



Air and Noise Emissions

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OUTLINE

- Monitoring Methods



- Regulations



- Emissions

- Dust (PM_{10} – $PM_{2.5}$)
- Gases
- Noise



- Sampling Strategy



Monitoring Methods



WIRELESS AIR MONITORING STATION



- Relative low cost
- Self sustaining
- 24 hour/day operation
- Easy to set up
- Remote capability





SOLAR PANELS

LIGHT



DUST

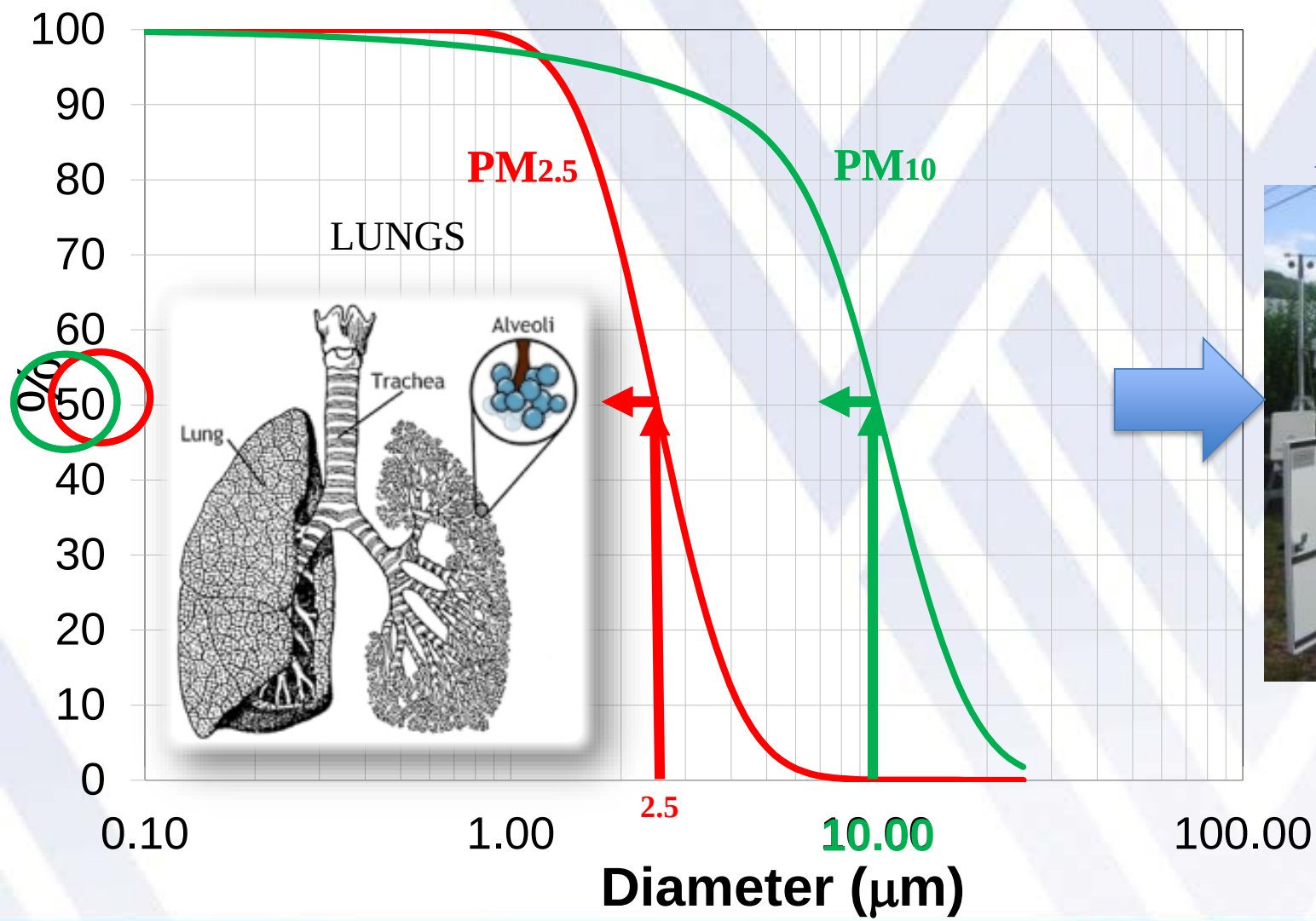


HYDROCARBONS



NOISE





AIR SAMPLER



Regulations



WHO Air Quality Guidelines Value

Pollutant	Averaging time	AQG value
Particulate matter PM2.5	1 year	10 $\mu\text{g}/\text{m}^3$
	24 hour(99 th percentile)	25 $\mu\text{g}/\text{m}^3$
PM10	1 year	20 $\mu\text{g}/\text{m}^3$
	24 hour(99 th percentile)	50 $\mu\text{g}/\text{m}^3$
Ozone, O₃	Ozone, O ₃ 8 hour, daily maximum	100 $\mu\text{g}/\text{m}^3$
Nitrogen dioxide, NO₂	1 year	40 $\mu\text{g}/\text{m}^3$
	1 hour	200 $\mu\text{g}/\text{m}^3$
Sulfur dioxide, SO₂	24 hour	20 $\mu\text{g}/\text{m}^3$
	10 minute	500 $\mu\text{g}/\text{m}^3$

Source: WHO, 2005. WHO air quality guidelines global update 2005, WHOLIS number E87950.



