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**THE UTILIZATION OF ENCLOSED CAB
BULLDOZERS FOR WILDFIRE SUPPRESSION
IN SOUTH CAROLINA**

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EXECUTIVE SUMMARY

The reduction in State government positions due to budget reductions and the overall economy of the State coupled with the changes in land use and the dramatic increase of “urban sprawl” has truly tested the South Carolina Forestry Commission’s Wildland firefighters over the past several years. Hazards from smoke produced by various plastics, rubber, solvents along with the natural dangers of a wildfire makes this occupation very dangerous. These men and women risk their lives each day and also jeopardize their future health. The following article recognizes several current issues of modern wildland firefighting and shows how enclosed cab bulldozers will alleviate these concerns.

THE ISSUE

In 1927, the S. C. Forestry Commission was created with one of the primary responsibilities to protect the forestlands from wildfires. In 1942, the first John Deere farm tractors with disc tillers were purchased to suppress wildfires. In 1947-48, the Commission purchased 4 crawlers and 31 farm tractors for suppression efforts. (See photo #1).¹ This marked the beginning of crawlers being used for suppressing wildfires. In the early 1960's, protective cabs were built to protect the operators in the 71 crawler tractors. Today, the fleet of 157 crawler tractors all have rollover protection (ROP) and screened cabs to insure operators safety. (See photo #2 and appendix)² It is now time for the Forestry Commission to make another vast improvement in our firefighting fleet. The implementation of enclosed cab bulldozers for fire suppression has numerous benefits and very few drawbacks for the safety of the modern wildland firefighters.

AIR QUALITY

PROBLEM: Smoke created by wildfires is becoming a growing concern. What used to be known as “part of the job” is now a growing health concern. “The effects of smoke range from eye and respiratory tract irritation to more serious disorders, including reduced lung function, bronchitis, exacerbation of asthma and premature death.”³

“During the 2000 wildfire season, large numbers of firefighters were required to seek medical attention for upper respiratory problems. ‘Breathing high smoke concentrations does expose those persons to toxic compounds contained in the smoke,’ says Shannon Therriault, air quality specialist with the Missoula City-County Health Department.

¹www.state.sc.us/forest/scmiss.htm.

²Ken Cabe, Interview, Media Spokesperson, S. C. Forestry Commission; 12/20/04

³www.arb.ca.gov/smp/prodev/pubeduc/wfgv8.pdf

‘One of the greatest hazards in smoke lies in the particulate matter, a general term for that mixture of solid particles and liquid droplets found in air. Particulate from smoke tends to be very small, and as a result, is more of a health concern than the coarser particles,’ Therriault said. ‘For example, the diameter of the average human hair is about 30 times bigger. These particles can build up in your respiratory system, causing a number of health problems, including burning eyes, runny noses, cough, headache and irritated sinuses. Long term exposure, such as on the order of what firefighters experience, can impair lung function and possibly lead to cardiopulmonary disease and lung cancer.’

Studies have found that fine particulate matter, alone or with other pollutants, is linked to a number of significant respiratory and cardiovascular-related diseases. In addition, airborne particles are respiratory irritants and laboratory studies show that high concentrations of particulate matter cause persistent cough, phlegm, wheezing and physical discomfort in breathing. Particulate matter also can alter the body’s immune system and affect removal of foreign materials like pollen and bacteria from the lungs.’⁴

See figure 1 and 2 for health effects and public health measures as it related to fire particulate matter.⁵

PROBLEM: In addition to particulates, other substances in smoke can cause health problems. Acrolein, formaldehyde and Benzene are known to be in smoke and can cause health risks such as nasal cancer, anemia, liver and kidney damage and other cancers. As more and more wildfire consume outbuildings, campers, trailers, and/or debris piles, the

⁴Robin Bible, “Breathless”, July 1, ’02; Wildfiremag.com (page 2 & 3)

⁵www.arb.ca.gov/smp/prodev/pubeduc/wfgv8.pdf

threat of smoke laced with “toxic chemicals such as polyvinyl chloride, which is used in upholstery, wire, pipe and wall coverings grows. Burning PVC creates hydrogen chloride and phosgene. Polyethylene and PVC often are more dangerous when smoldering than during the high heat of a working fire, emitting carbon monoxide, hydrogen cyanide, hydrochloric acid and other chemicals.”⁶

