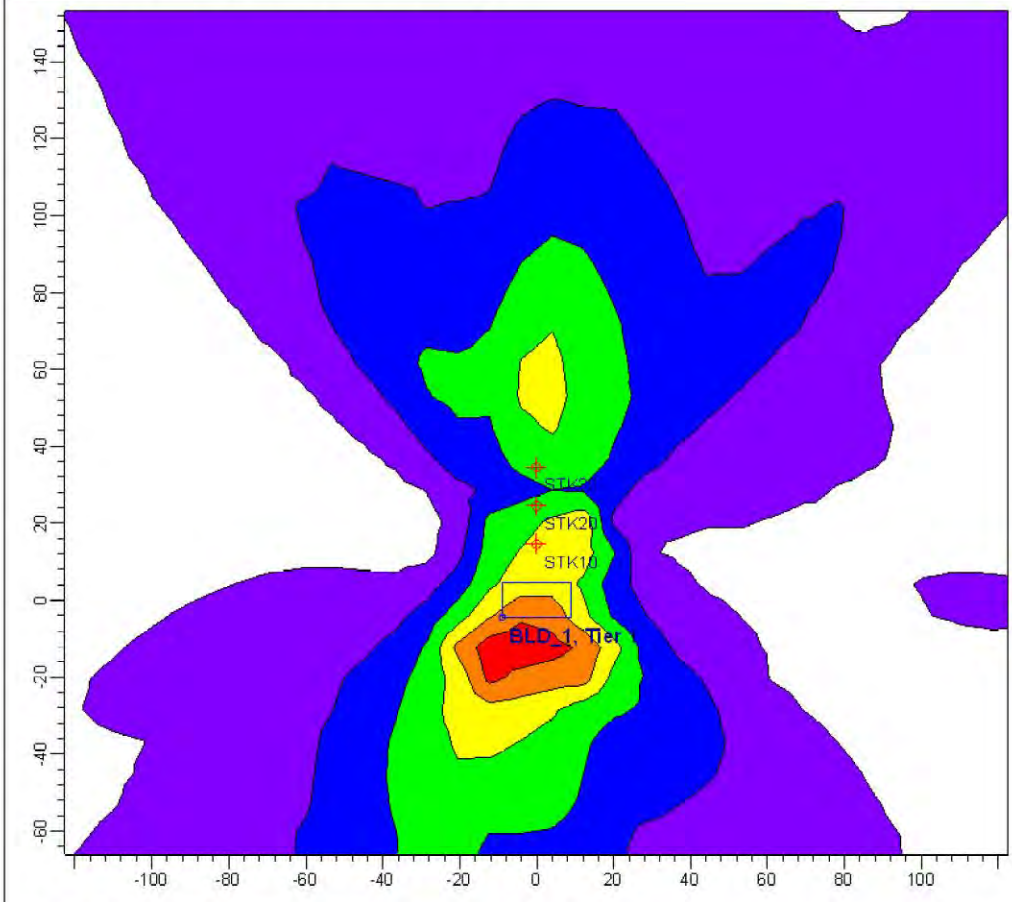
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: STK30 ug/m^3



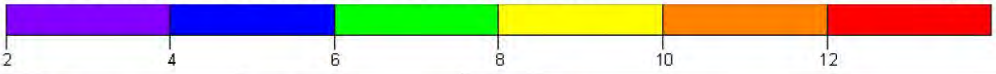
COMMENTS:	SOURCES:	COMPANY NAME:	
House Roof Ht = 7m Stack Ht = 5m Diam = 15 cm Vel = 10 m/s Temp = 250 F Emis Rate = 30 grams/hr	3		
	RECEPTORS: **1680**	MODELER:	
	OUTPUT TYPE: **CONC**	SCALE: 1:1,720 0 0.05 km	
	MAX: **20.01334 ug/m^3**	DATE: **11/21/2006**	PROJECT NO.: **30 M Set Back**

PROJECT TITLE:

Residential Woodburning Maximum PM2.5 Impacts
AERMOD Model, 2005 Gaylord Met Data, Max 24-hr Avg.