USEPA

National Ambient Air Quality Standards

Pollutant	Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide	primary	8-hour 1-hour	9 ppm 35 ppm	Not to be exceeded more than once per year
Lead	primary and secondary	Rolling 3 month average	0.15 µg/m ³	Not to be exceeded
Nitrogen Dioxide	primary	1-hour	100 ppb	98th percentile, averaged over 3 years
	primary and secondary	Annual	53 ppb	Annual Mean
Ozone	primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution	PM _{2.5}	primary secondary	Annual Annual	annual mean, averaged over 3 years annual mean, averaged over 3 years
	primary and secondary	24-hour	35 µg/m ³	98th percentile, averaged over 3 years
	PM ₁₀	primary and secondary	24-hour	150 µg/m ³ Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide	primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

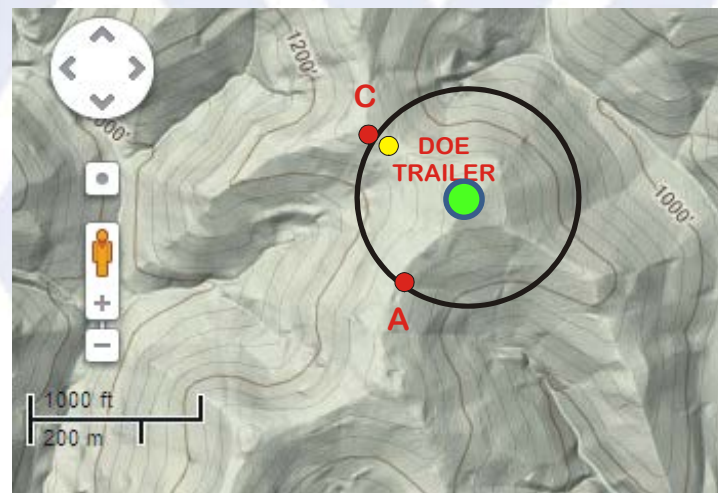
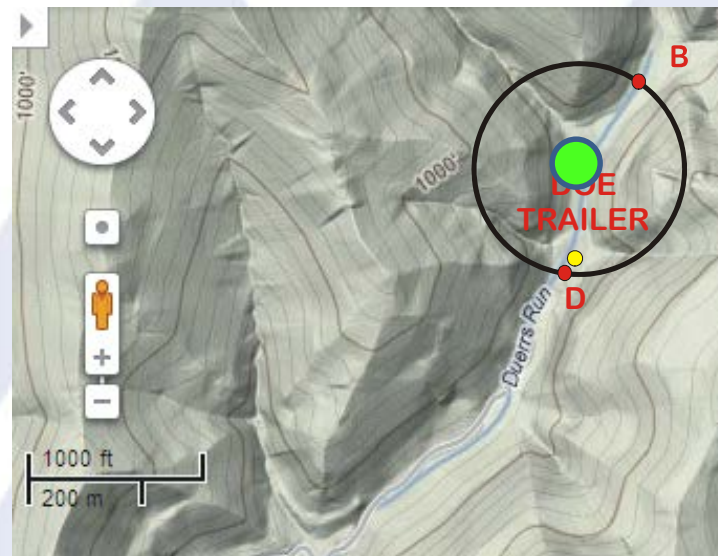


Emissions





Meteorology



Topography



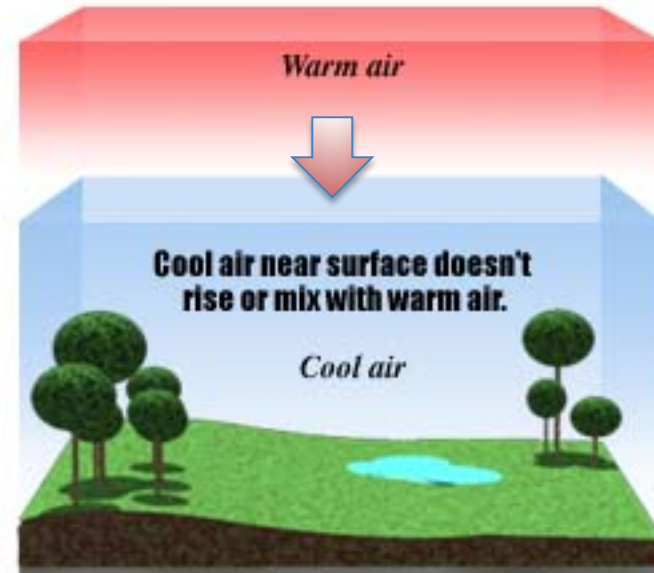
How atmosphere becomes stable or unstable