SOLUTION: To alleviate this concern, an enclosed cab equipped with a filtered air conditioning unit and a pressurized cab will greatly reduce, if not eliminate, this threat. The average particulate matter in smoke is “about 0.3 micrometers in diameter.”⁷ A filtration unit equipped with a purple High Efficiency Particulate Arrestor (HEPA) filters offer the highest protection. These filters remove 99.97 percent, or more, of the particulate matter (0.3 microns and greater).⁸ Combined with an organic vapor back-up, these filters can help reduce exposure to gases, such as benzene and aldehydes, as well as particles.”⁹ The key to a good filtration system is a pressurized cab. This positive inside air pressure eliminates contamination from outside the system, which makes the filtration system highly effective.¹⁰

⁶Robin Bible, “Breathless”, July 1, '02; Wildfiremag.com

⁷www.arb.ca.gov/smp/prodev/pubeduc/wfgv8.pdf

⁸www.labsafety.com/refinfo/ezacts/ezf275.htm Document #275 (page 4

⁹www.arb.ca.gov/smp/prodev/pubeduc/wfgv8.pdf

¹⁰Bill Frye, Interview, Owner, GR Manufacturing; 10/10/04

NOISE CONTROL

PROBLEM: Noise exposure levels to today's firefighters is another concern. "Noise is probably the most common occupational hazard facing people today. It is estimated that as many as 30 million Americans are exposed to potentially harmful sounds at work."¹¹ "According to an Environmental Protection Agency (EPA) reportmore than nine million Americans are exposed to daily average occupational noise levels above 85 decibels (dB)."¹²

The average dozer operator is exposed to 89-103 dB (decibels) with an average of 96dB.¹³ "A bulldozer that is idling (note that this is idling, not actively bulldozing) is loud enough that it can cause permanent damage after only one (1) work day (8 hours)".¹⁴

SOLUTION: The use of enclosed, acoustical cabs will reduce this threat of hearing loss. Operator ear noise levels per ISO 6396 are 5-8 dB lower with a cab.¹⁵ By reducing noise inside the equipment cabs, clearer radio communications can be given and received. Better communications will lead to less errors and misunderstandings on wildfires and controlled burns, allowing the firefighter to perform his job more safely and efficiently reducing the loss of life and property.

¹¹www.dangerousdecibels.org/hearingloss.cfm (page 2)

¹²Hoop, Cornelis F. de, et. al, " Some Measured Levels of Noise Produced by Logging Equipment in 1998" ; 8/ 7/03; (page 2)

¹³www.nonoise.org/resource/construc/bc.htm (page 7)

¹⁴www.dangerousdecibels.org/hearingloss.cfm (page 2)

¹⁵Hoop, Cornelis F. de, et. al, " Some Measured Levels of Noise Produced by Logging Equipment in 1998" ; 8/ 7/03; (page 2)

EYE CONCERNS

PROBLEM: Enclosed cabs offer a great deal of eye protection. “With more than 700,000 work related eye injuries happening each year and nearly one million Americans having already loss some degree of sight,”¹⁶ this protection is needed. Common hazards such as dust, smoke, chemicals (acids and bases, fuels, etc.) and organic debris (bark, wood, etc.) can lead to injuries such as corneal abrasions, chemical burns, eyeball laceration and facial contusion.¹⁷

SOLUTION: With the enclosed pressurized cab, eye injuries will be dramatically reduced. The glass is 550 degrees Fahrenheit safety glass which should protect the operator from outside contaminates and should offer some ultraviolet (UV) light protection, if tinted.¹⁸ This UV protection should also add to the operators eye safety. The rate of UV protection will depend on the type of glass and tint ordered for each individual tractor(s).

