

Residential and Community Strategies to Prevent Wildland Fire Smoke Exposures

January 16, 2019

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Missoula, Montana



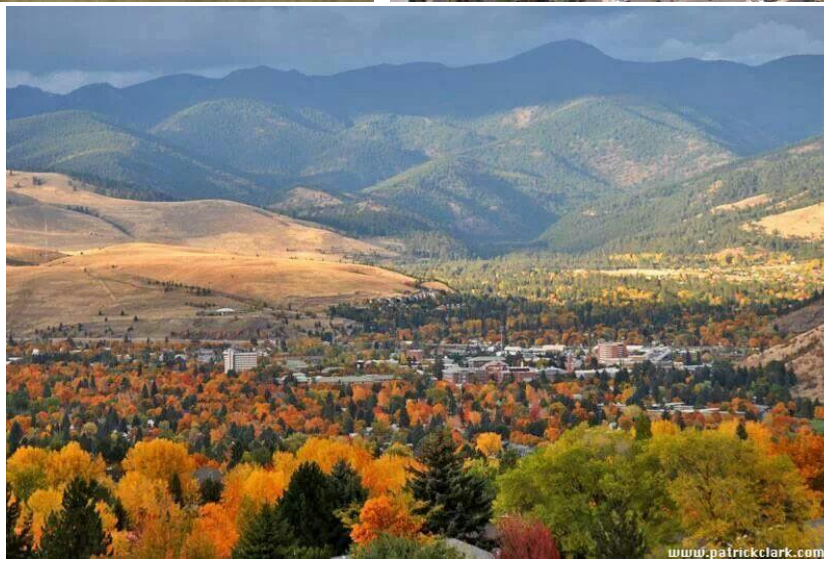
Missoula, Montana



Photo by Todd Goodrich



Photo by Todd Goodrich



[pinterest.com](https://www.pinterest.com)

Today's presentation

- What's in wood smoke and why should we care?
- Fires in the western United States.
- Outdoor exposures.
- Indoor exposures.
- Interventions: ways to prevent wildfire smoke exposures, including both residential and community strategies.

Air pollution in Montana?



Cars and Trucks



Industry Smoke Stacks



Road Dust



Slash Burning



Wildland Fires



What's in wildfire smoke?

- Wildfire smoke is composed primarily of carbon dioxide and water vapor.
- Other common smoke components present in lower concentrations are carbon monoxide, formaldehyde, acrolein, polyaromatic hydrocarbons, and benzene.



Chemistry of wildfire smoke, cont.

- 80 -90% of wildfire smoke, by mass, is within the fine particle size class of 2.5 micrometers in diameter or smaller (PM_{2.5}).

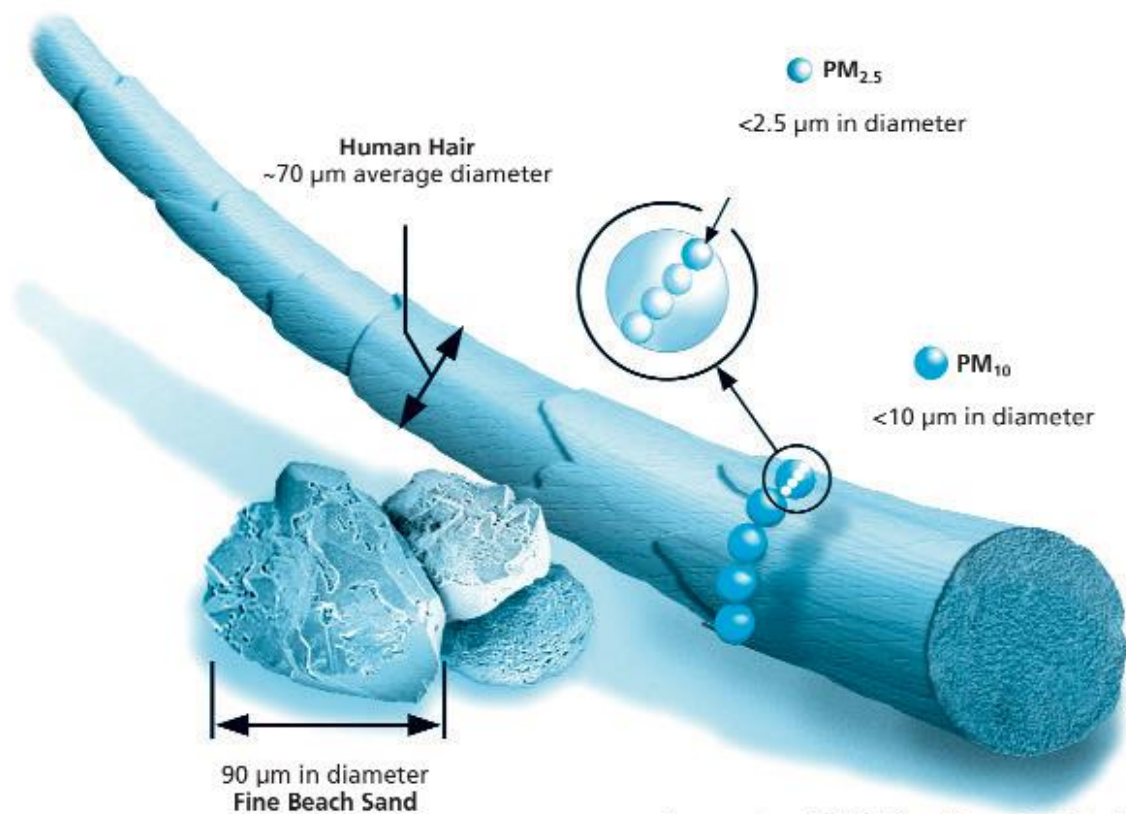


Image courtesy of EPA, Office of Research and Development

MT wood_soot - Ir coated



S4800-1 1.0kV 1.5mm x50.0k SE(U,LA2)

1.00um

PM_{2.5} – health effects



CBS San Francisco

Health effects

- Even though carbon dioxide is a major component of smoke, it poses a low health risk due to its low toxicity.
- Carbon monoxide and PM_{2.5} have been identified as the major health threats.
- Other chemicals are considered to be significant hazards but are found in concentrations that are too low to cause detectable health effects.
- Epidemiological studies have shown an association between adverse health effects and an increase in PM_{2.5} due to wildfire smoke.

Health effects, cont.

Critical Review of Health Impacts of Wildfire Smoke Exposure.

[Environ Health Perspect.](#) 2016 Sep;124(9):1334-43. doi: 10.1289/ehp.1409277. Epub 2016 Apr 15

[Reid CE¹](#), [Brauer M](#), [Johnston FH](#), [Jerrett M](#), [Balmes JR](#), [Elliott CT](#).

- Associations between wildfire smoke exposure and general respiratory health effects, specifically exacerbations of asthma and chronic obstructive pulmonary disease.
- Growing evidence suggests associations with increased risk of respiratory infections and all-cause mortality.
- Evidence for cardiovascular effects is mixed, but a few recent studies have reported associations for specific cardiovascular end points.
- Insufficient research exists to identify specific population subgroups that are more susceptible to wildfire smoke exposure.

Mental health

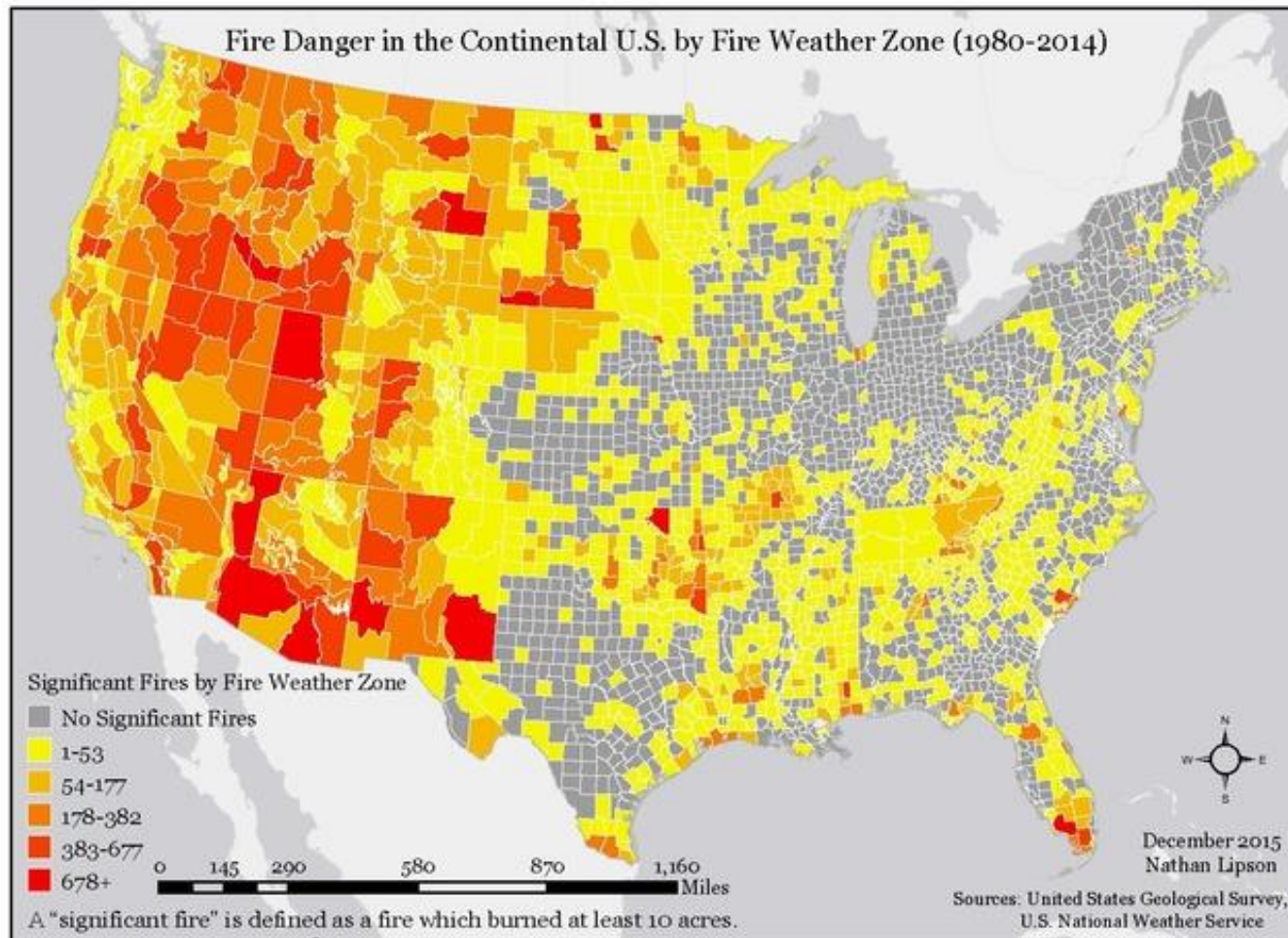
- Both adults and children have been found to exhibit several different mental conditions linked to their experience with wildfires.
- These include post-traumatic stress disorder (PTSD), depression, anxiety, and phobias.