Unstable

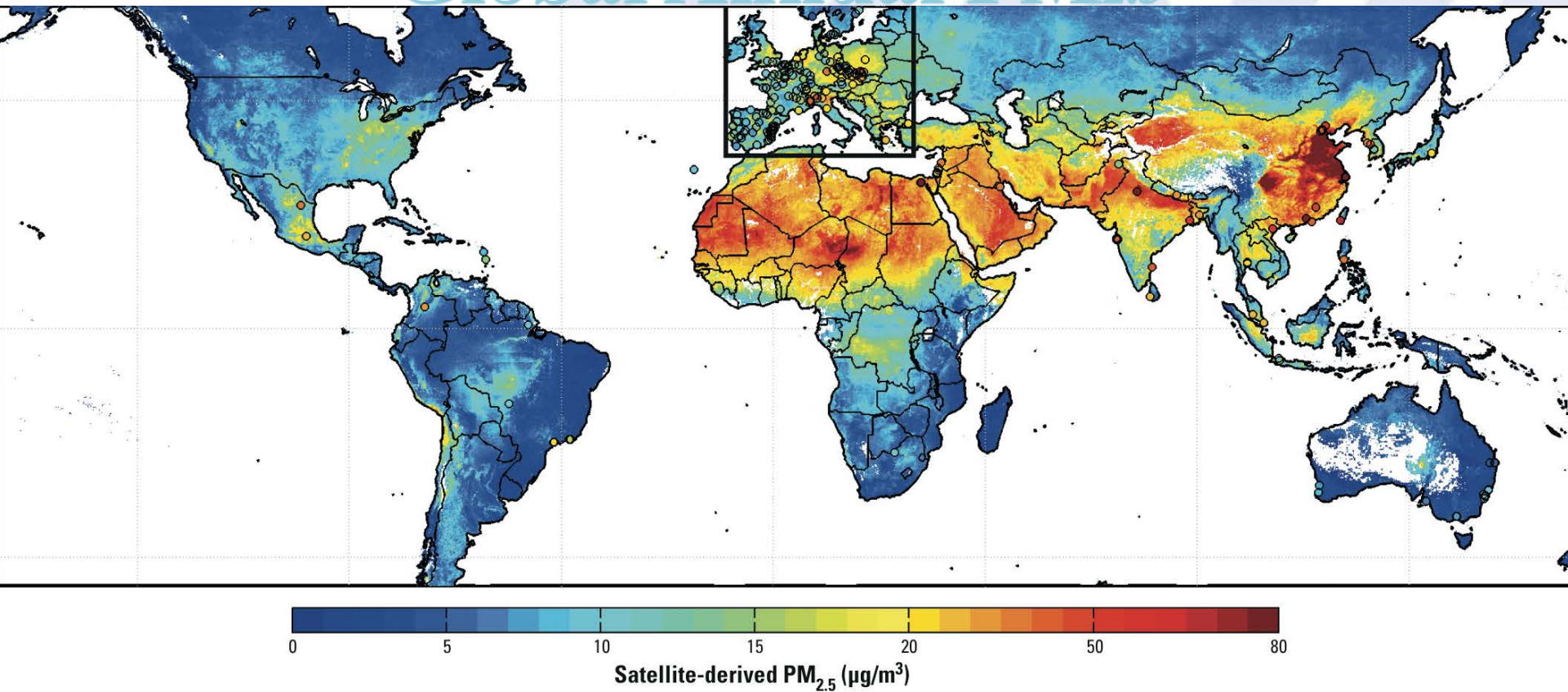


Stable

INVERSION



Global Annual PM_{2.5}



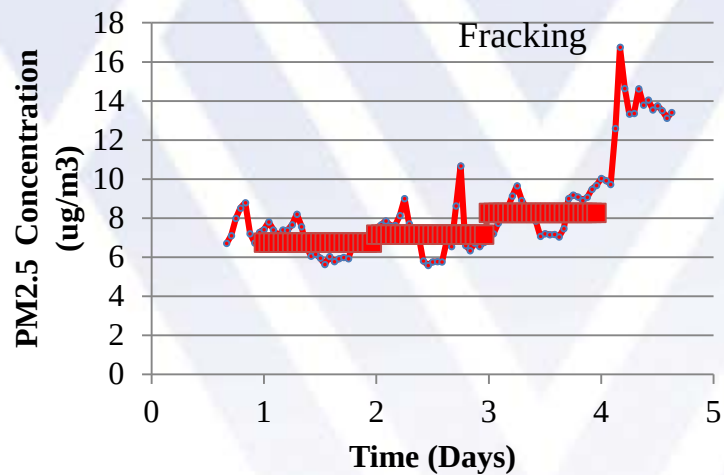
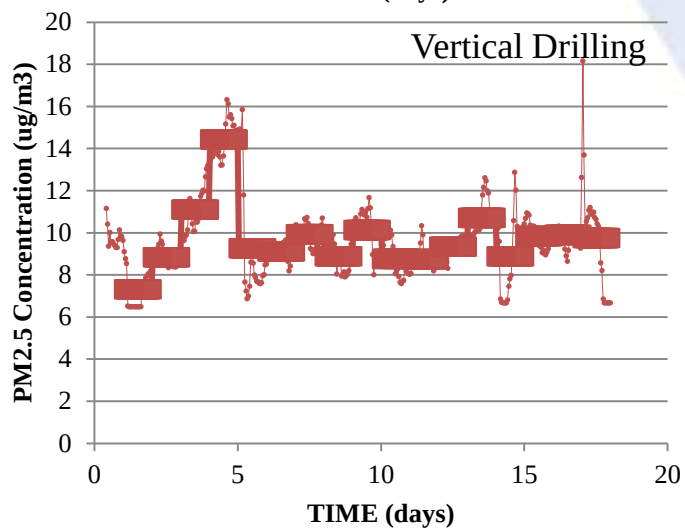
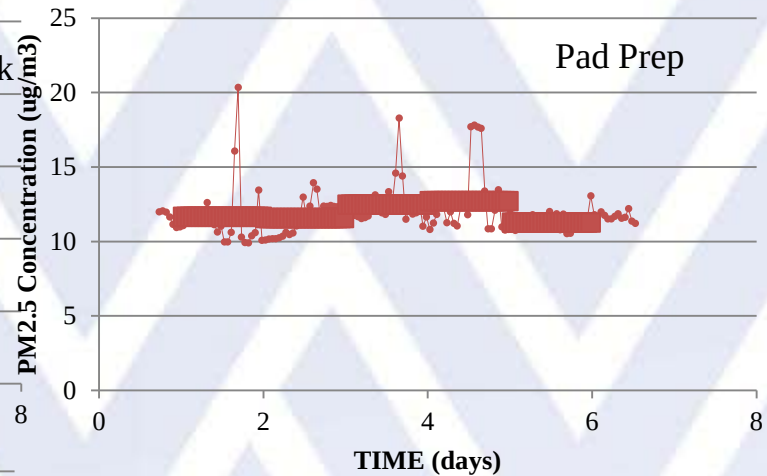
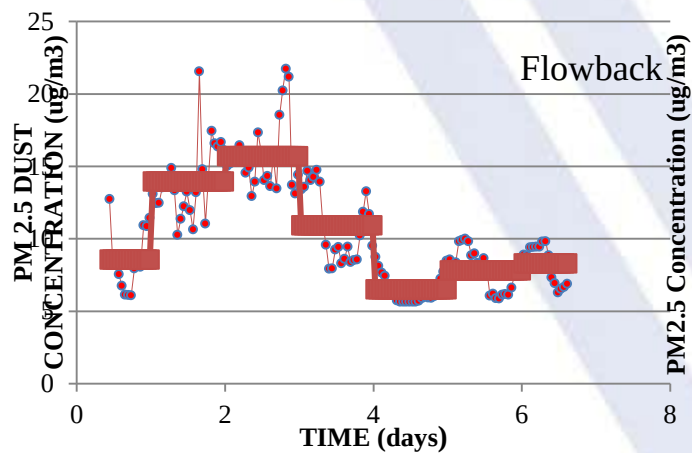
Source: *Environ Health Perspect* 118:847-855 (2010).



