Michigan Smoke Management Program

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Michigan Smoke Management Program Executive Summary

Prescribed fire, and to a limited extent naturally ignited wildfire (formerly known as wildland fire use) are important tools in Michigan for meeting land management objectives, restoring and maintaining fire dependent ecosystems, providing wildlife habitat, reducing hazardous fuel buildups and meeting silvicultural and other needs. However, (wildfire and prescribed fire) can be a intermittent source of particulates that have the potential to cause significant short-term impacts on human health, welfare, safety, and visibility. This Smoke Management Program (SMP) has been developed to minimize those potential air quality impacts associated with wildland fire while optimizing the opportunities to use fire as a land management tool.

The SMP has been developed based on the principles identified in The Exceptional Events Rule (EER) Parts 50 and 51 of March 22, 2007 and Section VI, "Smoke Management Programs" of the U.S. Environmental Protection Agency's (EPA) April 23, 1998 "Interim Air Quality Policy on Wildland and Prescribed Fires". The signatories to this SMP agree to abide by its provisions for wildland fires they ignite or for naturally ignited fires that they manage.

The purposes of this Smoke Management Program shall be to:

- Protect human health and prevent exceedence of the National Ambient Air Quality Standards (NAAQS).
- Mitigate public nuisance and safety hazards (e.g. on roadways and airfields).
- Reduce smoke intrusions into populated areas.
- Minimize unnatural visibility impacts in federal mandatory Class I areas.
- Provide the basis for basic smoke management practices.
- Provide the continued opportunity to use fire as a land management tool.

In the nine year period from 2001 through 2009, public land managing agencies, The Nature Conservancy, and members of the Landowner Incentive Program treated approximately 90,000 acres of land in Michigan using prescribed fire. While land managing agencies are projecting an increase in acreage treated with prescribed fire, there is also a significant private sector interest in restoring and maintaining ecosystems which could further increase the number of acres treated.

* Planning Process and Involvement

The Federal Clean Air Act, as amended, established National Ambient Air Quality Standards, and regulations that address pollutants emitted by wildland fire. The Michigan Department of Environmental Quality, Air Quality Division has the authority to implement and enforce these federal standards and regulations.

The Director of the Michigan Department of Natural Resources (MDNR) is granted authority in Michigan for issuing permits for open burning within the State. This authority was

established by the Michigan Natural Resources and Environmental Protection Act, Public Act 451 of 1994, as amended (Act 451), Part 515 and associated administrative rules.

Michigan generally has meteorological conditions that result in good ventilation and resultant smoke dispersion during the spring. Historically most wildland fire activity, including both prescribed and wildfire, takes place this time of year. Generally, topography has an insignificant influence on smoke dispersion in the state.

For the purposes of the Smoke Management Program, prescribed burn plans must include those elements under Item 1 below and consider the elements under items 2, 3, 4, 5, 6 and 7. Smoke impacts are considered and evaluated on all wildfires and affect management decisions and actions. Decisions on naturally ignited wildfires will consider duration of event and smoke impacts given current and predicted smoke impacts.

Item 1

A process for assessing and authorizing burns. This would include reporting of plan information to the administering agency that exceed the de minims size, 20 acres with a fuel loading of less than 3 tons/acre for purposes of this plan.

a. Location and legal description of the area to be burned.
b. Personnel responsible for managing the fire.
c. Type of vegetation or fuel type/model to be burned.
d. Area in acreage to be burned.
e. Estimated Fuel Loading (tons/acre) on the site.
f. Fire prescription including smoke management components.
g. Criteria the fire manger uses for the go-no-go decision.
h. Safety and contingency plans, which address smoke intrusions.

Item 2

Consider plans for the long-term minimization of emissions and impacts, including promotion of alternates to burning and the use of emission reduction techniques. This becomes a case by case basis dependent on the specific site objectives. i.e. there is no alternative to fire in the case of fire dependent ecosystems.

Item 3

Smoke management goals and procedures to be described in burn plans meeting the reporting requirement.

a. Actions to minimize emissions.
b. An evaluation of smoke dispersion.
c. Public notification and exposure reduction procedures to be implemented during air pollution episodes or smoke emergencies.
d. Air quality monitoring, currently there are limited air quality monitors at various locations around the state. Any additional monitoring would become the fiscal responsibility of the requiring party.

Item 4

Public education and awareness program development.

Item 5
Surveillance and enforcement of smoke management program compliance.

Item 6
Program and evaluation and a 2 year plan review period for the initial implementation of the SMP.

Item 7
Optional programs, these may include special protection zones, buffer areas or performance standards.

The agencies and organizations that are signatories to this document currently follow most of the recommendations found within it. Two requirements of this SMP that may require improvements to planning documents are the inclusion of information on fuel loading and the desired range of predicted ventilation index. Methods related to determination of these values are included in the SMP and related tables. The local offices of the National Weather Service (NWS) currently includes a daily ventilation index in their morning and afternoon forecasts which fire managers can use to make go, no-go decisions.

Michigan Smoke Management Program
April 2007

Chapter 1

1.1 An Overview of Michigan's Smoke Management Needs

Since pre-European settlement, fire has been used as a land management tool to enhance and maintain the State's forest, grassland, and wetland resources. *With ever increasing fragmentation and development of Michigan's landscape, the potential impacts to human populations from prescribed fire use increases.*

In 2003, several public and private land management agencies and organizations agreed to develop and implement a Smoke Management Program (SMP) to mitigate potential air quality impacts from wildland fire. Signatories to this plan will apply the provisions of the SMP to both prescribed fires they ignite or to any naturally ignited fires that they manage for resource benefit. The Program will become effective when the State Director of the Department of Environmental Quality certifies in writing to the Environmental Protection Agency (EPA) that a SMP has been adopted and implemented.

In general, agencies and organizations in Michigan that conduct prescribed burns prepare site specific burn plans and apply for open burning permits. State law and/or local ordinances require burn permits for all "open burning" except when the ground is snow covered -- *here only local ordinances may apply*. Currently most prescribed fire plans include provisions that address the effects of smoke. This SMP will begin a formal effort to minimize impact of smoke produced from managed wildland fires in Michigan by stressing best management practices (BMPs) when using fire as a tool.

This SMP is based The Exceptional Events Rule (EER) Parts 50 and 51 of March 22, 2007 and Section VI, "Smoke Management Programs" of the U.S. Environmental Protection Agency's (EPA) April 23, 1998 "Interim Air Quality Policy on Wildland and Prescribed Fires". These documents may be found at http://fire.r9.,fws.gov/ifcc/smoke/EPA_Policy.htm . The Program will be reviewed biennially and the document amended as necessary to achieve the purpose of the Plan and incorporate changes in regulations, policies and advances in technology. Currently agricultural burning is not addressed by the EPA's interim guidance document or state law. Changes in either case would be incorporated into the Program.

1.2 Use of Fire as an Ecosystem Management Tool in Michigan

Historically, the ecosystems of Michigan evolved with fire as a major agent of disturbance (Albert et al. 1986). As the expansive white pine forests of Michigan were logged off and cleared for farming in the late 1800's, major forest fires followed feeding on the resultant slash and altered climatology (Mitchell & Robson 1950).

The fires of this period resulted in expansion of many fire dependent/disturbance based ecosystems. Jack pine, oak savanna and prairie all increased at this time, replacing the white pine forests in many areas throughout Michigan. It's the remnants of many of these systems that are currently maintained and restored by prescribed fire.

Use of managed fire has been intermittent since the post-logging era fires. The various ecosystem types that have a fire dependent element have reflected the impacts of this intermittent pattern. Savannas, pine barrens, grasslands, and many other plant communities require fire for health and maintenance. The differing degrees of fire occurrence over the past 100 years have resulted in a loss of acreage of these systems.

The air quality impacts related to wildland fire-generated smoke emissions in the period of 1871-1925 when over 10,000,000 acres burned were greater than the impacts of today's fire generated emissions. We understand that air today is not cleaner than in the past as industrialized society has produced new sources of emissions from smokestacks to internal combustion engines.

The use of wildland fire presents the need to weigh the trade-offs associated with the ecological benefits of fire versus the impacts of a short term increase in emissions from current and accelerated burning programs. Part of this trade-off involves the careful consideration of and application of smoke management techniques to minimize the amount and/or impact of emissions while still meeting ecological needs. An example of this trade-off to be considered is the increased fuel consumption from a wild fire burning under severe meteorological conditions vs. the reduced fuel consumption of a prescribed fire ignited that might burn under moderate weather conditions.

In Michigan, agricultural and non-agricultural rural landowners, landscape companies, The Nature Conservancy (TNC), Michigan Nature Association (MNA), Michigan Department of Natural Resources (MDNR), National Park Service (NPS), U.S. Fish & Wildlife Service (USFWS), U. S. Forest Service (USFS), Michigan Department of Military and Veterans Affairs (DMVA), Michigan Department of Transportation (MDOT), the Bureau of Indian Affairs (BIA), Ann Arbor Parks, and several local units of government use fire to accomplish goals and objectives ranging from ecosystem management to fuels reduction. Used for the right reasons and under prescribed conditions, fire has proven to be a cost effective and environmentally sound management tool.