EXTREME TEMPERATURES

PROBLEM: In addition to respiratory and eye hazards, wildland firefighters also are subject to temperature extremes. Heat stress has long been identified as a problem, but firefighters may be exposed to stress from cold and damp conditions, especially on mid- and late-season fires. Cold weather conditions can lower body temperature, impairing performance and increasing the likelihood of injuries. When your body loses more heat than you can produce, your temperature falls. Hypothermia may occur and can become life threatening.¹⁹

¹⁶www.preventblindness.org/resources/factsheets/preventingocceyeinjuriesmk33.pdf, 2003; (page 1)

¹⁷www.cdc.gov/niosh/eyesafe.html, (page 2)

¹⁸Don Poindexter, Interview, Equipment Section Chief, Florida Division of Forestry, 1/7/05

¹⁹www.fs.fed.us/t-d/pubs/htmlpubs/html00512307/index.htm

SOLUTION: The heating system on these recommended cabs will alleviate this cold stress.

PROBLEM: Much more attention has been paid to heat related problems due to the relationship of the fire, the season, and the physical environment. Overheating is a serious concern. “Elevated core body temperature is a problem for many, including athletes, industrial workers, miners, firefighters and soldiers. As the temperature of the body’s core organs (heart, lungs, liver, kidneys, and brain) rise, fatigue sets in and strength, endurance and cognitive functions deteriorate rapidly.”²⁰

There are basically three standards to evaluate heat issues:

Heat Stress: Workers lose their concentration or become fatigued or irritable and thus increase the chance of accidents and injuries.

Heat Exhaustion: Victim may have all or some of the following signs or symptoms:
heavy sweating; clammy, flushed or pale skin; weakness; dizziness;
nausea; rapid and shallow breathing; headache; vomiting; or fainting.

Heat Stroke: A life threatening, heat related disorder which may result in coma or death. Signs include shivering, nausea, irritability and severe headache progressing to mental confusion, convulsions and unconsciousness.

SOLUTION: To prevent these potentially life threatening issues from occurring, several steps are recommended. Fluid replacement, acclimatization, etc. along with minimization of heat exposure can alleviate these maladies. Minimizing heat exposure and limiting exposure time both top the list to increase safe work practices.²¹ This can be accomplished by the air conditioning systems in the enclosed cabs.

²⁰www.hindu.com/seta/2004/04/08/stories/20040408000131800.htm ;4/8/04; (page 1)

²¹<http://are.berkeley.edu/heat/preventinginag.html> (page 1 & 2)

JOB STRESS

ISSUE: Stress is common in today's workplace. Most bulldozer operators deal with this problem on a daily basis. "Job stress can be defined as the harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources, or needs of the worker. Job stress can lead to poor health and even injury."²² In several cases, stress directly relates to the health of today's firefighters. Working conditions or the work environment strongly influences the source of job stress. Job stress can be related to:

Cardiovascular disease; Musculoskeletal disorders; Psychological disorders; Workplace injury; Suicide, cancer, ulcers and impaired immune functions"²³

SOLUTION: Although job stress may never be totally eliminated, a better work environment will lower the stress level.

BIOLOGICAL HAZARDS

PROBLEM: A less obvious benefit to enclosed cabs is the protection from insects. West Nile Virus is a mosquito-borne virus which can cause a serious condition called "encephalitis", an inflammation of the brain. "Although only 1 in 150 people who are infected with West Nile Virus will require hospitalization. There is a 3% to 15% death rate in humans who develop encephalitis."²⁴

Honey bees, yellow jackets, hornets, wasps and fire ants are all known to be hazardous to operators. Killer bees, although not wide spread across the Southeast yet, are a concern to operators in Texas, Florida and Arizona.²⁵ Deer ticks and common ticks also worry operators

²²www.cdc.gov/niosh/stresswk.html; 1/7/99; (page 6 & 11)

²³www.cdc.gov/niosh/stresswk.html; 1/7/99; (page 6 & 11)

²⁴www.azdhs.gov/phs/oids/westnile/wnv-qa.htm; 4/27/04; (page 1 & 2)

²⁵www.stingshield.com/2003news.htm

Lyme disease from deer ticks is a growing concern among the timber industry today.

SOLUTION: By utilizing enclosed, pressurized cabs the workers will be better protected and more confident in their operations.