Summary of PM10 and PM2.5 24 Hour Averages Measured by TEOM

	<u>PM10 ($\mu\text{g}/\text{m}^3$)</u>	<u>PM2.5 ($\mu\text{g}/\text{m}^3$)</u>
<u>NAAQS 24 Hour Standard</u>	<u>150</u>	<u>35</u>
Hydraulic Fracturing/Flowback1	12-29	6-15
Flowback	9-32	5-20
Vertical Drill1	9-54	6-17
Hydraulic Fracturing/Flowback2	9-90	5-24
Vertical Drill2	5-24	3-13
Horizontal Drill	2-50	1-13

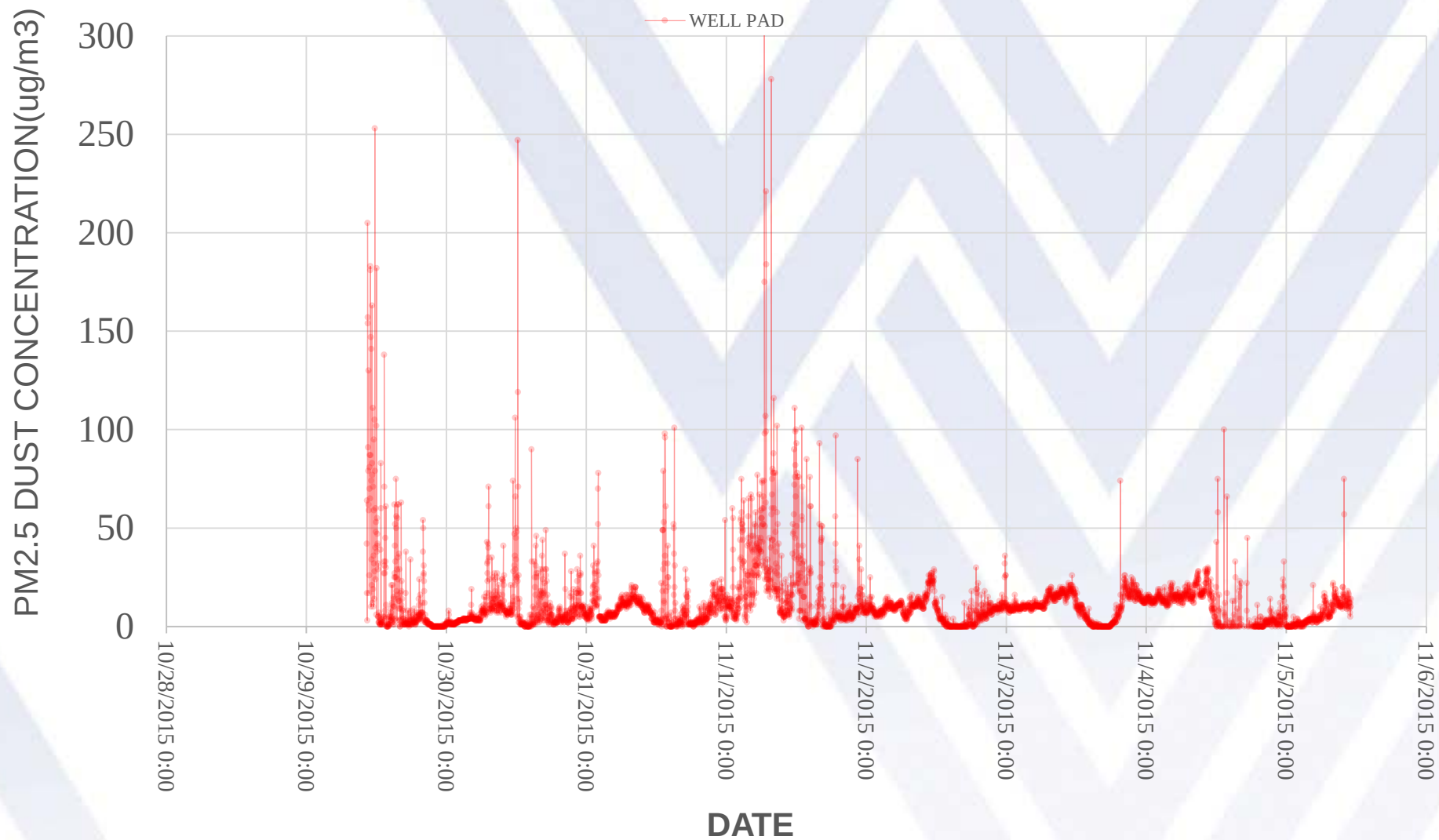


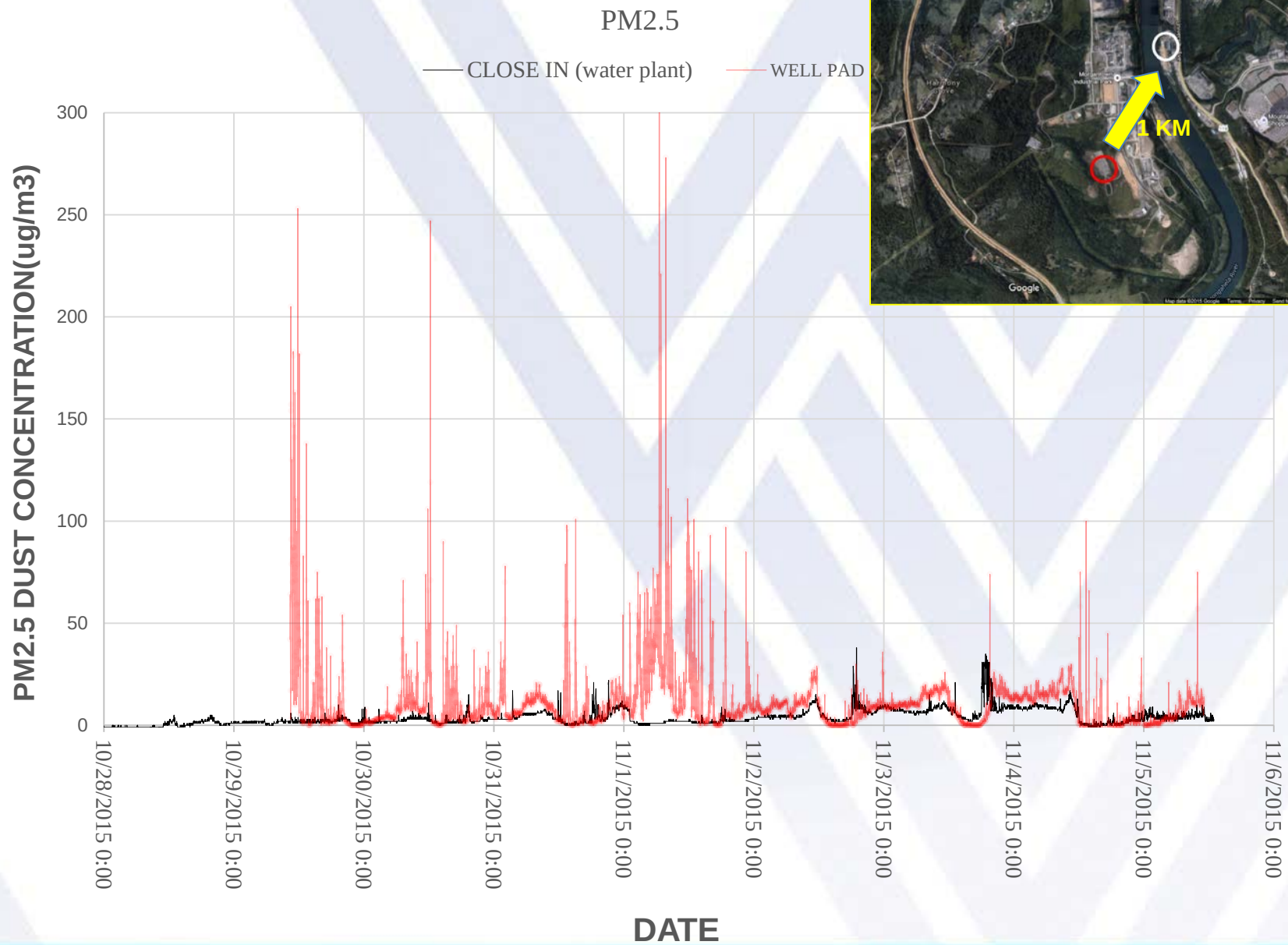


PM_{2.5}



PM2.5



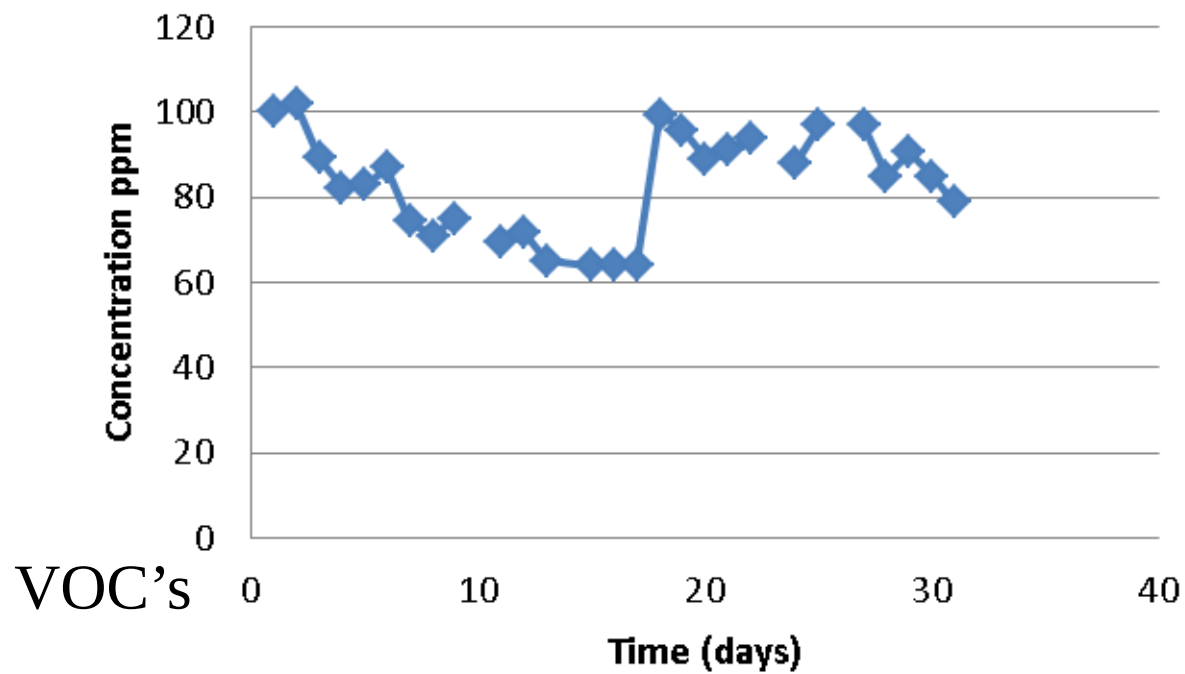


Gases

	Hydraulic Fracturing /Flowback1	Flowback	Vertical Drill1	Hydraulic Fracturing /Flowback2	Vertical Drill2	Horizontal Drill
O3 (8 hr avg)	9-56 ppb	4-78 ppb	20-67 ppb	2-69 ppb	11-61 ppb	14-56 ppb