USDA conservation programs offered through the Natural Resources Conservation Service (NRCS), as well as other programs, place an emphasis on prescribed fire, making the increased use of fire in the private sector a general trend.

In 2003 and 2004, public land agencies, TNC and other reporting groups burned 21,263 acres in Michigan. Of the total, 80% were grassland fuel types and 15% were timber litter fuel types. The same group projected to increase burning to 26,300 acres in 2005, and over 31,000 acres in 2006. Both years were short of this projection: 8099 acres in 2005 and 10,924 acres in 2006, because of a combination of weather factors and budget shortfalls.

Many of the vegetative communities within the state evolved with fire as the natural process. Prescribed fire, therefore, is the preferred management tool for restoration and maintenance when safety and environmental conditions permit. Vegetative types ranging from grasslands and prairie plantings, to wetlands, savannas, conifer and hardwood forests, brush lands and agricultural fields are all treated with fire. Broadcast burning is the preferred method for large scale land treatments. Piled slash is burned throughout the year

and, in some cases, is a practice legally mandated to mitigate insect and disease related problems, such as the Emerald Ash Borer and oak wilt.

Agricultural uses of fire range from removal of excess crop-residue prior to plowing, disking or planting to treatments to enhance the growth of perennial crops and to improve grazing.

Interagency RX Burn Completion Table			
Agency/ Organization	Year	Acres Projected/Treated	Fuel Models
USF&WS	2001	26	3
DNRE	2001	967	1,3,11
USFS	2001	900	1,2,8,9
TNC	2001	145	1,3,8,9
Ann Arbor Parks	2001	175	1,3,8,9
2001 Total		**2213**	
USF&WS	2002	10	3
DNR	2002	2269.5	1,3,8.11
USFS	2002	1300	1,2,8,9
TNC	2002	139	1,3,8,9
Ann Arbor Parks	2002	51	1,3,8,9
2002 Total		**3769.5**	
USF&WS	2003	1229	3,9,10
DNRE	2003	6224	1,3,8,9,11
USFS	2003	1900	1,2,8,9
TNC	2003	382	1,2,3,8,9
Ann Arbor Parks	2003	93	1,3, 8,9
DMVA Fort Custer	2003	80.9	1, 3, 9
2003 Total		**9908.9**	
USF&WS	2004	2740	3,5,9
DNRE	2004	4908	1,2,3,8,9,11
USFS	2004	2925	1,2,8,9
TNC	2004	582	1,2,3,8,9
Ann Arbor Parks	2004	134	1,3, 8,9
DMVA Fort Custer	2004	464.5	1, 3, 5, 9
2004 Total		**11753.5**	
USF&WS	2005	135	3,5
DNRE	2005	3867	1,2,3,8,11
USFS	2005	1904	1,2,8,9
TNC	2005	450	1,2,3,8,9
Ann Arbor Parks	2005	150	1,3,8,9
DNRE-LIP	2005	639	1,2,3
DMVA Fort Custer	2005	954.3	1, 3, 5, 9
USF&WS	2006	1818	3,9,10
2005 Total		**9917.3**	
DNRE	2006	2901	1,2,3,8,11
USFS	2006	2274	1,2,8,9
TNC	2006	600	1,2,3,8,9
Ann Arbor Parks	2006	175	1,3,8,9
DNRE-LIP	2006	897	1,2,3,8
DMVA Fort Custer	2006	2259.2	1, 3, 5, 9

2006 Total		**9106.2**	

Interagency RX Burn Completion Table			
USF&WS	2007	1332	3, 5, 9
DNRE	2007	3797	1, 2, 3, 8,11
USFS	2007	3887	1, 2, 8, 9
TNC	2007	360	1, 2, 3,8,9,10
Ann Arbor Parks	2007	83	3, 5, 8, 9
2007 Total		**9459**	
USFS&WS	2008	3145	3, 5, 9
DNRE	2008	9012	1, 2, 3, 8,11
USFS	2008	5210	1, 2, 8, 9
TNC	2008	462	1, 2, 3,8,9,10
Ann Arbor Parks	2008	136	3, 5, 8, 9
2008 Total		**17965**	
USFS&WS	2009	5558	3, 5, 9
DNRE	2009	3068	1, 2, 3, 8, 11
USFS	2009	5688	1, 2, 8, 9
TNC	2009	769	1, 2,3,8,9,10
Ann Arbor Parks	2009	172	3, 5, 8, 9
2009 Total		**15255**	

In summary, the reasons to use fire (prescribed fire and wildfire) include:

Wildlife habitat improvement and maintenance
Site preparation and seed production
Ecosystem management and restoration
Maintenance of biological diversity
Restoration of fire as a natural process
Control of insect and disease
Fuel reduction, including hazardous fuels
Range and pasture improvements and maintenance
Research ranging from ecosystem based, to fire behavior and smoke management modeling system evaluation.
Minimizing the potential for significant air quality impacts from wildfire
An additional benefit is the training of personnel resources and testing of suppression equipment and suppression techniques.

Basis for Developing a Michigan Smoke Management Program

The purpose of an SMP is directly related to the mitigation of public health, nuisance and safety hazards posed by smoke intrusions into populated areas and roadways. The goals are to prevent deterioration of air quality, violations of the National Ambient Air Quality Standards (NAAQS), and address visibility impacts on mandatory Class 1 Federal areas. The NAAQS referred to here are for particulate matter (PM) less than 2.5 microns ($PM_{2.5}$) and PM less than 10 microns (PM_{10}) in diameter.

The EPA "Interim Air Quality Policy on Wildland and Prescribed Fires" issued April 1998 states that there are "strong indications" that a SMP is necessary if any of the following result from fire use;

1. Citizens increasingly complain of smoke intrusions.

2. The trend of monitored air quality values is increasing (approaching the daily or annual NAAQS for $PM_{2.5}$ or PM_{10}) because of significant contributions from fires managed for resource benefits.

3. Fires cause or significantly contribute to monitored air quality that is already greater than 85 percent of the daily or annual NAAQS for $PM_{2.5}$ or PM_{10}; or

4. Fires in the area significantly contribute to visibility impairment in mandatory Class 1 Federal areas.

Only Item 1 – citizens' complaints of smoke intrusions – seems to have any broad based implications at the present time. NAAQS related issues are isolated and not related to wildfires managed for resource benefits at this time.

The reasons an SMP is being developed for Michigan are:

1. There has been a significant increase in the use of prescribed fire in Michigan.

Section 1.2 and Table 1.2a identify a trend of increased use of prescribed fire in Michigan. This follows a nationwide trend identified by federal and state land managers. Prescribed fire is increasing in use to maintain, enhance and restrore ecosystems and increase biodiversity and productivity. The adoption of the State Smoke Management Program may prevent PM NAAQS violations related to emissions from prescribed fire and other wildland fires managed for resources benefits in Michigan.

2. To protect and improve visibility in mandatory Class I areas in Michigan in accordance with the EPA Regional Haze Rule.

Section 169A of the Clean Air Act Amendments (CAAA) of 1977 sets forth "the national goal of preventing any future, and remedying any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from man-made air pollution." The EPA rules issued in 1980 included language directed at those sources "reasonably attributable" to visibility impairment. With the addition of section 169B of the CAAA of 1990, Congress addressed "regional haze" visibility impairment in the nation's national parks and wilderness areas. The EPA determined that all 156 listed mandatory Class I areas across the nation demonstrate impaired visibility based on monitoring data from the Interagency Monitoring of Protected Visual Environments (IMPROVE). This includes the Class I areas of Isle Royale National Park and the wilderness portion of the Seney National Wildlife Refuge. It should be noted that the Seney NWR has planned for extensive fire use to meet management objectives within that Class I area.

EPA published their final Regional Haze Rule on July 1, 1999 (64FR35714). This rule is directed at all air pollution sources that have the potential to cause or contribute to visibility impairment including: 1) stationary sources (industry), 2) mobile sources (vehicles), 3) area sources (gas stations, dry cleaners, etc.), and 4) the use of managed fire. Of the pollutants most responsible for haze (nitrates, sulfates, soil material, organic carbon, and elemental carbon), organic and elemental carbon are produced by vegetative burning. The regional haze program goal is to show continued improvement in monitored visibility in Class I areas and restore natural background conditions by 2064. States were required to submit a Regional Haze State Implementation Plan (SIP) to the EPA by December of 2007 that demonstrated reasonable progress toward the national visibility goal. For a number of reasons this submittal was delayed and EPA is now required to either approve Michigan's draft SIP or promulgate their own by November 15, 2012. This initial plan submittal will outline measures the States will implement through 2018, at which time the States will review their progress and revise their SIPs. The Smoke Management Program can require methods to minimize the impact of managed fire on visibility in Class I areas as part of their regional haze SIP submittal.

For the Class I areas in Michigan and the two in Minnesota (Voyagers National Park and the Boundary Waters Canoe Area Wilderness) it is important to note that smoke from wildland fires has not been found to be an important source of visibility impairment at this time (Midwest RPO, 2008)

3. To prevent PM NAAQS violations related to emissions from prescribed fire managed for resource benefits.

Through the implementation of the SMP, land management agencies, organizations, and the private sector manage potential emissions and smoke impacts from managed fires so that emissions do not contribute to "non-attainment" status with the NAAQS and State air quality standards. The EPA Interim Guidance document explains that States which implement a certified SMP and have wildfire smoke significantly contribute to an exceedence of the NAAQS, will not have these areas automatically designed as "non-attainment." This incentive by the EPA for implementation of a SMP is important if an area of the State were to violate the air quality standards due to smoke produced by prescribed burning.