EPA Regulated Air Pollutants

- Carbon monoxide
- Lead
- Nitrogen dioxide
- Ozone
- Sulfur dioxide

- **Particulate matter (PM₁₀ and PM_{2.5})**

- **Ambient PM_{2.5} 24-hour standard: 35 µg/m³**



Wildfires occur naturally and play a long-term role in the health of our ecosystems.

Wildland fires

- Immediate dangers of loss of property or life.
- Smoke impacts ambient air quality in downwind populations for days to weeks at a time.
- Worldwide it is estimated that 339,000 people die due to the effects of wildfire smoke each year.



www.cnn.com/



www.krtv.com

Wildland fire smoke

- Smoke can be transported over hundreds of kilometers. Local air quality is degraded even at great distances from the fire.



- The air pollutant of concern is $PM_{2.5}$.
- Ambient $PM_{2.5}$ can penetrate into the indoor environment, resulting in elevated, prolonged exposures.

Impacts on indoor air quality

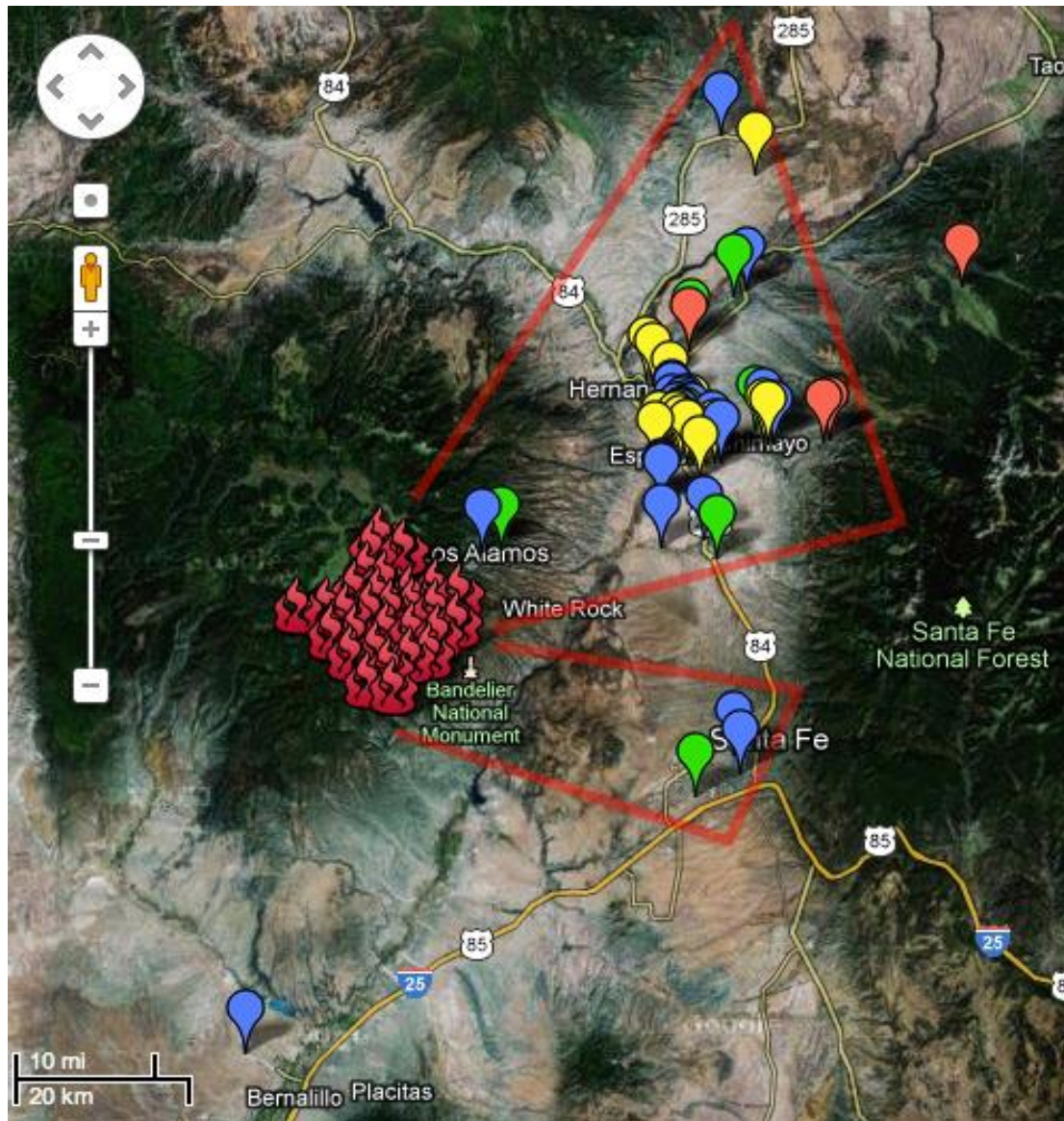
Las Conchas (New Mexico) Wildfire - 2011

- The Las Conchas wildfire burned between June 26 and August 3, 2011 was one of the largest in state history.
- The wildfire burned nearly 160,000 acres, with smoke significantly impacting downwind communities.



Las Conchas Wildfire, cont.

- In an effort to quantify the extent of smoke exposure to indoor environments, wipe samples were collected inside of 64 homes located throughout the north/central region of New Mexico.
- These wipe samples were analyzed for char and ash (indicators of biomass smoke) using Polarized Light Microscopy, with the results plotted in Google Maps.
- Out of the 64 residences that were investigated, char was detected from within 78% of the homes. Ash was not measured from any of the wipe samples.



Note: green (<1% char detected); blue (1-4% char detected); yellow (5-9% char detected); and red (10-30% char detected).

Las Conchas Wildfire, cont.

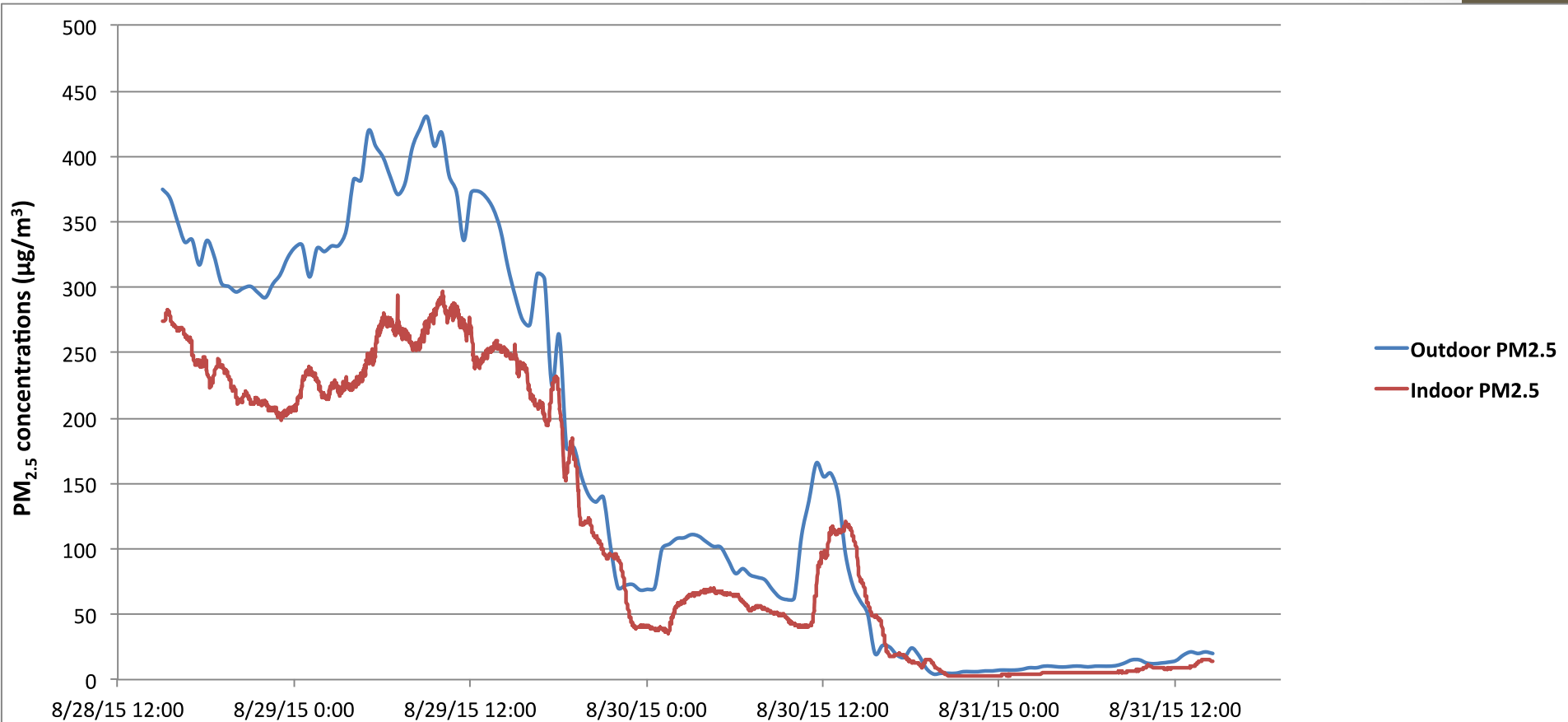
- Mapping of these results demonstrates the far-reaching impact that smoke from the Las Conchas wildfire had on downwind communities.
- Indoor wipe samples from homes up to 50 kilometers from the fire tested positive for char.