Nox (1 hr avg)	1.3-30 ppb	3.4-12ppb	7.8-38 ppb	23-138 ppb	9-151 ppb	-
CH4 (6 day avg)	2.1ppm	2.0 ppm	2.0 ppm	2.0 ppm	2.1 ppm	1.9 ppm
SO2 (3 hr avg)	1.9-10.4ppb	1.1-12.4ppb	1.6-8.4 ppb	1.1-9.6 ppb	1.7-3.7 ppb	2.1-5.3 ppb



MiniRAE 3000 (C)



CHRONIC MRL HAZARD QUOTIENTS



Summa Canister –
3 day average by EPA
Method TO 15 (Rpt.
limit 0.5ppb Benzene)

@ 625 feet

Pad	site	RESUL TS ppb(v)	RESULT S (ug/m3)	Hazard Quotient	COMPOUN D NAME
Lewis Wetzel Three	4	1.1	3.6	0.4	Benzene
Lewis Wetzel Three	4	1.0	3.3	0.3	Benzene
Lewis Wetzel Three	4	0.78	2.5	0.3	Benzene
Lewis Wetzel Two	3	3.0	9.7	1.0	Benzene
Lewis Wetzel Two	3	2.4	7.8	0.8	Benzene
Lewis Wetzel Two	3	2.4	7.7	0.8	Benzene
Lewis Wetzel Two	3	2.1	6.7	0.7	Benzene
MAURY (Fracking)	5	85	270	28.3	Benzene
MAURY (Fracking)	5	49	160	16.3	Benzene
MAURY (Fracking)	5	12	39	4.0	Benzene
WEEKLEY (Fracking)	2	8.2	26	2.7	Benzene
WEEKLEY	2	4.5	14	1.5	Benzene
WEEKLEY	2	4.2	13	1.4	Benzene
WEEKLEY	2	3.9	12	1.3	Benzene
WEEKLEY	2	2.9	9.2	1.0	Benzene
WVDNR (Horizontal Drill)	7	13	41	4.3	Benzene
WVDNR	7	3.0	9.5	1.0	Benzene
DONNA	1	2.2	7.0	0.7	Benzene
DONNA	1	2.1	6.8	0.7	Benzene
DONNA	1	1.7	5.3	0.6	Benzene
LEMON (Vertical Drill)	6	15	48	5.0	Benzene

CHRONIC MRL = 3ppb; INTERMEDIATE = 6 ppb; ACUTE = 9
ppb
65 days + 14-364 days 1-14 days



NOISE

- EPA has identified a 24-hour exposure level of 70 decibels as the level of environmental noise which will prevent any measurable hearing loss over a lifetime