The EPA Exceptional Events Rule published on March 22, 2007 further clarifies that all wildfires and wildland fire use fires will be considered as natural events and will not be counted in determining an area's attainment or non-attainment status. The impact of prescribed fires may be discounted if the State has certified that the fire was conducted under an SMP or the burner was using basic smoke management practices.

If an area of a state violates the NAAQS for either $PM_{2.5}$ or PM_{10}, the state must prepare a PM SIP (State Implementation Plan) and submit it to EPA for approval. The PM SIP sets forth measures that the state will undertake to reduce levels of Particulate Matter air pollution and to return non-attainment areas to compliance with the standards. Air monitors for $PM_{2.5}$ and PM_{10} collect air samples that are analyzed to measure compliance or non-compliance. Air modeling is done to determine the sources of the pollutants and the effect of emission reductions on the concentrations of those pollutants. The SIP requirements can

include restrictions on the construction of new sources of emissions, or emissions reductions on existing sources whose emissions contributed to the violations. When the EPA approves an SIP, its conditions become federally enforceable. At that time, facilities and other sources addressed in the SIP are accountable to both the state and to the EPA for a compliance schedule of emissions reductions.

As previously stated, with the projected increase of prescribed burning in Michigan, it is prudent to set in place a SMP so that smoke emissions do not contribute in non-attainment status with the NAAQS. These standards are further discussed in Chapter 2.

Chapter 2 Compliance and Responsibilities

2.1 Legal Requirements and Environmental Regulations for a Michigan Smoke Management Plan

The Clean Air Act (Public Law 95-95) as amended in 1977 and 1990 identifies standards and legal requirements that must be met by the EPA, other Federal agencies, the states, and industry. Prior to 1990, the Federal Clean Air Act did not directly address prescribed burning. However, the latest amendments contain a number of sections which may result in both direct and indirect regulatory controls.

Section 109 of the Clean Air Act (CAA) requires EPA to develop primary ambient air quality standards to protect human health and secondary standards to protect welfare. In July of 1987, the EPA promulgated ambient air quality standards for those particulates less than 10 microns in diameter (PM_{10}). The PM_{10} standards were designed to protect that portion of the population which is most susceptible to the effects of airborne respirable particles with an adequate margin of safety. However, more recent research indicated that the PM_{10} standard did not protect those people who already had existing respiratory problems. As a result EPA issued their initial fine particulate standards in July, 1997 to regulate those particulates less than 2.5 microns in diameter ($PM_{2.5}$). These standards are of interest to the wildland fire community because approximately 70% of the particulate emitted from biomass burning are in this size range. More current epidemiological studies indicate a much stronger relationship between increases in $PM_{2.5}$ concentrations and mortality and morbidity. As a result, EPA revised these standards in September, 2006 reducing the 24 hr standard from 65 to 35 micrograms per cubic meter ($\mu g/m^3$). The annual standard stayed the same at 15 ($\mu g/m^3$). (see Table 1, PM Ambient Air Quality Standards)

Michigan has been in attainment for PM_{10} since October 1996. However, a review of the State's $PM_{2.5}$ monitoring data for the years 2001-2003, showed 6 out of 39 total $PM_{2.5}$ monitors in the State measured a 3-year average above the NAAQS of 15 $\mu g/m^3$ (micrograms/cubic meter). Thirteen other monitors met the standard but measured a 3-year average value greater than 85 % of the annual standard. Five of the six monitors with high values are located in the industrial area of Detroit, the sixth is just downwind from Toledo, Ohio.

$PM_{2.5}$ has been decreasing in the nonattainment areas in Michigan in recent years, Until the

3 year period (2007-2009), the new 24 hour standard of 35 µg/m^3 was not being met at

some monitors. Air monitors indicate that both the annual and 24 hour $PM_{2.5}$ standards are now being met.

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Up-to-date monitoring data and monitor address information is available from the USEPA web site.

Prescribed fire does not contribute to these NAA situations at this time as the majority of prescribed fire activity occurs away from the areas cited above. The SMP will play a role in maintaining this.

EPA's PM Standards: Old and New

	1997 Standards July 17, 1997		2006 Standards September 21, 2006	
	Annual	**24-hour**	**Annual**	**24-hour**
$PM_{2.5}$ (Fine Particles)	**15 µg/m³** Annual average	**65 µg/m³** 98th percentile	**15 µg/m³** Annual average	**35 µg/m³** 98th percentile
PM_{10} (Coarse Particles)	**50 µg/m³** Annual average	**150 µg/m³** 1 expected exceedance	**Revoked**	**150 µg/m³** 1 expected exceedance

Section 110 CAA requires the state to develop State Implementation Plans (SIPs) which identify how the state will attain and maintain national ambient air quality standards (NAAQS) and meet other Federal air quality regulations.

Section 112 identifies 187 hazardous air pollutants (HAPs); the EPA has identified 33 HAPS as part of their urban area source program as required under Section 112 (k) but is only one portion of the air toxics program. *Five of these HAPs are emitted from biomass burning: Acetaldehyde, Acrolein, 1,3 Butadiene, Formaldehyde, and Polycyclic organic matter.*

While this section focuses control requirements on major and minor stationary air pollution sources, the State and EPA are trying to determine the risk to the public from all air toxic emission sources including biomass burning.

Section 116 allows states to develop standards and regulations which are more stringent than Federal standards and regulations.

Section 118 requires all agencies to comply with all Federal, State, and local air quality regulations to the same degree as any non-governmental entity. This was amended in 1990 so that it applies to:

A. Any requirement whether substantive or procedural. This would include any record keeping or reporting requirements and permitting.
B. Any requirement to pay a fee or charge imposed by the State or local agency to defray the cost of its air pollution regulatory program.
C. The exercise of any Federal, State, or local administrative authority.
D. To any process and/or sanction, whether enforced in Federal, State, or local courts or in any other manner.

Sections 160-169 provide for the prevention of significant deterioration of air quality in those areas of the county which currently have air quality concentrations which are better than the standards set under Section109. *This section of the Act would not apply to wildland fire.*

Section 169A provides visibility protection for the mandatory Federal Class I areas in Michigan which are the wilderness portion of the *Seney NWR and Isle Royal NP.* Pictured Rocks and Sleeping Bear National Lakeshores are not Class I areas and would not fall under the regional haze rules to improve visibility in these areas. However, these and other scenic areas in Michigan are important to its residents and the tourism industry. See the EPA's Visibility and Regional Haze website for more information.

Section 176 (c) prohibits Federal Agencies from permitting, approving, providing financial assistance, or supporting in any way an activity which does not conform to an EPA approved State Implementation Plan. This section of the Act only applies to federal agencies. However, a federal agency's prescribe burn emissions are presumed to conform to these plans provided the burn is conducted under a certified smoke management program (SMP), and thus no determination is required.

Section 190 directs the EPA to issue technical guidance on reasonably available and best available control measures for prescribed silvicultural and agricultural burning. This guidance was developed in 1992, but is out of date due to language changes in other parts of the act and significant improvement in smoke management technology.

Section 319 directs EPA to promulgate regulations governing the review and handling of air quality monitoring data influenced by an exceptional event .These regulations were designed to codify a number of existing EPA policies into a rule. That rule was published on March 22, 2007. Basically, the Rule provides that if exceptional events cause violations of the NAAQS, EPA would use its discretion not to redesignate an area as non-attainment.

An important policy included in the Rule was the 1998 EPA Interim Air Quality Policy on Wildland and Prescribed Fire. The policy integrated two public policy goals: (1) to allow fire to function as nearly as possible in its natural role in maintaining healthy wildland ecosystems, and (2) to protect public health and welfare by mitigating the impacts of air pollution emissions on air quality and visibility. The document identified significant procedural and legal benefits for the States and the users of wildland fire if they develop smoke management programs that are State certified and submitted to the EPA. A State

Smoke Management program would establish a standard framework of those related procedures and requirements for managing smoke from prescribed fires.

However as a result of the new Exceptional Events Rule, EPA has committed to revise the Interim Policy.

The Rule defines an exceptional event as an event that:

- Affects air quality
- Is not reasonably controllable or preventable
- Is an event caused by human activity that is unlikely to recur at a particular location
- Is a natural event

Examples of Exceptional Events are:

- Chemical Spills and Industrial Accidents
- Structural Fires
- Exceedances due to Transported Pollution
- Exceedances due to a Terrorist Attack

Natural Events:

- Volcanic & Seismic Activities
- Natural Disasters & Associated Clean-up Activities
- High Wind Events
- Wildfires
- Stratospheric Ozone Intrusions

The rule states that wildfires or "wildland fire use fires" will be treated as natural events. Prescribed fires managed for resources benefits may qualify for exceptional events if they meet certain criteria:

- "Unlikely to recur at the same location" and "not reasonably controllable or preventable"
- Where State certifies that a smoke management program (SMP), or basic smoke management practices were followed on an event by event basis.

EPA's handling of data from all other fires will continue to be addressed under the Interim Air Quality Policy for Wildland and Prescribed Fires.