Missoula, Montana - 2015

- During the 2015 summer forest fire season in Missoula, PM_{2.5} measurements were made during a smoke event.
- PM_{2.5} concentrations were measured inside one of the research laboratories at the University of Montana between August 28-31, 2015.



Ambient/indoor comparison



Average indoor levels = $123.8 \pm 27.3 \mu\text{g}/\text{m}^3$

Average outdoor levels = $169.1 \pm 162.7 \mu\text{g}/\text{m}^3$

75% of ambient PM_{2.5} measured indoors.

2017 Wildfire Season

- This was an especially bad wildfire season.
- The western U.S. had about 50,000 wildfires, with more than 3.4 million hectares burned.



2017 Wildfire Season, cont.

- 2017 was the most expensive firefighting year on record for the US Forest Service with over \$2.4 billion spent.
- The Northern California wildfires in October burned over 245,000 acres, destroyed ~8,900 structures and killed 44 people (with 192 injured).



2017 Montana Wildfire Season

- There were 21 large wildfires (141 >100 acres) in Montana, with 1.3 million acres burned.
- 2017 was the second biggest fire season on record in the Northern Rockies Region, surpassed only by the summer 2012.
- The most expensive fire season in Montana (\$74 million spent).



agweb.com



missoulain.com

2017 Montana Wildfire Season

- Lolo Peak Fire: Started on July 15 and burned nearly 54,000 acres through October.
- Rice Ridge Fire: Started July 24 and burned over 160,000 acres through October. Was identified as the nation's top wildfire priority.