	<u>dBA</u>		<u>dBA</u>		<u>dBA</u>
Quiet Room	28-33	Printer	58-65	Garbage Disposal	76-83
Whisper, Quiet Library at 6'	30	Normal conversation at 3'	60-65	Air Popcorn Popper	78-85
Computer	37-45	Window Fan on High	60-66	City Traffic (inside car)	85
Refrigerator	40-43	Alarm Clock	60-80	Jackhammer at 50'	95
Typical Living Room	40	Dishwasher	63-66	Snowmobile, Motorcycle	100
Forced Hot Air Heating		Clothes Washer	65-70	12 Gauge Shotgun Blast	165
System	42-52	Phone	66-75		
Clothes Dryer	56-58	Push Reel Mower	68-72		
		Inside Car, Windows Closed, 30 MPH	68-73		
		Handheld Electronic Games	68-76		
		Kitchen Exhaust Fan, High	69-71		
		Inside Car, Windows Open, 30 MPH	72-76		

Increased risk of cardiovascular disease –

Increased risk of hypertension -

66-70dBA

66-70dBA



**Maximum Noise Emission Levels
as Required by EPA for In-Use Medium and
Heavy Trucks
with GVWR Over 4,525 Kilograms Engaged in
Interstate Commerce(40CFR202)**

Speed	Maximum Noise Level 15 Meters from Centerline of Travel
< 56 kph	83 dBA
> 56 kph	87 dBA
Stationary	85 dBA

ACTIVITY AT 625 FEET FROM WELL CENTER



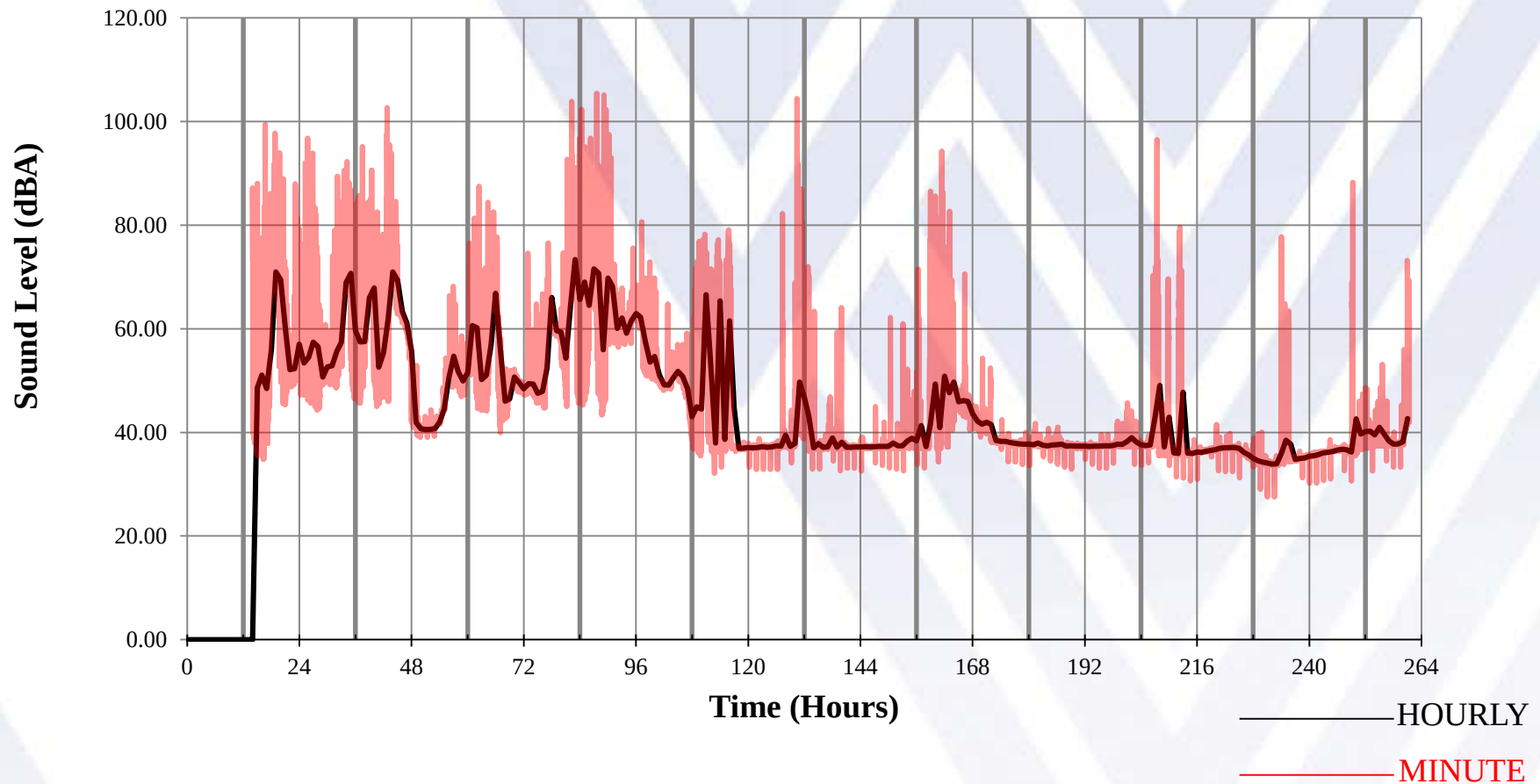
NOISE

AVERAGE FOR ENTIRE SAMPLING PERIOD

	Hydraulic Fracturing/Flowback1	Vertical Drilling1	Pad Preparation	Hydraulic Fracturing/Flowback2	Vertical Drilling2
Mean (dBA)	46	57	68	53	54
Standard Deviation	12	7	10	6	6