2.2 Agency Authority

The Michigan Department of Environmental Quality – Air Quality Division (MDEQ – AQD), has the authority to implement and enforce Federal regulations related to air quality standards.

The MDEQ – AQD maintains the air monitor system throughout the state. If an air monitor in the state exceeds the NAAQS for a criteria pollutant for the first time, then the area in violation of the standard is designated as "non-attainment." As required by Section 110 of the CAA, the state must submit a SIP to the EPA identifying what measures the state will take to reduce emissions affecting the area in order to meet and maintain compliance with the standard. Each plan shall include "enforceable emission limitations and other control

measures" as required by Section 110. This would apply to facilities and sources that contribute to the violation of the standard. Construction and modification of stationary sources within non-attainment areas would be subject to emission offset regulations which require any new emissions to obtain emission offsets from existing air pollution sources. This requirement is designed to result in a net emission decrease to help bring the area back into attainment.

By implementing the requirements of a SIP that has EPA approval, the MDEQ-AQD enforces compliance with air quality standards within the State of Michigan. Regulatory instruments that may be included in a SIP in order to return an area to compliance with an air quality standard, include statutes, rules, orders, or permit conditions. If any of these become part of a federally approved MI SIP, the measure would become both State and Federally enforceable

Michigan has developed a draft Regional Haze SIP and submitted it to EPA for approval. The Haze SIP addresses Michigan's impact on: its two Class I areas (Isle Royale NP and Seney NWR), as well as other neighboring Class I areas. The EPA is under court order to take final action on the draft haze SIP by November 15, 2012.

2.3 DNR Responsibilities and Role as Smoke Management Program Central Authority.

The MDNR Forest Resources Division is responsible for issuing permits for open burning in Michigan. This authority is stated in the Natural Resources and Environmental Protection Act, Public Act 451 of 1994, as amended (Act 451), Part 515 and associated administrative rules.

The Department of Natural Resources issues permits for open burning of vegetative materials during that period when the ground is not covered with snow. Permits for prescribed burning are required at all times, including when the ground is snow-covered (Rule R281.424)

Some municipalities and/or townships may have local ordinances more restrictive than the state rules. In these cases permitting of open burning is administered locally.

Historically the Federal agencies in Michigan have complied with state burning regulations. Procedures for coordinating open burning restrictions between state and federal agencies have been handled by the Michigan Interagency Wildland Fire Protection Association. This SMP shall represent a formal agreement among signatory agencies and organizations to guide future state burning regulation compliance for prescribed burning with regard to smoke impact reduction.

Chapter 3 - Fire Management in Michigan

3.1 Agency/Organization Overview

The primary agencies and organizations that use prescribed burning as a management tool in Michigan are the MDNR, USFWS, USFS, DMVA, MDOT, TNC, BIA, NRCS, Ann Arbor Parks and the Michigan Nature Association. All of these organizations are projecting an increase in the use of prescribed fire as a management tool in the future. It is estimated that 75 percent of the acreage they currently and project to burn are vegetated in grasses. The balance is forested with hardwoods or conifer types with a limited amount of slash burning.

The objectives of prescribed fire use are similar between all the above users. Most prescribed fires in Michigan have an ecosystem management objective. Restoration and maintenance of native plant communities, forest silvicultural treatments, wildlife habitat improvement and maintenance, insect and disease control, improving biological diversity, invasive species management, along with an increasing number of fuel reduction projects, are the basic objectives of most prescribed burning in Michigan. Several federal agencies have the authority to use naturally ignited wildfires to achieve management objectives.

Climate Factors that Influence Smoke Production and Dispersion

An important element of a SMP includes consideration of the factors that affect smoke production and dispersion. Smoke production is a function of fuel consumption and associated fuel moisture. Smoke dispersion is a function of ventilation, which is the process within the atmosphere that mixes and transports smoke away from its source.

Michigan is dominated by two major biotic associations, the Eastern Broadleaf Forest of the southern Lower Peninsula and the Laurentian Mixed Forest of the Upper Peninsula and the northern Lower Peninsula. These correspond, more or less, with the Köppen climatic classification of Michigan as *Humid Continental*, with temperature extremes distinguishing the two regions.

More specifically, the climate of Michigan is controlled by five major influences:

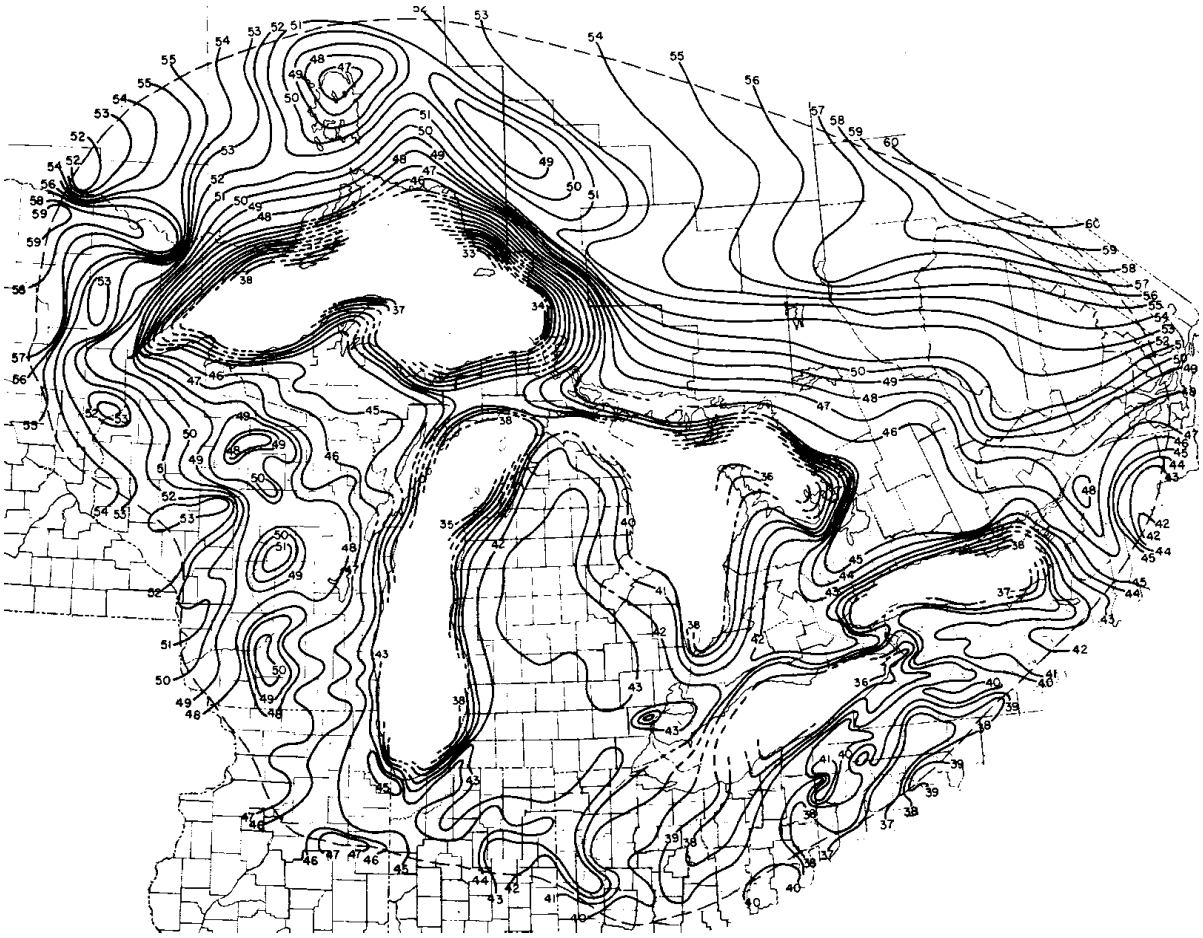
- **Latitude**, which controls day length, is responsible for seasonal temperature contrasts and influences many of the other atmospheric conditions that affect weather. Michigan, located in the mid-latitudes, experiences sharp temperature contrasts from season to season that result in a range in smoke dispersion potential.
- **Continentality** of the region is related to Michigan's position in the interior of North America. Because large land masses tend to absorb and re-radiate solar energy more quickly than large water bodies, Michigan's continentally generally reinforces and intensifies the sharp temperature contrasts produced in the mid-latitudes because the moderating influence of the oceans is reduced.
- **Large Air Masses** generally control day-to-day variations within particular seasons. **Tropical Maritime** air masses, which originate in the Gulf of Mexico, are the principal source of moisture. About 75 percent of Michigan's annual precipitation is associated with these air masses. **Polar Maritime** air masses, which originate in the North Pacific Ocean and, at times, in the Atlantic Ocean, generally lose much of their moisture before reaching the Great Lakes. **Arctic** air masses from the Arctic Ocean and **Polar Continental** air masses from northern Canada deliver little moisture, bringing mostly cold air. The character of an air mass may affect smoke dispersion.