Lolo Peak Fire



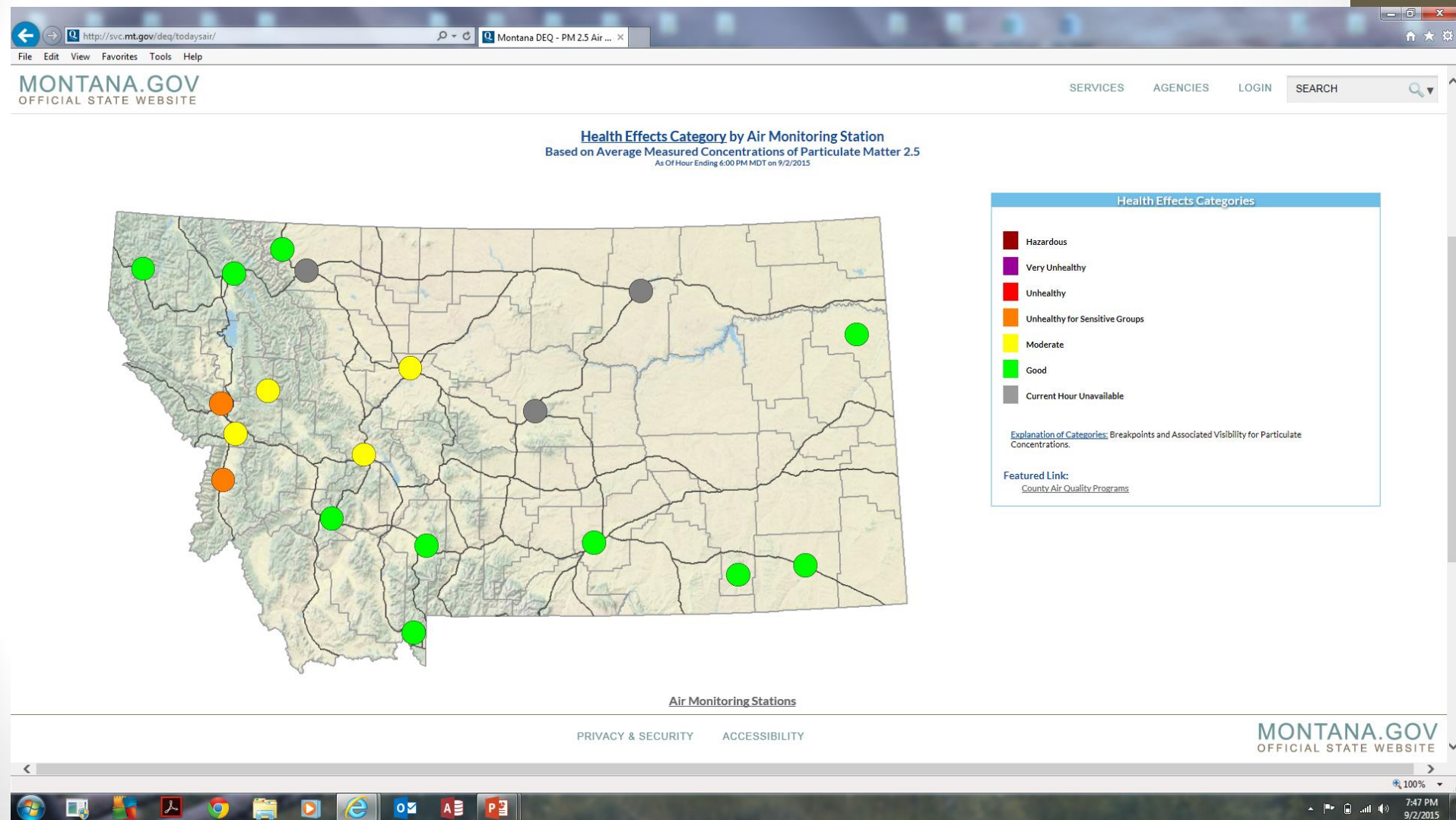
Rice Ridge Fire



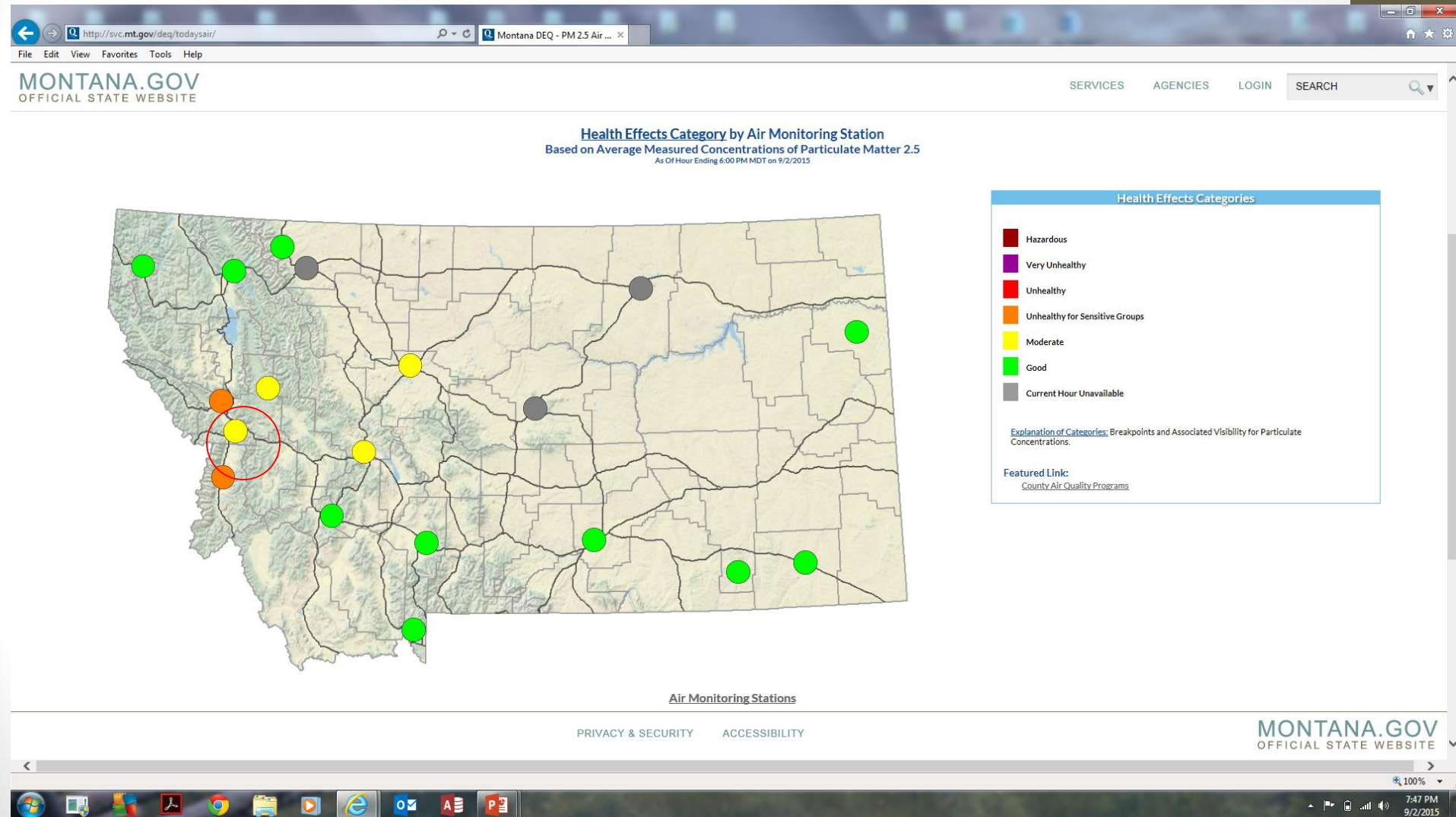
PM_{2.5} Sampling Site - Missoula



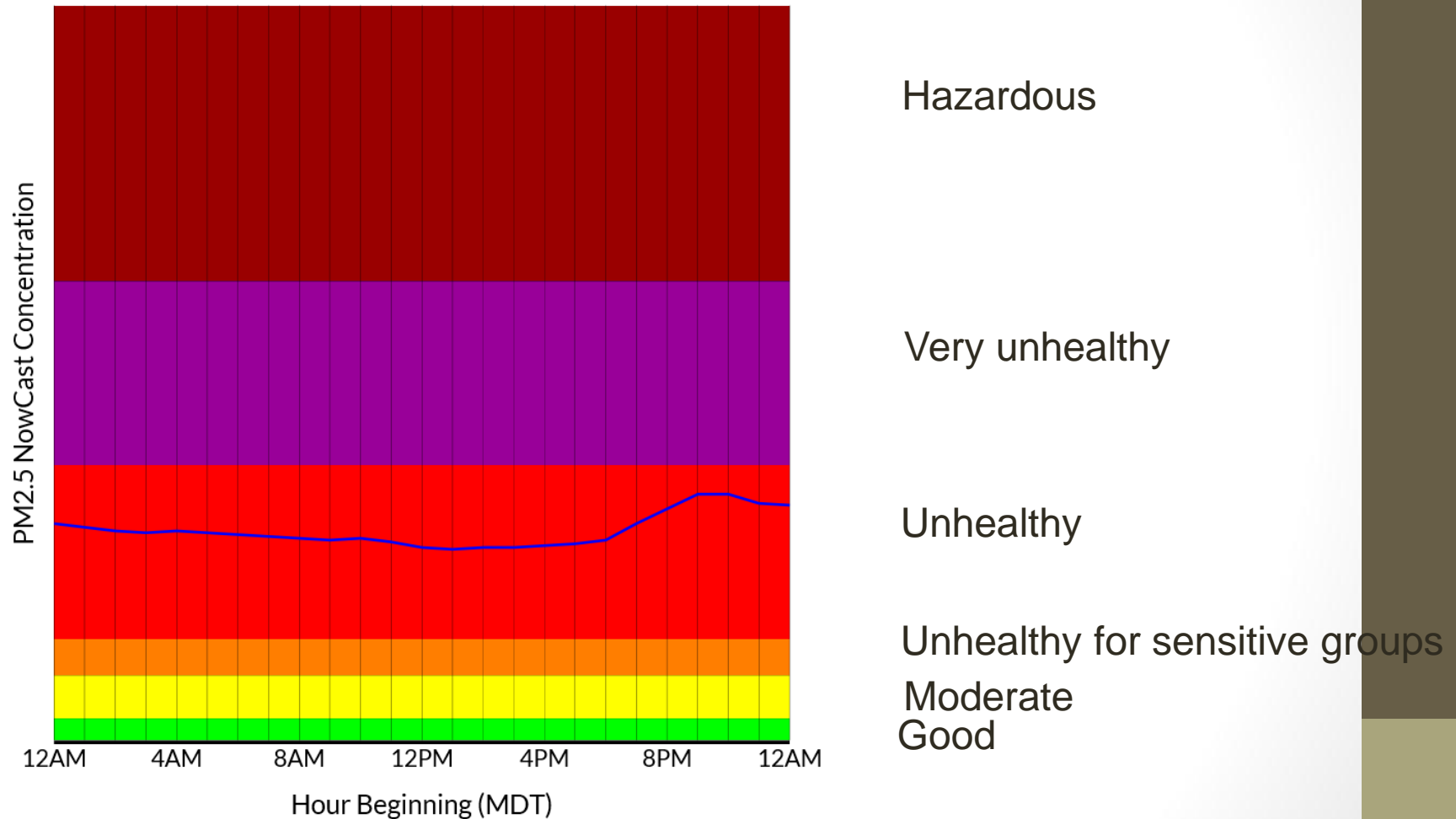
Montana DEQ Air Monitoring Stations.



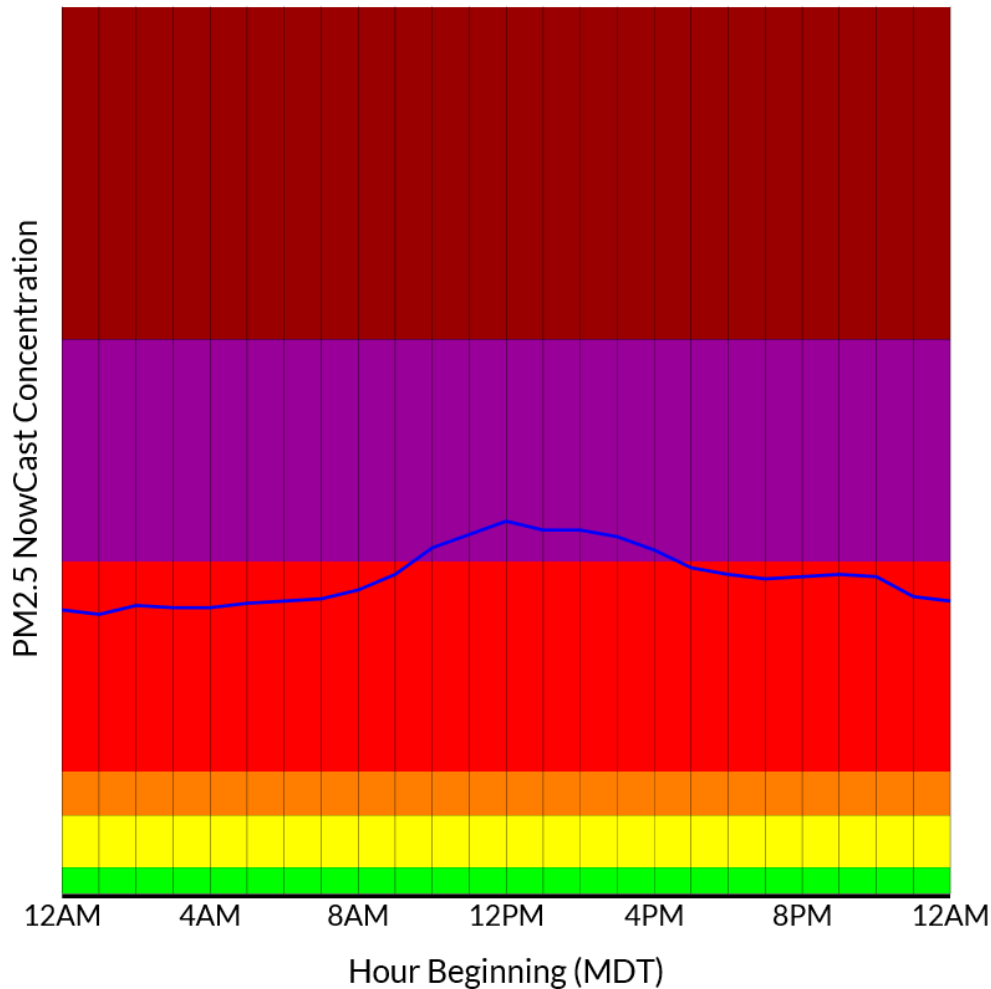
Montana DEQ Air Monitoring Stations.