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: STK10 ug/m^3

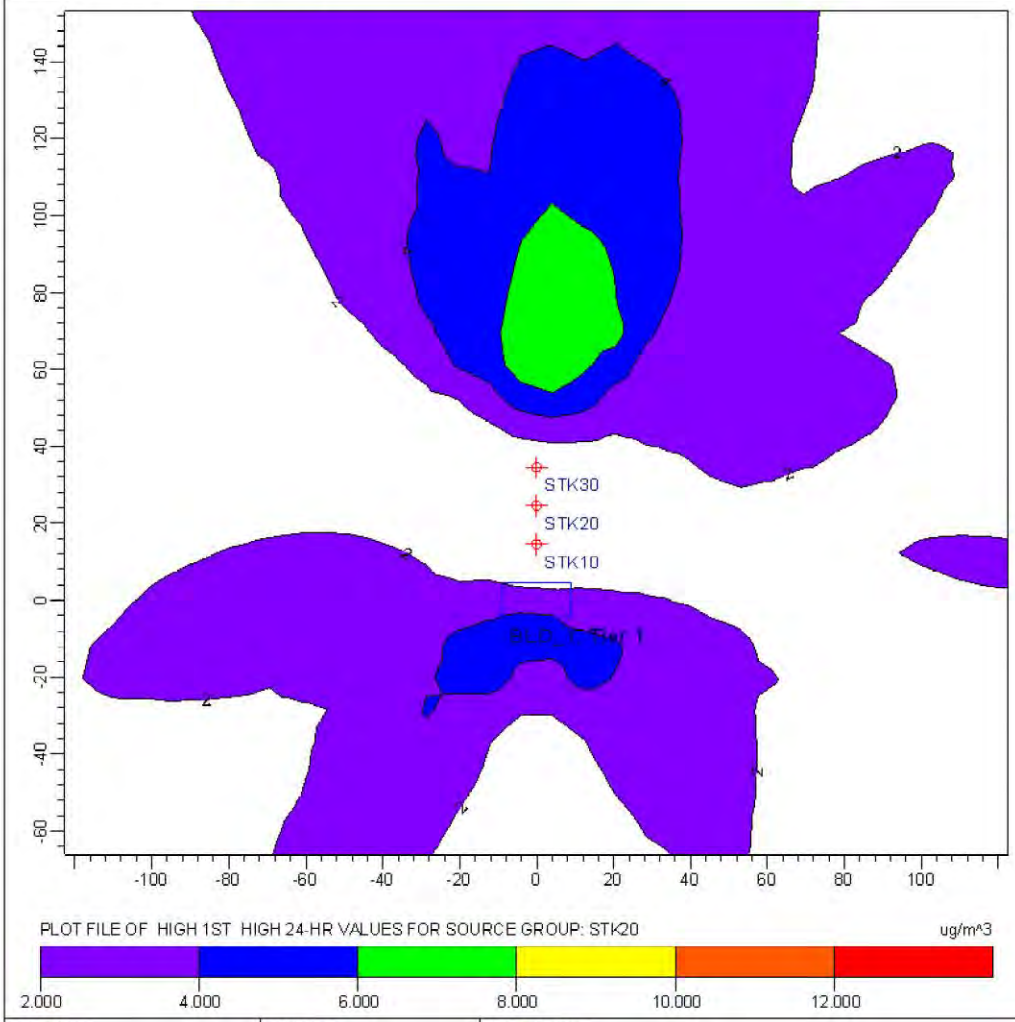


COMMENTS:	SOURCES:	COMPANY NAME:	
House Roof Ht = 7m Stack Ht = 5m Diam = 15 cm Vel = 10 m/s Emis Rate = 30 gram/hr Temp = 250 F	3		
	RECEPTORS: 1680	MODELER:	
	OUTPUT TYPE: CONC	SCALE: 1:1,495 0 0.05 km	
	MAX: 14.49843 ug/m^3	DATE: 11/20/2006	PROJECT NO.: **10 M Set Back**

ISC-AERMOD View - Lakes Environmental Software C:\ISC\View4\WOODSTV2.isc

PROJECT TITLE:

Residential Woodburning Maximum PM2.5 Impacts
AERMOD Model, 2005 Gaylord Met Data