- **Atmospheric Disturbances** are responsible for much of the severe weather and abrupt changes in weather conditions, occurring most frequently along the “jet stream” which represents the boundary between air masses moving south from the polar regions and those moving north from the tropics. The jet stream and the associated disturbances are most frequently overhead in the spring and fall, producing greater instability and windiness in those seasons.
- The **Effects of the Great Lakes** that form much of Michigan’s border (Huron, Michigan, and Superior) significantly modify its continentally. Figure 1 depicts the continentality index, an indicator developed by Victor Conrad in 1950. Values of the index range from 0 to 100, with 0 representing the least continental and 100 representing the most. As shown by the tight contours and the lower values, areas most modified by lake effect are along Lake Superior and Lake Michigan, especially the eastern Upper Peninsula.

As a result, the state has been divided into climate zones in a number of different ways:

- In the Upper Peninsula, east and west divisions are generally accepted, with strong lake effect dominating the east more than the west.
- In the Lower Peninsula, divisions are less obvious, though the effect of Lake Michigan is greater than that of Lake Huron, leaving a large interior region. These create east/west divisions to go along with the north/south division identified earlier, resulting in at least 6 zones (Northwest, North Central, Northeast, Southwest, South Central and Southeast).

Figure 1: Continentality around the Great Lakes (Eichenlaub, 1979)



Climatology of Atmospheric Ventilation

The most common overall index for measuring atmospheric ventilation is the **Ventilation Index** (VI). It is simply the product of Mixing Height and Transport Wind Speed and indicates the lower atmosphere's ability to diffuse and disperse smoke. A formula and interpretation table can be found on page 30 & 31 of this document. **Transport Wind Speed** is the arithmetic average (speed and direction) of wind in the mixing layer. **Mixing Height** is defined as the upper limit of a mixed layer in unstable air, in which upward and downward exchange of air occurs.

In general, the optimum conditions for effective smoke ventilation are a dry, windy (but not too windy) and unstable lower atmosphere. Poorest dispersion is usually the result of moist, calm and stable conditions in the lower atmosphere. A high VI means smoke should disperse in an efficient manner while a low value means the dispersion of smoke in the lower atmosphere will be hindered. However, as surface winds increase, smoke is less and less likely to reach the mixing height. And, as with many simple indices based on the product of two or more factors, a high VI value may obscure the fact that one of the factors may be low and effectively reduce smoke dispersion itself. Both the component transport wind and mixing height should be considered along with the VI when evaluating potential smoke dispersion.

Daily monitoring of atmospheric conditions and weather forecasts are necessary to determine the impacts of large air masses and atmospheric disturbances on smoke dispersion. Mixing Height, Transport Windspeed, and Ventilation Index are produced as part of daily Fire Weather Planning Forecasts in Michigan. These forecasts may be found on the fire weather page for each National Weather Service Forecast Office (Marquette, Gaylord, Grand Rapids, and Pontiac). They may also be accessed at http://fire.boi.noaa.gov/

In General:

- For much of the year throughout much of the state, atmospheric conditions are capable of acceptably dispersing wildland fire smoke and smoke byproducts. However, seasonal trends in atmospheric dispersion potential should be part of any plans for smoke management associated with fire use.
- Subsidence inversions that form as a result of sinking and warming air under a broad ridge of high pressure can impede smoke dispersal for a period of days or weeks. They can occur in any season, and are most important in the spring when they produce critical fire weather conditions in Michigan. Persistent summertime high pressure can produce a similar situation.
- Radiation inversions that occur through the cooling of the earth's surface during the night result in shallow inversions that may linger through part or much of the following day and impede smoke dispersal. These are generally more important in the spring, fall and winter.
- Local factors, especially marine inversions associated with cooler seasons and onshore breezes associated with the summer months affect smoke dispersal. They may reduce or enhance smoke dispersal in the areas where the great lakes influence is the greatest.

In addition to the daily variations in weather factors, seasonal and spatial variations over the state will impact smoke dispersal. In fact, because the Ventilation Index is an open index, it is important to know the range of variability found in any given area. This aspect of Michigan's climatology is managed within the USFS Pacific Northwest Research Station's Ventilation Climate Index System. Derived from 40 years of historic data, it provides graphics representing day-to-day and year to year variability for windspeed, mixing height and ventilation index for specific locations using a 5km grid cell size. In addition the data can be displayed as statewide maps of monthly averages for the same three variables.

The monthly depictions of Mixing Height and Ventilation Index in Michigan reflect some of the seasonal and spatial variation apparent in the state. Here are a few of the more significant interpretations:

In the Upper Peninsula:

- The months of May, June, August and September historically represent the highest overall VI, though the somewhat lower mixing heights in August and September may represent more potential problems.
- Overall, the eastern Upper Peninsula exhibits higher VI's than the west.
- Overall, the moderating influence of Lake Superior appears to increase VI.

- The historic record indicates that conditions in July provide for the lowest VI.

In the Lower Peninsula:

- Overall, the western Lower Peninsula exhibits the lowest ventilation index historically anywhere in the state, with historically low values in July and August
- The most favorable months for ventilation index appear to be May, June and September. Unlike the Upper Peninsula, August appears to be much less favorable for at least the west half of the Lower Peninsula.
- The historic record indicates that the East Central Lower Peninsula (Saginaw Bay and Thumb area) exhibits generally favorable ventilation index for much of the fire season, with lowest values surprisingly found in May

Climatology of Fuel Moisture and Fuel Availability

Seasonal trends in temperature and moisture conditions also vary from one region to another, affecting fuel availability, fuel moisture and smoke production. In addition to the Ventilation Climate data, there is considerable historic weather data collected by fire management agencies in Michigan. In the Upper Peninsula, there are at least 6 fire weather stations (Watersmeet, Gwinn, Doe/Blue Lake, Elkhorn, Seney, and Raco) that have recorded data reaching back into the mid 1970's. In the Northern Lower Peninsula, another 3 stations(Atlanta, Baldwin, and Mio) have similar records. Daily weather observations at these stations include temperatures (1300 EST, daily max/min), relative humidity (1300 EST, daily max/min), wind speed and direction, and daily precipitation amount and duration. From these, a variety of fuel moisture codes and fire indices are calculated. Among these, two individual codes provide valuable insights into variations in fuel availability and consumption both seasonally and spatially.

Michigan fire management agencies have agreed to use the Canadian Forest Fire Danger Rating System (CFFDRS). Definitions of the Canadian Forest Fire Weather Index (FWI) System codes and indexes referenced in this plan are available on the Natural Resources Canada website.

- The Buildup Index (BUI) is used to indicate the total amount of fuel available for combustion by a moving flame front. It is based on temperature, relative humidity and precipitation quantity.

- The Drought Code, (DC) is an indicator of moisture content in deep, compact organic layers. This code represents the fuel layer approximately 4 to 8 inches deep, having a potential fuel loading of about 200 tons/acre. The DC is indicative of long-term moisture conditions and can be used in estimating the potential for deep burning fires.

The graphs prepared for each climate division depict the seasonal progression for BUI and DC, showing the historic average and maximum plots for a single station or group of stations (SIG) where enough records are available. In addition to these, two historic years for Michigan are included as reference, 1976 (most significant fall drought season) and 1988 (most significant spring/early summer season).

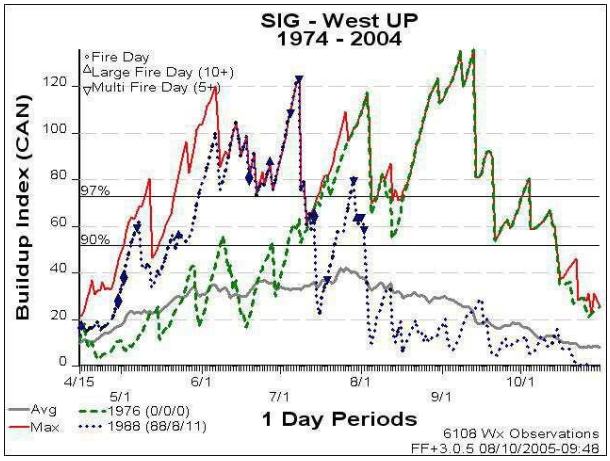
Trend lines for the average and maximum values show the variation in potential fuel availability throughout the fire season. Peak values indicate the effect of latitude and continentality on the potential availability and consumption of fuels.

Western Upper Peninsula: Strongly continental, with only moderate influence along the Lake Superior shoreline. Temperatures are extremely cold in the winter. Snowfall and rainfall are heavy adjacent to Lake Superior as a result of moisture-laden air from the lake being forced to rise rapidly over the bedrock uplands at the northern edge of the section. Overall, only 14 to 29 percent of the precipitation occurs between November and February, with the lower percentages to the south and west. This probably accounts for the reduced numbers of forest fires in the northern and eastern parts, along with the reduced dominance of upland conifers.

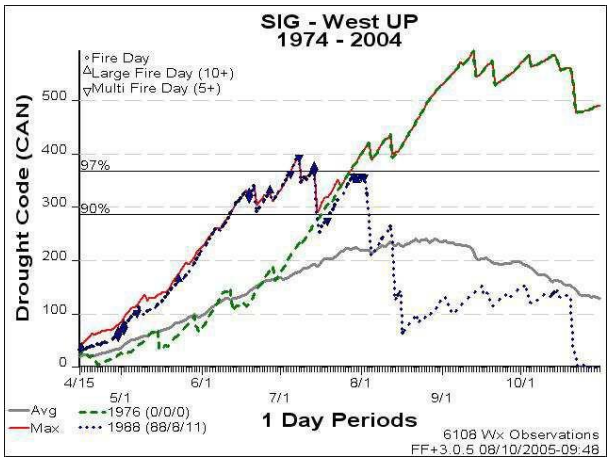
Average BUI peaks in late July with values just over 40 while 90% of all BUI values are below 55. At the same time, average values for DC peak at 250 in late August, while 90% of all days have DC's less than 300.