Missoula - September 6, 2017



September 7, 2017



Hazardous

Very unhealthy

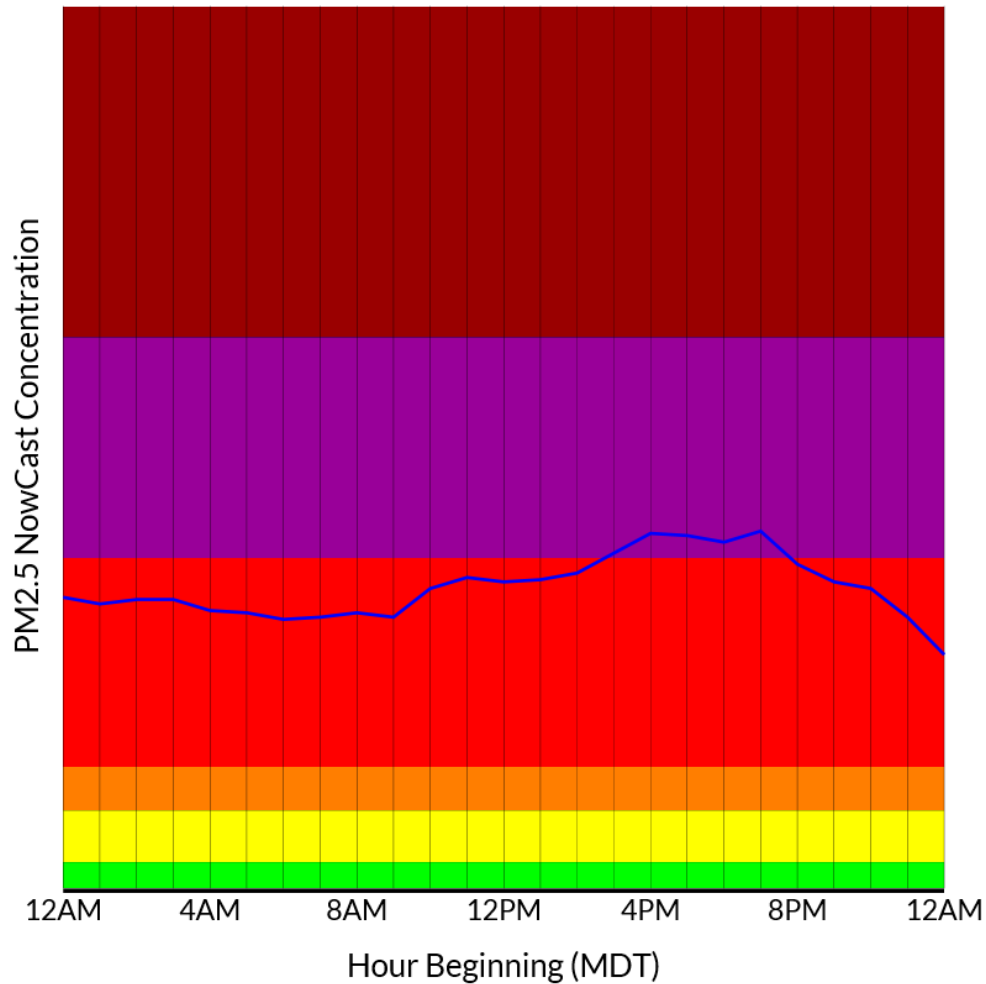
Unhealthy

Unhealthy for sensitive groups

Moderate

Good

September 8, 2017



Hazardous

Very unhealthy

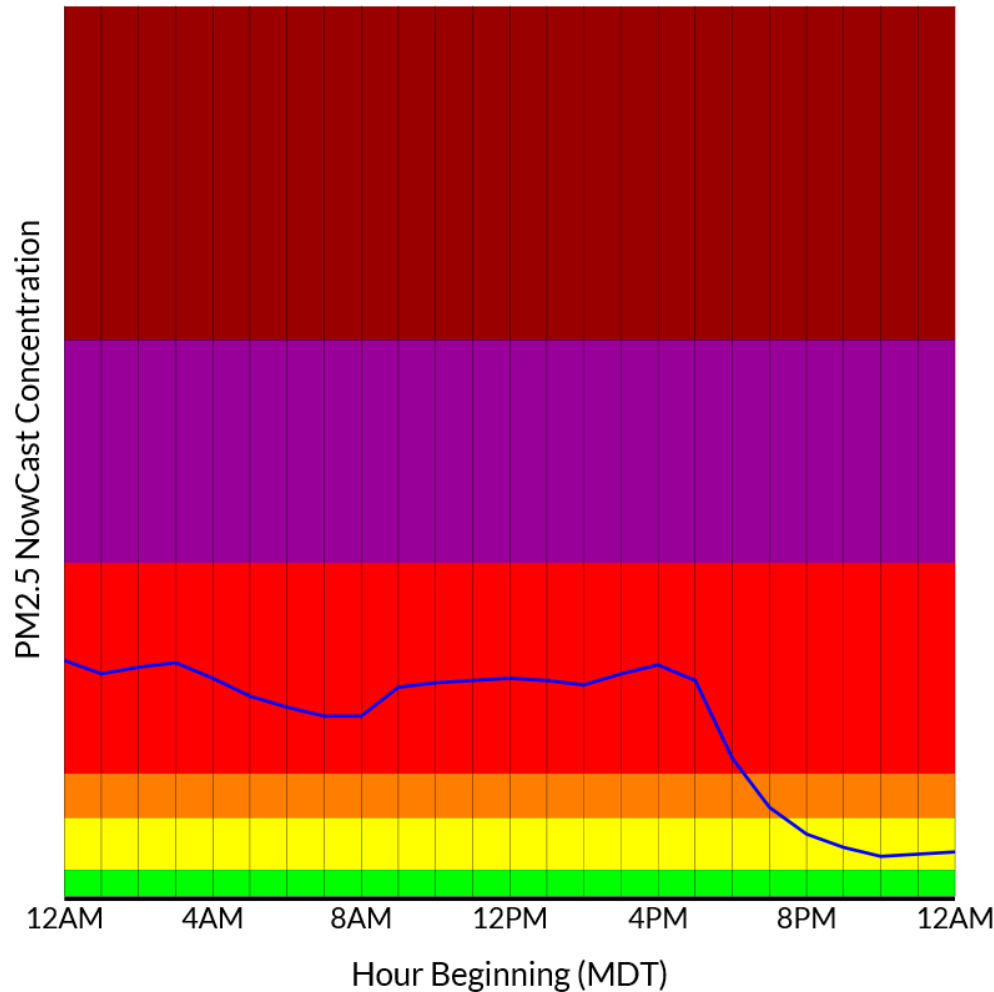
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Saturday, September 9, 2017



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2017 Indoor PM_{2.5} Study (Sept 7, 2017)

Location	Average (µg/m ³)	Max (µg/m ³)	Min (µg/m ³)
Children's Play Area	93.2 ± 15.4	123.2	66.2
Business Office	43.8 ± 12.1	73.4	27.3
Fitness Club	61.5 ± 16.4	94.1	29.7
High School	111.2 ± 39.2	209.7	41.2

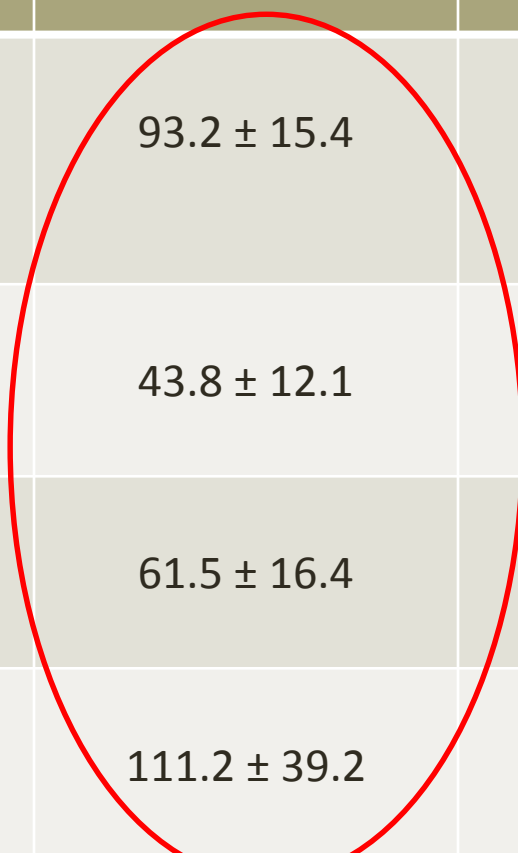
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Gym	61.5 ± 16.4	94.1	29.7
High School	111.2 ± 39.2	209.7	41.2

24 hour NAAQS: 35 µg/m³

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EPA 24-hour ambient standard: 35 µg/m³