DRAWBACKS

CONCERNS: With the many benefits, there are a few drawbacks to enclosed cabs. Many seasoned firefighters who have been placed in enclosed cabs have initially complained of lacking the ability to sense the fire's intensity and hear engine sounds. After reconditioning themselves, these same operators will not run anything else.²⁶ Several operators experienced a problem with glare from the window glass. This glare and/or reflection gives them the false sense that the fire had crossed their firebreak. From a maintenance standpoint, the filtration system on the cabs fill up quickly in harsh conditions (heavy smoke, dry dust, etc.). This can reduce or stop the air conditioning system from functioning. If a window glass breaks (or) the filtration system breaks, the tractor must be taken out of service for repairs. In addition to these drawbacks, the average enclosed cab tractor will cost more. However, this cost is minimal at approximately 7% to 9% per unit more than the traditional open cabs.²⁷

CONCLUSION

Within the last ten years, the S. C. Forestry Commission has suppressed 4,589 wildfires for an average per year of 26,576 acres. Counties such as Williamsburg and Berkeley, have an average of 350 – 400 fires per year (based on the past 10 years with 6-8 operators per county). The decision to equip our tractors with enclosed cabs is clear after considering the demanding workload, an increase in urban population, a drop in experienced operators

²⁶Don Poindexter, Interview, Equipment Section Chief, Florida Division of Forestry, 1/7/05

²⁷Paul Williams, Interview, Manager of State and Federal Accounts, John Deere, 1/14/05

(decrease in number from 229 in 1983 to 150 operators in 2005) and the above mentioned environmental hazards for the operators.²⁸ South Carolina State Forester Robert C. Schowalter states, “The tractor-plow unit is the primary wildfire suppression tool throughout the southeast; as such, it is one measure of capacity. Over the past fifteen years, the S C. Forestry Commission has lost more than 40 tractor-plow units. In terms of sheer numbers, that sets us back more than thirty years. . . right where we were in 1972”.²⁹ The time has come for a new era. To deny the State’s wildland firefighters the best resources available would hinder, if not risk, the lives of the men and women that protect our land, property and our lives each fire season.

²⁸Ken Cabe, Interview, Media Spokesperson, S. C. Forestry Commission; 12/20/04

²⁹Robert C. Schowalter; “Carolina Forestry Journal”, 10/1/04; (page 2)

BIBLIOGRAPHY

- Bible, Robin. "Breathless". Wildfiremag.com. July 1, '02 (page 2 & 3)
- Cabe, Ken. Interview. Media Spokesman. S. C. Forestry Commission. 12/20/04
- Frye, Bill. Interview. Owner. GR Manufacturing. 10/10/04
- Hoop, Cornelis F. de, et. al, "Some Measured Levels of Noise Produced by Logging Equipment in 1998" ; 8/ 7/03; (page 2)
- <http://are.berkeley.edu/heat/preventinginag.html> (page 1& 2)
- Poindexter, Don. Interview. Equipment Section Chief. Florida Division of Forestry. 1/7/05
- Schowalter, Robert C. "Carolina Forestry Journal". 10/1/04. (page 2)
- Williams, Paul. Interview. Manager of State and Federal Accounts. John Deere. 1/14/05
- www.arb.ca.gov/smp/prodev/pubeduc/wfgv8.pdf (page 4, 9, 10, 11)
- www.azdhs.gov/phs/oids/westnile/wnv-qa.htm; 4/27/04; (page 1& 2)
- www.cdc.gov/niosh/eyesafe.html (page 2)
- www.cdc.gov/niosh/stresswk.html; 1/7/99; (page 6 & 11)
- www.dangerousdecibels.org/hearingloss.cfm (page 2)
- www.fs.fed.us/t-d/pubs/htmlpubs/htmlpubs/htm00512307/index.htm
- www.hindu.com/seta/2004/04/08/stories/20040408000131800.htm ;4/8/04; (page 1)
- www.labsafety.com/refinfo/ezacts/ezf275.htm Document #275 (page 4)
- www.nonoise.org/resource/construc/bc.htm (page 7)
- www.preventblindness.org/resources/factsheets/preventingocceyeinjuriesmk33.pdf ;2003; (page 1)
- www.state.sc.us./forest/scmiss.htm (page 1)
- www.stingshield.com/2003news.htm

Photo 1



1950

Photo 2



1980

First fireplow: Hester heavy plow, purchased fall 1932; used with CCC or cooperator tractors.
This was used as a fireline plow to establish permanent breaks, not for fire
fire suppression.