West Upper Peninsula

CFFDRS Buildup Index (BUI)

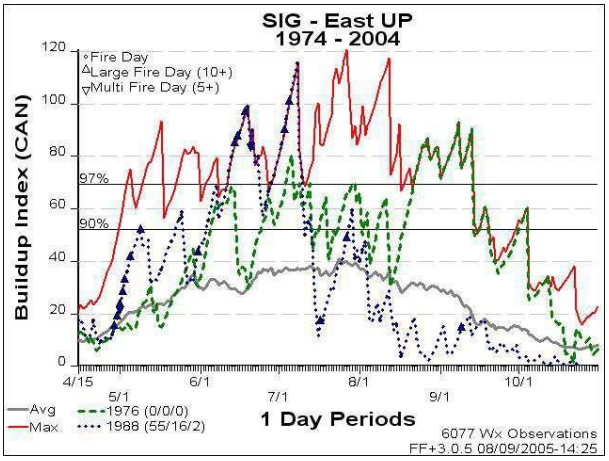


CFFDRS Drought Code (DC)

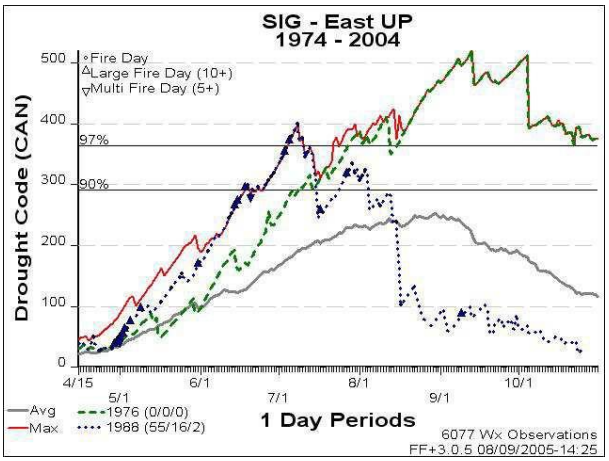


East Upper Peninsula

CFFDRS Buildup Index (BUI)



CFFDRS Drought Code (DC)



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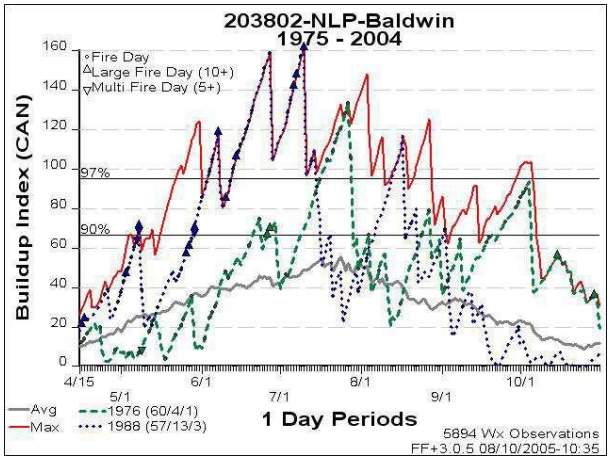
Eastern Upper Peninsula: Most air masses cross the Great Lakes before entering this section, resulting in reduced continentality. It is warmer in winter and cooler in summer. Lake-effect snow and rain characterize parts of the section near the Great Lakes shorelines, especially the Lake Superior shoreline. As with other sections with climates influenced by the Great Lakes, the Eastern Upper Peninsula has rainfall more evenly distributed throughout the year than much of the Western UP.

Average BUI peaks in late July with values just over 40 while 90% of all BUI values are below 55. At the same time, average values for DC peak at 250 in late August, though the decline in September and October is steeper than in the Western UP. 90% of all days have DC's less than 300.

Northern Lower Peninsula: Most air masses cross the Great Lakes before entering these areas, resulting in reduced continentality. Compared to areas of equivalent latitude in Wisconsin and Minnesota, the division is warmer in winter and cooler in summer. Lake effect snow characterizes portions of the area within 20 to 30 miles of the Great Lakes shorelines. The High Plains, the part of the Northern Lower Peninsula most distant from the Great Lakes and also the highest elevation above them, has the most continental climatic conditions within the division. It has more summer precipitation, the greatest summer and winter temperature extremes, the shortest growing season, and the greatest risk of spring freeze. Of annual precipitation, 26 to 28 percent occurs during November through February; 36 to 40 percent falls during the growing season.

Baldwin (Lake County) NW LP

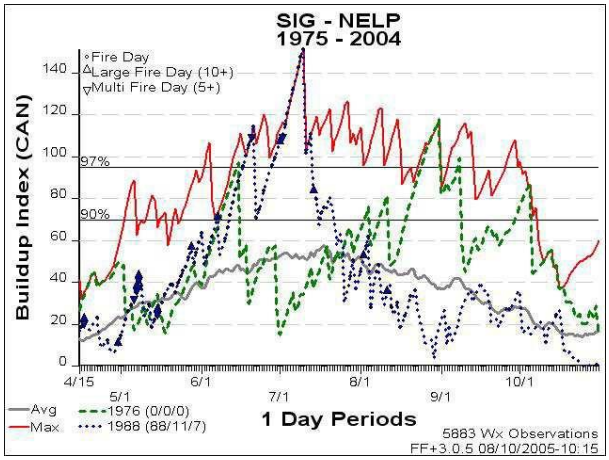
CFFDRS Buildup Index (BUI)



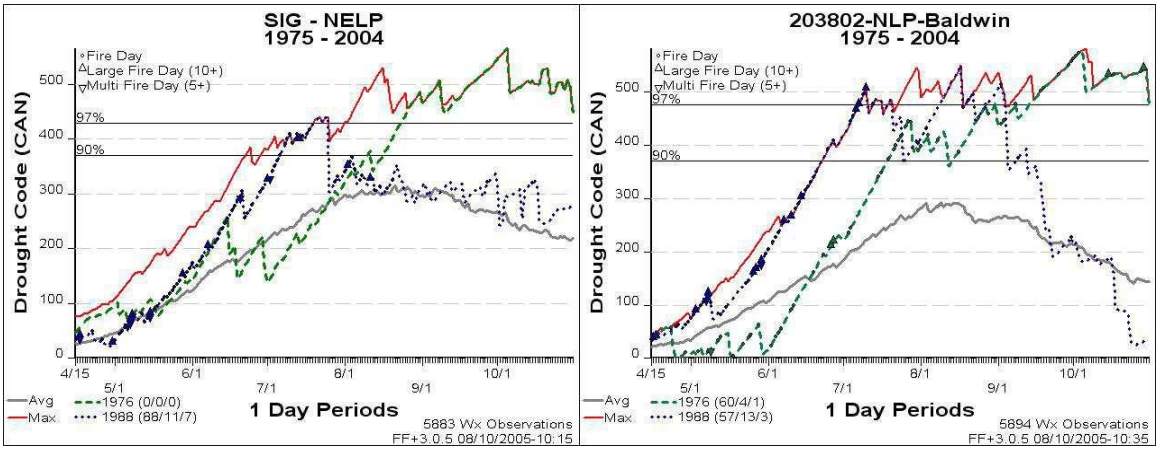
CFFDRS Drought Code (DC)

Interior Northern Lower Peninsula

CFFDRS Buildup Index (BUI)



CFFDRS Drought Code (DC)



Average BUI peaks in late July with values near 60 while 90% of all BUI values are below 70. At the same time, average values for DC peak at nearly 300 in late August. Note the steeper decline in both BUI and DC in the late summer and fall on the west side (Baldwin). 90% of all days have DC's less than 380.

Southern Lower Peninsula: The climate of the section is strongly influenced by the Maritime Tropical air mass, with some lake-effect snows and moderation of temperature from Lake Michigan (Albert *et al*. 1986, Denton 1985, Eichenlaub 1979, Eichenlaub *et al*. 1990). Compared to the rest of the state, the southern Lower Peninsula of Michigan has more warm humid air masses from the Gulf of Mexico and fewer cold dry air masses of continental origin. Winter precipitation is higher (7 to 10 inches; 23 to 26 percent of annual precipitation) and more of it falls as rain than in Wisconsin to the west or northern Michigan. The growing season is longer and warmer than the northern Lower Peninsula or the Upper Peninsula.

Implications for Managers

In Michigan, the number of fires and acres burned are usually greater in the spring of the year due to low fuel moisture in cured fine fuels and very low live fuel moisture in conifers. As green-up occurs fire spread and fuel consumption is slowed. However, per acre fuel consumption and smoke production are generally lower because of generally higher large fuel moisture. Available fuel in most fuel complexes peaks in mid to late summer, resulting in greater fuel consumption and larger volumes of smoke for each acre burned. Depending on the acreage burned, this higher smoke production rate may combine with reduced mid-summer ventilation to produce air quality problems. The fire manager's knowledge of climate and weather factors that contribute to smoke production and dispersal should allow them to avoid or mitigate most of those problem situations.