Seeley Lake, Montana

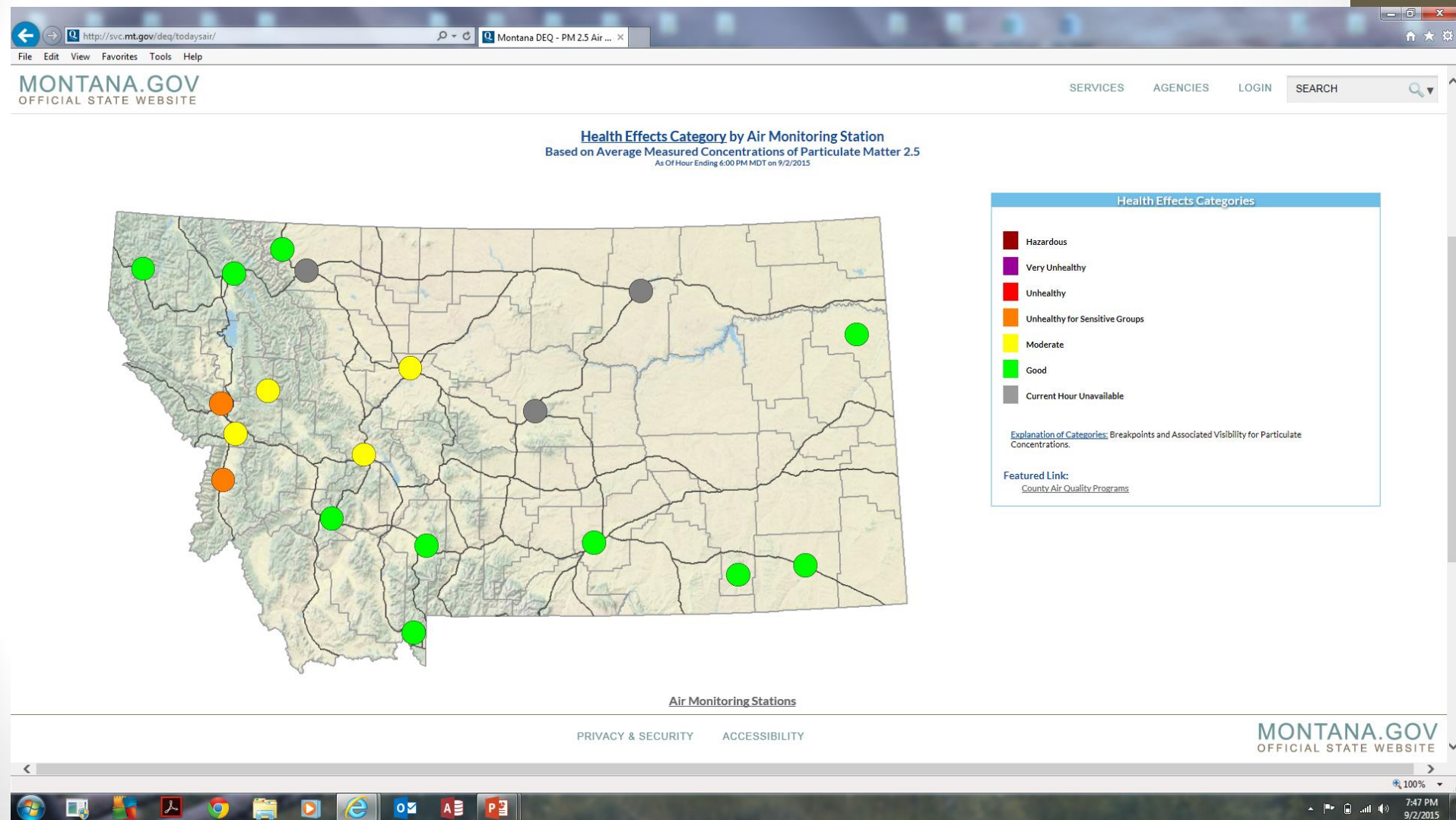


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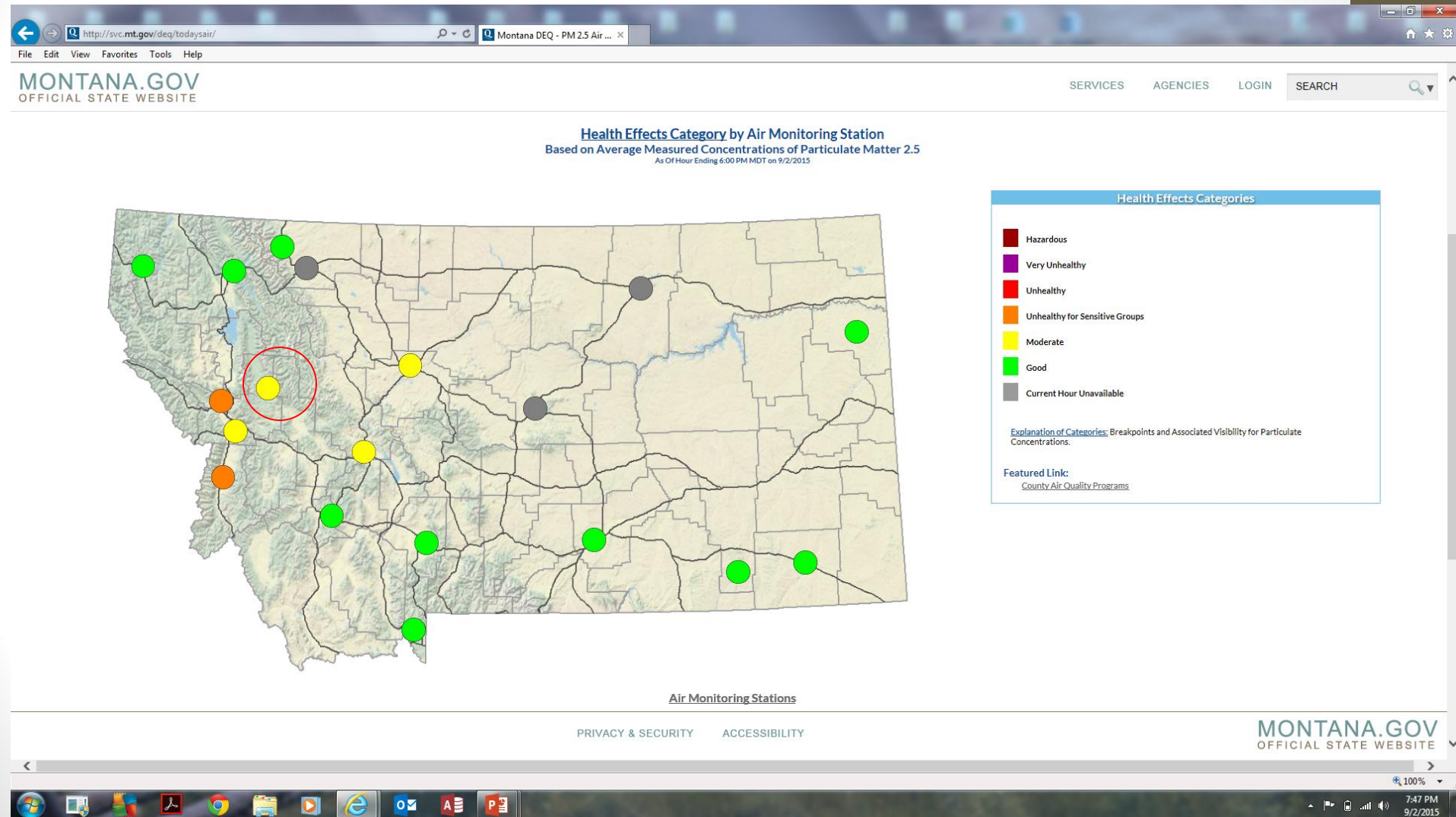
Population of Seeley Lake: ~2,000.



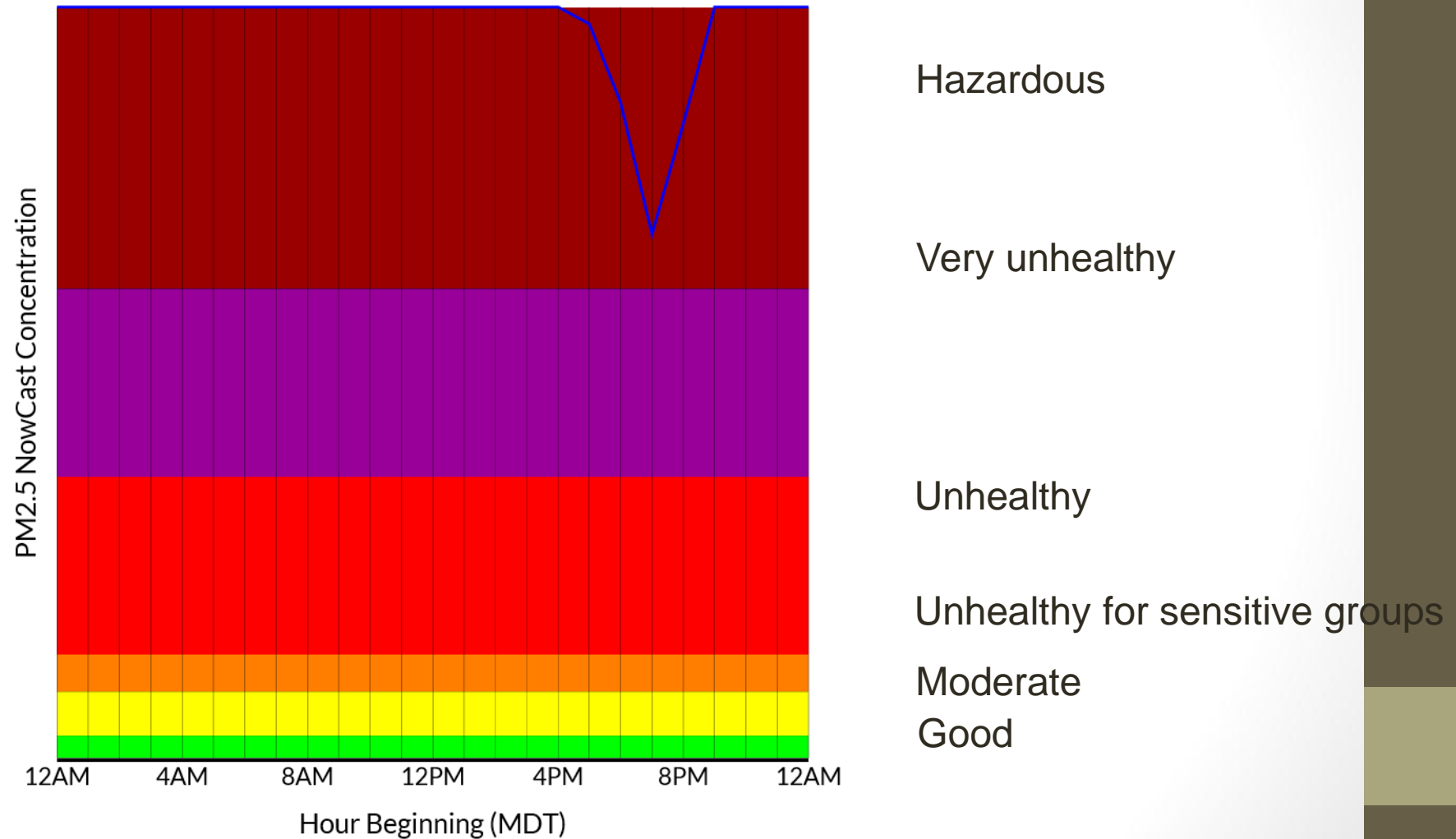
Montana DEQ Air Monitoring Stations.



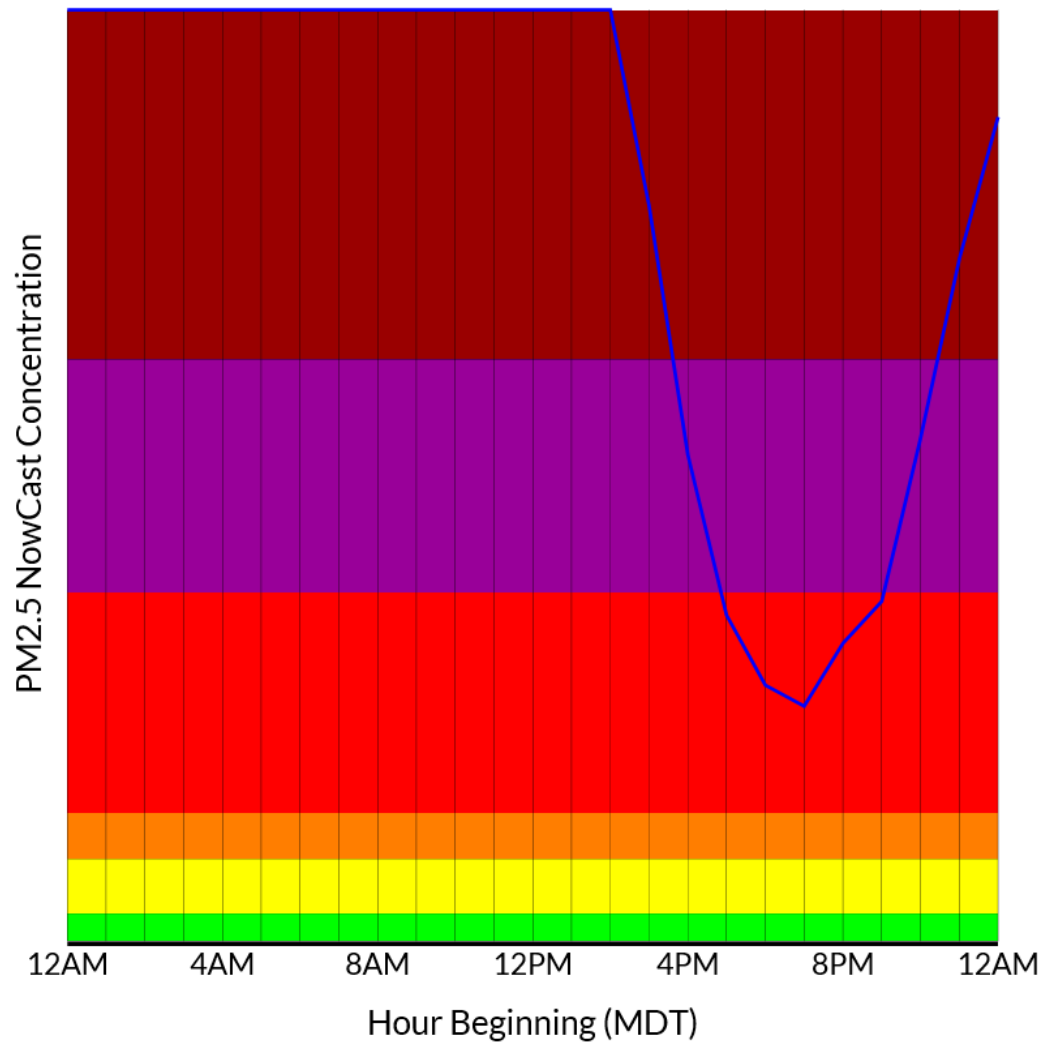
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Seeley Lake - September 6, 2017