Hydraulic Fracturing/Flowback1

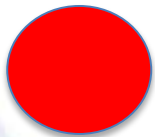


Hydraulic Fracturing

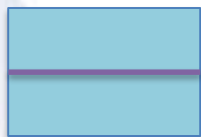
Site A (near impoundment above pad)			Site C (near road)			Site D (1200 ft from pad)		
time above sound level (minutes)	% of time above sound level	sound level (DbA)	time above sound level (minutes)	% of time above sound level	sound level (DbA)	time above sound level (minutes)	% of time above sound level	sound level (DbA)
53	0.4	90	6	0.04	90	3	0.02	90
191	1.3	80	52	0.35	80	19	0.13	80
644	4.3	70	930	6.26	70	138	0.93	70
2277	15.3	60	4949	33.32	60	658	4.44	60
4261	28.7	50	11331	76.30	50	2760	18.63	50
7353	49.5	40	12048	81.13	40	10028	67.68	40
14845	100	30	14851	100.00	30	14817	100.00	30

Pad Construction			Away from Construction (near road)		
time above sound level (minutes)	% of time above sound level	sound level (DbA)	time above sound level (minutes)	% of time above sound level	sound level (DbA)
68	0.80	90	1	0.01	90
855	10.07	80	7	0.08	80
4046	47.63	70	242	2.85	70
7045	82.94	60	3336	39.27	60
8416	99.08	50	8202	96.56	50
8494	100.00	40	8482	99.86	40
8494	100.00	30	8494	100.00	30





Well Pad



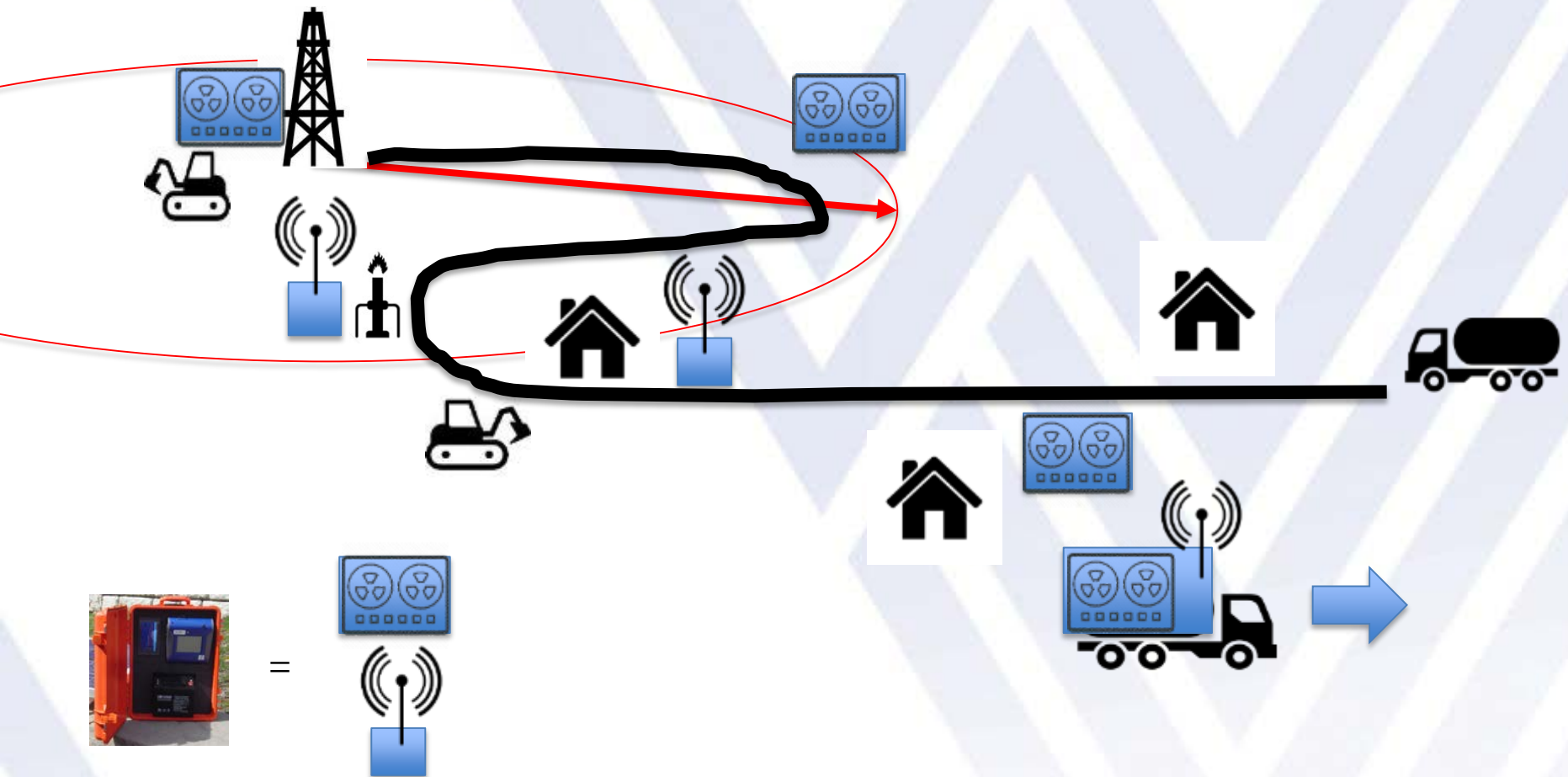
Road



Sampling Strategy



Sample Site Locations



¿ ? ?
¿ QUESTIONS ?
? ? ¿

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PM2.5 ≠ Lung Dose