3.2 Fuel Loading and Consumption on the Michigan Landscape

It is unlikely that the quantity of smoke produced from wildland fires will be measured directly until more sophisticated remote sensing techniques are developed. Considering

that, and because the decision to burn requires that there be some prudent prediction of smoke production, fuel loading and fuel consumption estimates for each wildland and prescribed fire location should be considered. The following tables (Tables 3.3a & 3.3b) provide the best indirect sources of information available as related to the various fuel complexes and consumption across the state. With additional emission factor information, these tables are also one way to estimate air emissions.

- As the acreage to be burned and the fuel consumption increases, the potential for health and safety problems related to smoke production grow. When a burn is expected to produce measurable smoke and emissions for a period longer than two days, site specific measurements for fuel consumption will be essential to the planning process. Most sites will be burned without that level of detailed measurement. At the same time, preliminary estimates to determine the planning need for large burns can be derived from a set of classical or average fuel situations. The tables 3.3a and 3.3b are designed to produce that preliminary estimate.

Fuel loading and consumption, as characterized here, depend on three factors:

1. SEASONALITY: During the dormant season, especially in the spring, fires burn the fine fuels quickly but generally leave the large woody materials and organic material in the soil unaffected. During the growing season, fuel loading increases with the development of the current season's growth which has increased moisture. Directly related is the effect of increased moisture due to the live fuel load.

2. COVER/FUEL TYPE: Fuel loading, and therefore consumption, is dependent on what is or has grown on that site. Michigan's landscape has a wide variety of plant communities, both natural and cultivated. These tables attempt to classify this variation into a manageable set of categories. The range of fuel loads in each category is fairly broad and may not be adequate for a particular burn. Conifer crown fire, not considered among these categories, is capable of dramatically increasing smoke production. In these situations, specific site estimates may be necessary.

3. FUEL MOISTURE SCENARIO: Wet fuels may produce more smoke per ton of fuel consumed than dry fuels. However, the total fuel consumed on wet sites can be so much lower that total smoke production is reduced. Selecting the fuel moisture from among these four categories (WET, MODERATE, DRY, VERY DRY) can be a very intuitive process. The criteria included are calculated codes and indices from the Canadian Forest Fire Danger Rating System (Fire Weather Index system). Representative values for sites across the State can be obtained at the Great Lakes Fire/Fuels website. Ranges listed here are to be considered interpretive tools rather than firm boundaries in the classification process.

From the combination of classifications for these three factors, the user can estimate a range of fuel load, and the range of potential fuel consumed by burning of the site. These tables can assist with post burn requirements for burn unit reports, which are currently required for burns completed on state owned lands. They may also be valuable in the future for developing and maintaining emissions inventories.

Table 3.3a
DORMANT SEASON

Cover/Fuel Type	Description	Fuel Loading	Fuel Consumption			
			Wet Fuels	Moderate Fuels	Dry Fuels	Very Dry Fuels
			FFMC <75 DMC <15	FFMC 75-88 DMC 15-25	FFMC 89-91 DMC 25-50	FFMC 92+ DMC 50+
Slash	Activity Fuels & Natural Disturbance, much of the loading is woody limbs and tops, but litter and duff are included	15-50 t/ac	<10%	20%	40%	60%
Forest Under story	Primarily Pine, Oak and Aspen types, any shaded forest floor that is not dominated by shrubs or grasses	10-30 t/ac	<10%	21%	30%	40%
Shrub lands	Hazel, Cherry, Rubus, Sumac, Rose, and Viburnam as examples with admixtures of grass/herbaceous cover	5-15 t/ac	20%	50%	65%	75%
Open lands, Light Load	Openings dominated by cool season grasses/herbs. Burned savannah/barrens. Little if any vegetative mat	1-3 t/ac	20%	70%	90%	100%
Open lands, Moderate Load	Fallow pasture, productive forest openings, barrens and savannahs	3-10 t/ac	30%	70%	90%	100%
Open lands, Heavy Load	Cultivated plots and productive sites of warm season grasses, generally under winter or spring	10-20 t/ac	50%	70%	90%	100%
Emergent Wetlands	Cattails/Phragmites as predominantly dead fuels, generally under winter and spring conditions	20-30 t/ac	<50%	90%	100%	100%
Fen/Wet Prairie	Sedges/graminoids on organic soils that may be seasonally dry	10-20 t/ac	<10%	60%	80%	100%

Table 3.3b
GROWING SEASON

Cover/Fuel Type	Description	Fuel Loading	Fuel Consumption			
			Wet Fuels	Moderate Fuels	Dry Fuels	Very Dry Fuels
			FFMC <80 BUI <30 DC <200	FFMC 80-88 BUI 30-50 DC 200-300	FFMC 89-91 BUI-50-100 DC 300-400	FFMC 92+ BUI 100+ DC 400+
Slash	Activity Fuels & Natural Disturbance, much of the loading is woody limbs and tops, but litter and duff are included	15-50 t/ac	20%	30%	50%	75%
Forest Under story	Primarily Pine, Oak and Aspen types, any shaded forest floor that is not dominated by shrubs or grasses	10-30 t/ac	7%	18%	30%	50%
Shrub lands	Hazel, Cherry, Rubus, Sumac, Rose, and Viburnam as examples with admixtures of grass/herbaceous cover	5-15 t/ac	<10%	20%	60%	75%
Open lands, Light Load	Openings dominated by cool season grasses/herbs. Burned savannah/barrens. Little if any vegetative mat	1-3 t/ac	<10%	20%	50%	90%
Open lands, Moderate Load	Fallow pasture, productive forest openings, barrens and savannahs	3-10 t/ac	<10%	30%	60%	90%
Open lands, Heavy Load	Cultivated plots and productive sites of warm season grasses, generally under green growing season conditions	10-20 t/ac	<10%	40%	70%	100%
Emergent Wetlands	Cattails/Phragmites as predominantly live fuels during the growing season	20-30 t/ac	<10%	<10%	20%	50%
Fen/Wet Prairie	Sedges/graminoids on organic soils that may be seasonally dry	10-20 t/ac	<10%	35%	65%	95%

Chapter 4 Smoke Management Program Guidelines

4.1 Authorization To Burn

The Director of the Michigan Department of Natural Resources serves as the Central Authority for the State's SMP.

The Director of the MDNR is granted authority by the Natural Resources and Environmental Protection Act 451 of 1994, Part 515, as amended to control open burning in Michigan. Permitting of all open burning on other than federal lands within the State is by delegated authority to Forest Resources Division of the MDNR, except in those cases where local governing bodies have enacted ordinances authorizing opening burning provided other burning regulations are not violated. Currently burning on Federal Agency administered lands is conducted under Interagency agreement.

This document would serve to propose that a web based tracking database be developed for all prescribed burning within the state with data entry being the responsibility of each individual prescribed burn boss or prescribed fire manager. The minimum requirements for a burn plan should serve to address most data base needs with notification that a burn unit is complete and out with a completion factor. These minimum requirements are stated in Section 4.2. As interagency agreements are reviewed and updated, this procedure would be addressed as part of the agreement.

In the event that a smoke/air quality emergency is declared (example from Air Quality Index the trigger point, would be a AQI of 151 to 200 adjective of unhealthy), the Director of the Department of Natural Resources, will have the authority to cancel all open burning related to prescribed fire. Notification procedures for disseminating this information would be similar to that for wildfire danger, and posted with the associated tracking data base, and on the MDNR website.

4.2 Burn Plans

All agencies and organizations in Michigan require prescribed burn plans for each burn. For other than agency burning, a certified prescribed burn manager, under the law, is required to have a prescription (written plan) on site when conducting a prescribed burn. Plans developed by agencies and organizations are written following protocols specific to each. They will be on file at agency/organization offices and are available upon request. For the purposes of this Smoke Management Program, these prescribed burn plans must include the following elements at a minimum:

- Location and legal description of the area to be treated, including ownership.
- Personnel and/or certified prescribed burn manager responsible for managing the fire.
- Type of vegetation or fuel model (NFFDRS or CFFBPS) to be burned.
- Area in acres to be burned.
- Any target of fuel to be consumed (tons/acre or % of the available fuel load) maybe best addressed in the site objectives for most burn units.

- Fire prescription including smoke management components and ventilation and or dispersion index limits.
- Criteria the fire manager will use for making go, no-go burn decisions.
- Safety and contingency plans.

4.2.1 Smoke Management Components of Burn Plans

Efforts to Minimize Fire Emissions -- Prescribed fire is the means to meet an objective. In consideration of this objective, any steps that can be taken to minimize or reduce air emissions should be documented in the planning document. This could include, but may not be limited to, any of the following measures:

- Minimize the area burned, reduce the acreage burned per burning period, or use non-fire treatments.
- Reduce the fuel loading in the area to be burned by mechanical means, or by using frequent, low intensity burns to gradually reduce fuels.
- Reduce the amount of fuel consumed by the fire by burning when large non-target fuel moistures and duff moistures are higher.
- Minimize emissions per ton of fuel consumed, by using mass ignition techniques, using backing fires, increasing combustion efficiency and performing rapid and complete mop-up.
- Pre-treat heavy fuels or use firing techniques that exclude them from the burn.