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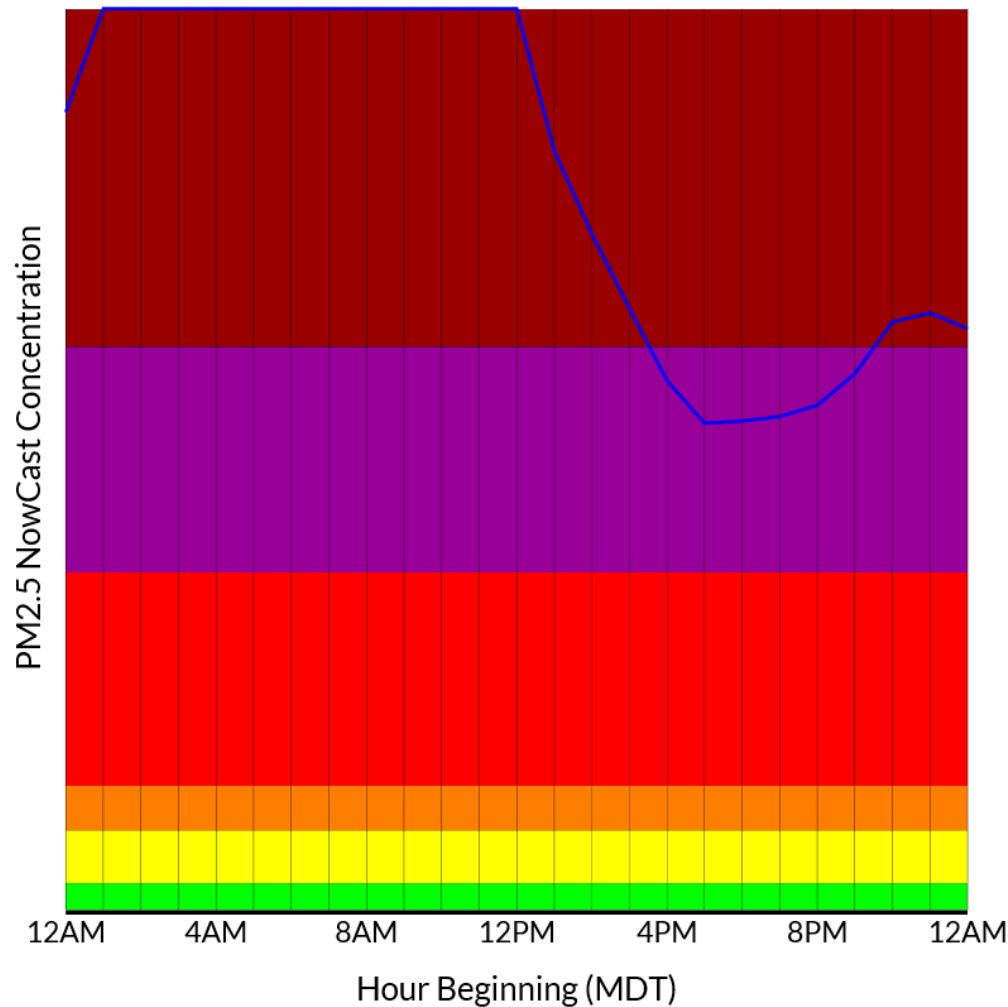
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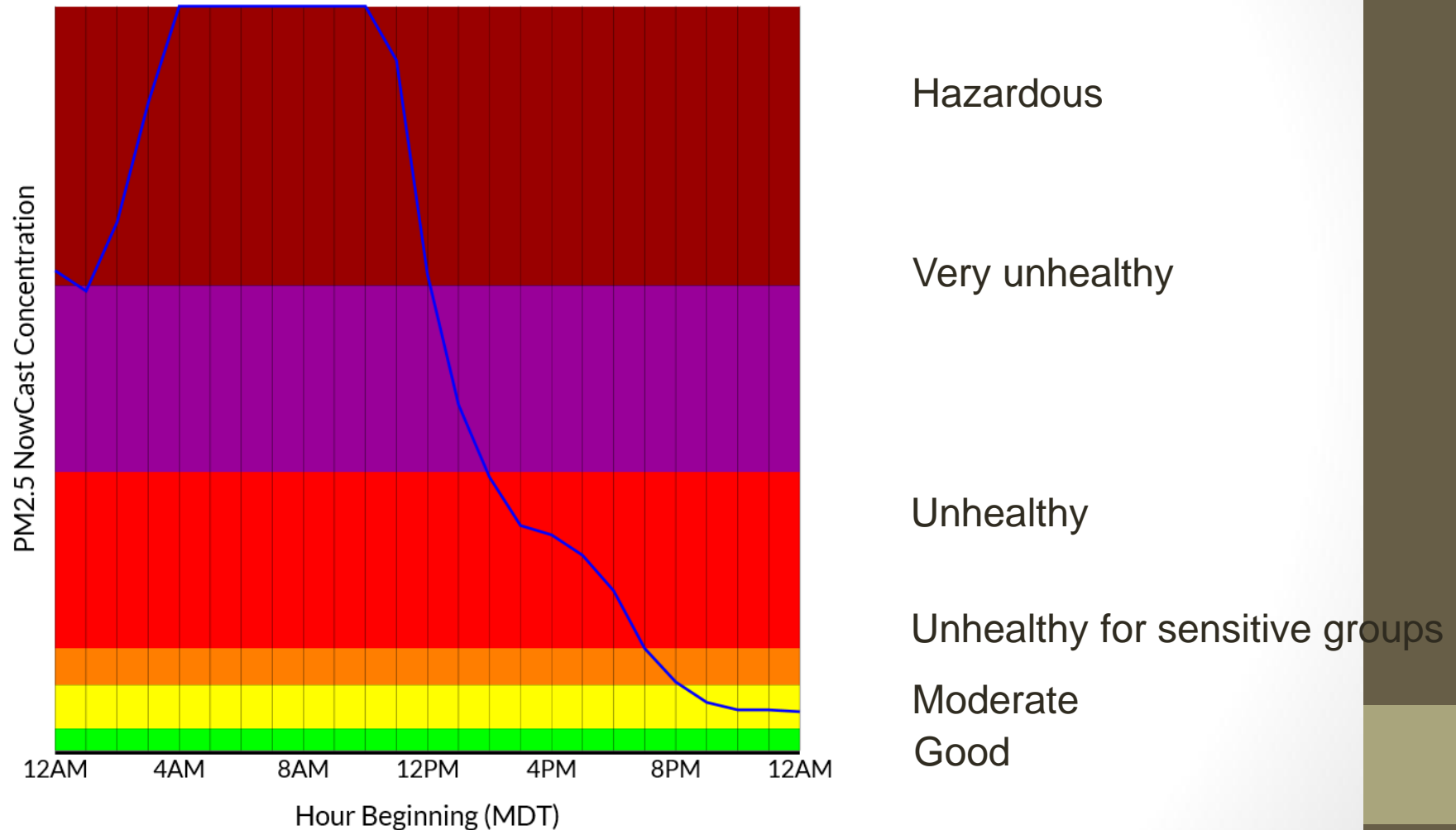
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Saturday, September 9, 2017



35 days of Hazardous air quality

How do we stay protected from
wildfire smoke?

Lots of great resources

- Wildfire Smoke – A Guide for Public Health Officials – USEPA
https://www3.epa.gov/airnow/wildfire_may2016.pdf
- Protect Yourself from Smoke – Centers for Disease Control and Prevention
<https://www.cdc.gov/features/wildfires/index.html>
- Guidance for BC Public Health Decision Makers During Wildfire Smoke Events – British Columbia Centre for Disease Control
http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Health-Environment/WFSG_BC_guidance_2014_09_03trs.pdf

Lots of great resources, cont.

- Montana DPHHS <http://dphhs.mt.gov/publichealth/airquality>
- Washington State Department of Health
<https://www.doh.wa.gov/CommunityandEnvironment/AirQuality/SmokeFromFires/WildfireSmoke>
- Oregon Health Authority
<http://www.oregon.gov/oha/ph/Preparedness/Prepare/Documents/OHA%208626%20Wildfire%20FAQs-v6c.pdf>
- Climate Smart Missoula <https://www.missoulaclimate.org/wildfire-resources.html>
 - 1-pager for kids, asthmatics, and seniors.

What you can do.

- Limit your exposure outdoors.
- Pay attention to local air quality reports
 - <https://www.airnow.gov/>
 - <http://svc.mt.gov/deq/todaysair/>
- Reduce activity outdoors.
- Stay indoors.

What you can do, cont.

- Keep indoor air as clean as possible.
 - avoid activities that increase indoor air pollution like burning candles, cooking (frying), smoking, or vacuuming.
- Keep windows and doors closed.
- Run an air conditioner if you have one.
 - keep the fresh-air intake closed and the filter clean to prevent outdoor smoke from getting inside.

What you can do, cont.