First tractors: two RD 4 Caterpillar diesel crawlers purchased 1937-38, used for fireline maintenance

First suppression tractors: five John Deere medium farm tractors with three-disc tillers purchased 1942-43
Photo is on page 15 of the 1969-70 annual report.

FY 47-48: 4 crawlers, 31 wheel tractors

FY 48-49: 5 heavy crawlers, 6 light crawlers, 25 wheel tractors
skeleton brush guard over the hood of some light crawler tractors (BG Cletrac), nothing
over driver
no protection at all on heavy units
(photos in SCFC annual report FY 48-49 pp 40-41)

FY 49-50: 5 heavy crawlers, 6 light crawlers, 24 wheel tractors
still no canopy over heavy units; photo annual report 49-50, p. 25
no canopy over wheel tractors
began installing Bombardier half tracks on wheel tractors, photo p. 38

FY 50-51: 5 heavy crawlers, 1 medium crawler, 5 light crawlers, 17 light semi-crawlers (half-tracks)
still no canopy on heavy crawlers; photo annual report p. 92

FY 51-52: 5 heavy crawlers, 1 medium crawler, 5 light crawlers, 29 half-tracks
no canopies on half-tracks; photos pp.22, 43
no canopy on light crawler; photo p. 31

FY 55-56: first use of call letters on top of trucks.

FY 56-57: crawler with a grab bar and protective frame in front of cab. Annual Report p. 54

FY 57-58: light crawler with shield in front of cab. Annual Report p.30. May be same arrangement
as noted on p. 54 of 1957 annual report.
Still no protection on heavy unit; photo Annual Report p. 30.

FY 59-60: mentioned shops building "equipment bodies". Could have included some crawler cabs; see
following entry.

FY 60-61: first photo of cab on medium crawler, Annual Report, p 49. Also shows a light crawler with
no protection. Report again mentions building "equipment bodies."

FY 64-65: photo on p. 19 of Annual Report shows tractors with cabs.

FY 65-66: photos of spring blow-up on p.30-31 shows cabs on tractors. Still no screens across the front.

FY 66-67: photos of tractors with canopies and partial screens on side; Annual Report, p. 16.
Other photos p. 27-29 show all tractors with canopies.

NOTE: very few pictures in Annual Reports after 1967.

RECORD OF TRACTOR-PLOW UNITS OWNED BY SCFC BY YEAR

<u>FY</u>	<u># UNITS</u>
42-43	7
43-44	14
44-45	17
45-46	17
46-47	35
47-48	35
48-49	35
49-50	37
50-51	37
51-52	37
52-53	37
53-54	40
54-55	45
55-56	52
56-57	56
57-58	63
58-59	68
59-60	70
60-61	71
61-62	71
62-63	74
63-64	78
64-65	81
65-66	87
66-67	96
67-68	107
68-69	124
69-70	145
70-71	161
71-72	178
72-73	192
73-74	202
74-75	212
75-76	214
76-77	229
77-78	229
78-79	229
79-80	229
80-81	229
81-82	229
82-83	229
2001-02	183
2004-05	157

Table 2. Health Effects and Cautionary Statements

Category (see Table 3)	Health Effects	Cautionary Statements ¹	Other Protective Actions
Good	None expected	None	None
Moderate	Possible aggravation of heart or lung disease	Unusually sensitive individuals should consider limiting prolonged or heavy exertion. - People with heart or lung disease should pay attention to symptoms - If you have symptoms of lung or heart disease, including repeated coughing, shortness of breath or difficulty breathing, wheezing, chest tightness or pain, palpitations, nausea, unusual fatigue or lightheadedness, contact your health care provider.	- If symptomatic, reduce exposure to particles by following advice in box below.
Unhealthy for Sensitive Groups	Increasing likelihood of respiratory or cardiac symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly.	<i>Sensitive Groups:</i> People with heart or lung disease, the elderly, children and pregnant women should limit prolonged or heavy exertion. - Limit time spent outdoors - Avoid physical exertion - People with asthma should follow asthma management plan - If you have symptoms of lung or heart disease that may be related to excess smoke exposure, including repeated coughing, shortness of breath or difficulty breathing, wheezing, chest tightness or pain, heart palpitations, nausea, unusual fatigue or lightheadedness, contact your health care provider.	- Keep doors and windows closed, seal large gaps as much as possible - If cooling is needed, turn air-conditioning to re-circulate mode in home and car, or use ceiling fans or portable fans (but do not use whole house fans that suck outdoor air into the home). - Avoid indoor sources of pollutants, including tobacco smoke, heating with wood stoves and kerosene heaters, frying or broiling foods, vacuuming, and using paints, solvents, and adhesives - Keep at least 5-day supply of medication available. - Have supply of non-perishable groceries that do not require cooking.