COMMENTS:	SOURCES:	COMPANY NAME:	
House Roof Ht = 7m Stack Ht = 5m Diam = 15 cm Vel = 10 m/s Emis Rate = 30 gram/hr Temp = 250 F	3		
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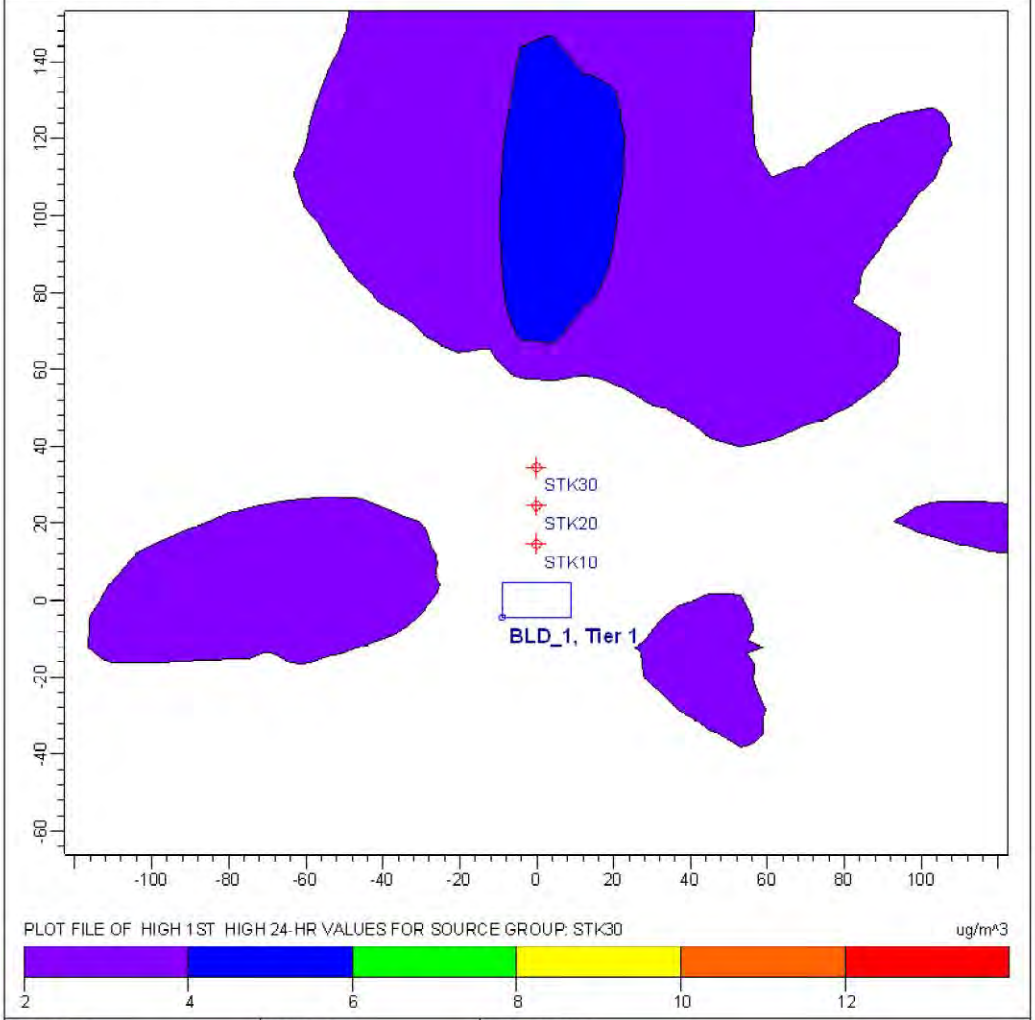
PROJECT TITLE:

Residential Woodburning Maximum PM2.5 Impacts
AERMOD Model, 2005 Gaylord Met Data



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: STK30 ug/m^3

2 4 6 8 10 12

COMMENTS:	SOURCES:	COMPANY NAME:	
House Roof Ht = 7m Stack Ht = 5m Diam = 15 cm Vel = 10 m/s Emis Rate = 30 gram/hr Temp = 250 F	3		
	RECEPTORS: 1680	MODELER:	
	OUTPUT TYPE: CONC	SCALE: 1:1,495 0 0.05 km	
	MAX: 7.19265 ug/m^3	DATE: 11/20/2006	PROJECT NO.: **30 M Set Back**