- If you do not have an air conditioner and it is too warm to stay inside with the windows closed, seek shelter in a designated evacuation center or away from the affected area.
- Create a clean room at home:
 - interior room with no windows, uses air filtration, no air pollution sources.
 - can use full time or only a few hours per day.
- Community clean air shelter:
 - building (or part of a building) with filtration.
 - can use full time or only a few hours per day.

Home filtration units.



3M Filtrete.

Filtrete results – wood stove homes

Pre filter PM_{2.5} measures:

PM_{2.5} median of 17.1 (range: 6.1, 163.1) $\mu\text{g}/\text{m}^3$.

Post filter PM_{2.5} measures:

PM_{2.5} median of 6.5 (range: 0.7, 65.6) $\mu\text{g}/\text{m}^3$.

- Geometric mean PM_{2.5} concentrations were reduced by 69%, while PM_{2.5} spikes were reduced by 54%.

What you can do, cont.

- Do not rely on surgical masks, dust masks, or wet bandanas.

- An “N95” Disposable Particulate Respirator, properly worn, will offer some protection.



Six Steps to wearing the N95 MASK



Step 1
Wash your hands before putting on the mask.



Step 2
Select a N95 mask that fits you well. It is available in different adult sizes and models*.



Step 3
Hold the mask in your hand and place it firmly over your nose, mouth and chin.



Step 4
First, stretch and position bottom band under your ears. Then, stretch and position top band high at the back of your head.



Step 5
Press the thin metal wire along the upper edge gently against the bridge of your nose so that the mask fits nicely on your face.



Step 6
Perform a fit check by breathing in and out. While breathing out, check for air leakage around your face.



*For instructions on how to wear different mask models:
www.moh.gov.sg/mask

For more information or updates on the haze:
www.e101.gov.sg/haze
www.haze.gov.sg
Tel: 1800 333 99 99 (MOH 24-hour Haze Hotline)

Elderly people, people with chronic lung disease, heart disease or stroke, and pregnant women should consult their doctor on the use of the N95 mask if they feel uncomfortable while breathing. N95 masks are not certified for use on children, so children should remain indoors as much as possible.



Call to leave Seeley Lake



Recommendations for Seeley Lake Residents to Avoid Smoke Unprecedented High Levels of Harmful Air Pollution from Wildfires Issued August 9, 2017

The Missoula City-County Health Department is issuing stronger recommendations for Seeley Lake residents to avoid the dangerous wildfire smoke in the community. Recent air monitoring readings show record levels of harmful wildfire smoke in Seeley Lake. Indoor air is not safe. The smoke that is outside is also inside the buildings.

The recommendations are for everyone, but they are especially important for groups with higher health risk from breathing smoke: infants, children, pregnant women, people with asthma, lung or heart disease, and everyone 65 and older.

- Spend as little as time in the Seeley Lake area as possible.
 - If you must be in Seeley Lake during the day, leave the area at night. The worst smoke is gathering overnight and is entering buildings.
 - Consider moving at-risk family members out of the area
 - If you do not have anywhere to go, the Red Cross has set up a shelter in the Potomac Valley. Anyone seeking to stay at the shelter may call the Red Cross of Montana at 1800-272-6668.

California wildfires - 2018

Carr Fire

- 229,651 acres (7/23/18 – 8/30/18).
- 1,079 residences, 22 commercial structures, 503 outbuildings destroyed
- 3 firefighters and 5 civilians killed



Mendocino Complex

- 459,123 acres, 7/27/18 – 9/18/18.
- 157 residential buildings destroyed, 123 others destroyed
- 1 firefighter killed, 4 firefighters injured



Camp Fire

- 153,336 acres, 11/8/18 – 11/25/18.
- 19,068 structures destroyed, 669 structures damaged
- 5 firefighters injured, 86 civilian deaths, 12 civilians injured, 3 civilians still missing
- “deadliest, most destructive wildfire in CA to date”



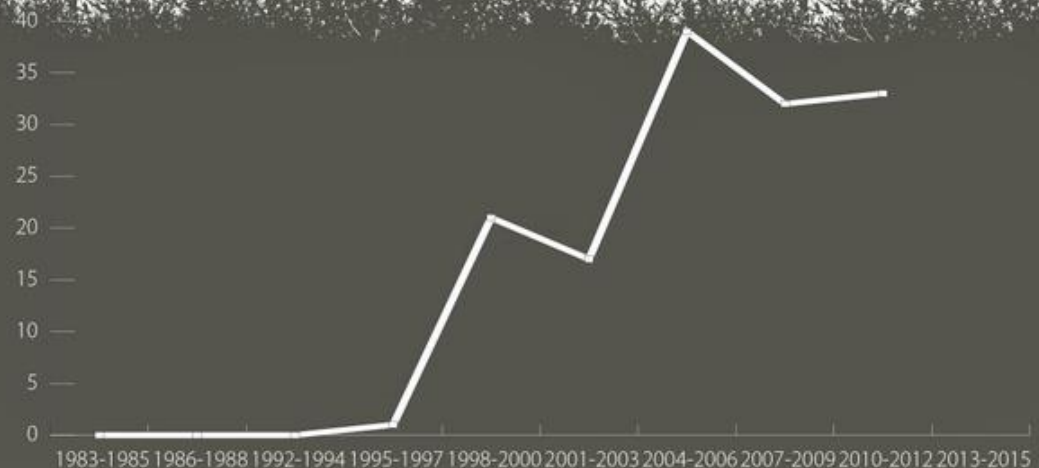
California air quality / health effects

- “Wildfire smoke brings world's worst air quality to northern California” – USA Today, Nov 15, 2018.
- “The smoke’s gone, but hearts and lungs still may be in danger months after wildfires” – Reveal, Nov 28, 2018.



Wildfires' Impacts Are Growing Exponentially

Number of wildfires,
larger than 100,000 acres
in size, that burned each year



Senator Maria Cantwell, Ranking Member
Senate Energy and Natural Resources Committee

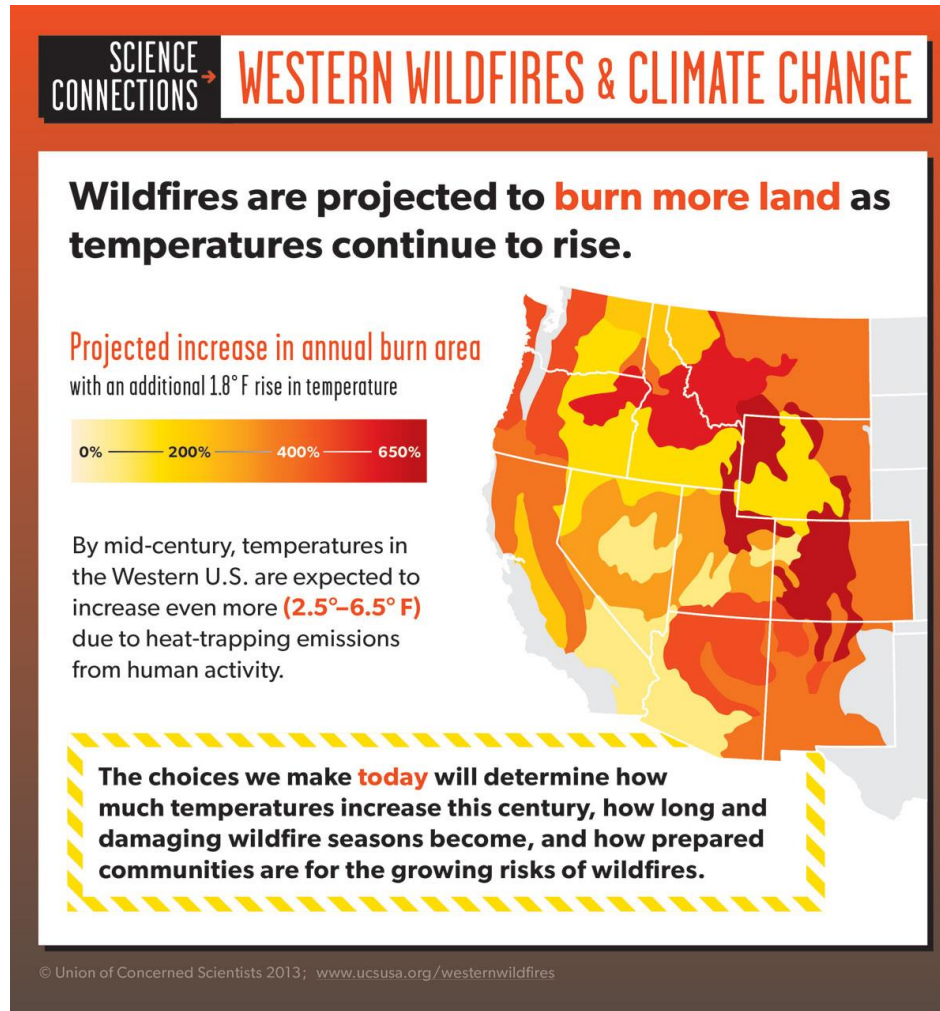
 **@SenateEnergy**

<http://wildfiretoday.com/tag/statistics/>

Montana Wildfires in the future

- **Temperatures:** projected to increase by ~3-10 °F by the end of the century, with the largest increases expected in the summer.
- **Winter precipitation:** projected to decline.
- **Summer precipitation:** projected to decline up to 30%.
- Declines in **snowpack** (amount and earlier melting) and **stream flows** (higher in late winter and early spring, and lower in summer).

Future wildfire projections



Every ecosystem type is projected to experience an increase in average annual burn area.



Missoula, MT Mon Sep 24 13:46:52 2012



Ellie Boldman-Hill Smith is at [University District, Missoula](#).

Yesterday at 12:17pm · Missoula, MT · 🌤️

In conclusion...

- Forest fire events are becoming more frequent and more intense.
- This impacts outdoor air quality, but perhaps more importantly, indoor air quality.
- Lots of great resources for public and environmental health professionals, as well as community members, to use during smoke events.
- There are several interventions available for reducing indoor PM_{2.5}, especially for sensitive populations.



Thank you.

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