¹ Higher advisory levels automatically incorporate all of guidance offered at lower levels.

Table 2. Health Effects and Cautionary Statements (continued)

Category (see Table 3)	Health Effects	Cautionary Statements ¹	Other Protective Actions
Unhealthy	Increased aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; increased respiratory effects in general population.	<p><i>Sensitive Groups:</i> should avoid prolonged or heavy exertion</p> <ul style="list-style-type: none"> - Stay indoors; avoid exertion. <p><i>General Population:</i> should limit prolonged or heavy exertion</p> <ul style="list-style-type: none"> - Limit time spent outdoors - If you have symptoms of lung or heart disease that may be related to excess smoke exposure, including repeated coughing, shortness of breath or difficulty breathing, wheezing, chest tightness or pain, palpitations, nausea or unusual fatigue or lightheadedness, contact your health care provider. 	<p><i>Sensitive Groups:</i></p> <ul style="list-style-type: none"> - Stay in a "clean room" at home (where there are no indoor smoke or particle sources, and possibly an air cleaner is used). - Go to a "cleaner air" shelter (see Appendix A) or possibly out of area <p><i>General Population:</i></p> <ul style="list-style-type: none"> - Follow advice for sensitive groups in box above. - Identify potential "cleaner air" shelters in the community (see Appendix A).
Very Unhealthy	Significant aggravation of heart or lung disease, premature mortality in persons with cardiopulmonary disease and the elderly; significant increase in respiratory effects in general population.	<p><i>General Population:</i> should avoid prolonged or heavy exertion</p> <ul style="list-style-type: none"> - Stay indoors, avoid exertion 	<p><i>General Population:</i> If symptomatic, evacuate to cleaner air shelter or leave area, if safe to do so.</p>
Hazardous	Serious aggravation of heart or lung disease, premature mortality in persons with cardiopulmonary disease and the elderly; serious risk of respiratory effects in general population.	<p><i>General Population:</i> should avoid any outdoor activity.</p>	<p><i>General Population:</i> If symptomatic, evacuate to cleaner air shelter or leave area, if safe to do so.</p>

¹ Higher advisory levels automatically incorporate all of the guidance offered at lower levels.

FIGURE 2

Table 3. Recommended Actions for Public Health Officials

Category	PM _{2.5} or PM ₁₀ Levels (µg/m ³ , 1- to 3-hr avg.)	Visibility - Arid Conditions (miles)	Recommended Actions
Good	0 - 40	≥ 10	If smoke event forecast, implement communication plan
Moderate	41 - 80	6 - 9	<ul style="list-style-type: none"> - Issue public service announcements (PSAs) advising public about health effects/symptoms and ways to reduce exposure - Distribute information about exposure avoidance
Unhealthy for Sensitive Groups	81 - 175	3 - 5	<ul style="list-style-type: none"> - If smoke event projected to be prolonged, evaluate and notify possible sites for clean air shelters - If smoke event projected to be prolonged, prepare evacuation plans
Unhealthy	176 - 300	1.5 - 2.5	<ul style="list-style-type: none"> - Consider "Smoke Day" for schools (i.e., no school that day), possibly based on school environment and travel considerations - Consider canceling public events, based on public health and travel considerations
Very Unhealthy	301 - 500	1 - 1.25	<ul style="list-style-type: none"> - Consider closing some or all schools (However, newer schools with a central air cleaning filter may be more protective than older, leakier homes. See "Closures", below) - Cancel outdoor events (e.g., concerts and competitive sports)
Hazardous	> 500	< 0.75	<ul style="list-style-type: none"> - Close Schools - Cancel outdoor events (e.g., concerts and competitive sports) - Consider closing workplaces not essential to public health - If PM level projected to continue to remain high for a prolonged time, consider evacuation of sensitive populations