Evaluate Smoke Dispersion – Prescribed fire plans should identify and evaluate potential smoke impacts on sensitive receptors. Fires should be timed to minimize exposure of sensitive populations (those that smoke may present particular health risks). Plans should avoid visibility impacts in mandatory Class I Federal areas to the degree that the impacts limit the public's enjoyment and use of the areas. Sensitive receptor sites are usually defined as locations where human populations tend to concentrate and where smoke could impact the health of those populations or significantly impact visibility or the enjoyment of scenic qualities of the landscape. These may be residential concentrations in the form of towns or cities, or locations where people tend to gather in groups such as parks and schools. Travel routes such as highways may be labeled as sensitive receptor sites where smoke can be a factor in potential motor vehicle accidents. Particular areas along highways or other locations may be more prone to being declared sensitive receptor sites because of topographic and microclimate features. The plan should identify the distance and direction from the burn site to local sensitive receptor areas where appropriate. Fire prescriptions must specify minimum requirements for the atmospheric capacity for smoke dispersal such as minimum surface and upper level wind speeds, desired wind direction, minimum mixing height, and dispersion index. Utilize the Ventilation Index in section 4.3 for minimum requirements.

Another source of information for burn day decisions could be the Air Quality Index for the area of the burn and downwind impact zone. This index is posted on the Air Quality Division website, Values reaching the unhealthy level or those with excessive PM or Ozone readings should be considered in the decision making process. It should be noted that these monitors are

sparse in out-state areas and may not fully address the situation on any given day and should only be considered as a broad- based average.

Public Notification and Exposure Reduction Procedures – The plan should identify actions that will be taken to notify populations and authorities at sensitive receptors, including those in adjacent jurisdictions, prior to the fire. The plan should also identify contingency actions that will be taken during a fire to reduce the exposure of people at sensitive receptors if smoke intrusions occur.

Air Quality Monitoring – The plan should identify how the effects of the fire on air quality at sensitive receptors and visibility in mandatory Class I Federal areas will be monitored. The extent of the monitoring plan should match the size of the fire, fuel loading and consider the proximity to smoke sensitive areas. For small, or short duration fires (such as those in grass or leaf litter), visual monitoring of the directions of the smoke plume and monitoring nuisance complaints by the public may be sufficient. Other monitoring techniques include posting personnel on vulnerable roadways to evaluate visibility impairment and initiate safety measures for motorists; posting personnel at other sensitive receptors to look for smoke intrusions; using aircraft to track the progress of smoke plumes; and continued tracking of meteorological conditions during the fire. For fires in fuels with longer duration burning (such as timber litter or slash), and which are expected to last more than one day, locating real-time PM monitors at sensitive receptors may be warranted to facilitate timely response to smoke impacts.

4.2.2 Smoke Management Related to Road Impacts:

The Michigan Department of Transportation (MDOT) is responsible for maintaining the state and federal highways within Michigan. State roads are designated Michigan “M” routes and federal roads are designated “US” or Interstate “I” routes:

MDOT has 7 Region offices, 26 Transportation Service Centers (TSC) and 28 Maintenance Garages to serve the transportation needs of Michigan motorists.

Planning for smoke management adjacent to state and federal highways begins with contacting the local MDOT TSC. If a prescribed burn is being planned within MDOT right-of-way (ROW) by another state or federal land management agency, organization or private landowner the following three documents must be submitted to the TSC Permit Agent:

1. *Individual Application & Permit - Use of State Trunkline* (MDOT Form 2205)
2. *Certificate of Insurance* (MDOT Form 2020) (not required for federal or state agency)
3. The Burn Plan

The MDOT ROW permit process includes review by the Traffic and Safety Engineer, Regional Resource Specialist and Natural Features Coordinator in addition to other internal reviews as required by the *MDOT Construction Permit Manual*.

MDOT forms are available from the local TSC and online. The Michigan Department of Transportation website contains information on TSC locations and contact information as well as access to MDOT forms. For TSC locations select *About MDOT > Our Regions* and select your area on the map to access the directory. For online forms begin at the MDOT website under *Favorite Links > MDOT Forms* and enter the form numbers.

Processing time for permit approval is up to 30 days and is intended for non-emergency activities.

The thresholds for pre-planning the distance of a burn from travel routes will be determined on a site-by-site basis. Property ownership, rural vs. urban environment, average daily traffic (ADT) and the justification for burning to the edge-of-metal (up to the pavement) or within the vegetated ROW should be evaluated and addressed within the burn plan.

Likewise, personnel for flagger control of the smoke zone and pilot car travel will be provided by the agency or organization conducting the burn and addressed in the burn plan, if it is deemed necessary.

Participation in the MDOT ROW permit process as described above will assure that the Burn Manager will receive specific information on the required signage and its proper placement within the ROW. The use of electronically programmable signs for smoke warning and speed reduction is an option. Programmable signs can be delivered on site and immediately reprogrammed with a phone call. The responsibility for providing signs lies with the agency or organization conducting the prescribed burn. Traffic control devices placed and maintained by the State, County, City or other local officials are required by Michigan Law to conform to the *Michigan Manual on Uniform Traffic Control Devices*. The manual can be downloaded from the MDOT website from the dropdown list under *Organization > Highway Delivery > Traffic and Safety > Quick Links>Traffic Standards, Typicals, Guides and MMUTCD.*

For emergency situations fire officials should immediately contact the local TSC Manager and the Region Emergency Coordinator for the fastest response. The use of signage, the decision to temporarily close a state or federal highway and to reroute traffic must be coordinated within MDOT in cooperation with fire officials and the Michigan State Police.

Overview of MDOT Contacts and Permit Approval Response Time

Burn Manager	Fire Event	MDOT Contact	MDOT Permit Required	Response Time
MDOT	Prescribed Burn	Natural Features Coordinator	NA	NA
State or Federal Land Manager	Prescribed Burn	TSC Permit Agent	Yes	5-30 days
Private Landowner	Prescribed Burn	TSC Permit Agent	Yes	10-30 days
Fire Official	Emergency Situation	TSC Manager, Region Emergency Coordinator	No	Immediate

Responsibility for county, local and privately owned roads is under the jurisdiction of the County Road Commissions. Please refer to the following website for contact information for each County Road Commission in Michigan: http://www.micountyroads.org/crcs.htm.

For detailed information about all roads within the state of Michigan including State and Federal Routes, County roads, Forest Service roads, Heritage Routes, etc. please visit the Michigan Highways website.

4.2.3 Smoke Management Related to Railway Impacts:

The *Official Rail Map* and directory of private and state owned railroads is available from the MDOT public website. Select *Rail & Public Transit* > *Rail Safety Services* > *Reports & Information*.

The *Michigan Rail Map*, *Emergency Railroad Phone Numbers* and *Required Clearances near Railroad Tracks* are just a few of the documents available to assist in planning for smoke management along railroad corridors. Contact the emergency management representative from the specific railroad effected. These representatives will have firsthand knowledge of their internal processes for emergency response to smoke and the timing of rail activity along the rail line.

4.2.4 Smoke Management Related to Air Traffic Impacts:

The coordination of smoke management for a prescribed burn should be consistent with coordination that is currently followed by the USFS for unplanned forest fires. The coordinating agency should contact any private and/or public airport within 10 miles of the closest burn perimeter so that air traffic control is aware of the situation. Prescribed burning within 5 miles of an airport perimeter should be closely coordinated with the airport manager/owner so that the burn does not conflict with airport usage (e.g. new pilot training).

For more detailed information on airport locations and contact information, please visit www.airnav.com/airport/. If smoke production reaches a point where an air space restriction becomes a consideration this would requested through the same channels as in a wildland fire situation by contacting Flight Service at 800-992-7433.

4.2.5 Smoke Management Related to Utility Impacts:

The safety of fire line personnel in relation to fire use near overhead transmission lines, where smoke, ash and incidental mist from fire line operations may contaminate the insulators on transmission structures would be a consideration. Standard utility recommendations are to maintain a minimum radial distance of 35 feet between firefighters, vehicles and transmission structures to protect fire fighting personnel from this electrical hazard. Further recommendations would be to place containment lines no closer than 100 feet of and parallel to the edge of the outer most conductor.

A heavy smoke plume on power lines may cause a conductor to ground short. Planning to address the direction and dispersion of smoke in these situations is critical. The inclusion of any utility owner/operator that maybe impacted should be a consideration of the planning process. Qualified company representatives are responsible for safely adhering to all other rules pertaining to this subject matter.

4.3 Smoke Management and Dispersion

The National Weather Service forecast offices in Marquette, Gaylord, Grand Rapids, and Detroit/Pontiac provide twice daily fire weather forecasts every day during the fire season (roughly April 1 to November 1). The fire weather forecasts issued by the respective NWS offices by 0700, and than again by 1600, include projected smoke management information. The Fire Weather Annual Operating Plan (FWAOP) available at the forecast offices or most agency dispatch or coordination centers provides extensive forecast information.

To ensure optimum dispersal of smoke emissions during prescribed burns, the mixing height must be deep enough and have sufficient transport wind speed to ensure the dilution and dispersal of emission concentrations. The ventilation index multiplies mixing height (measured in feet) and transport wind speed (measured in mph) divided by 100 to produce an index that expresses the ability of the atmosphere to disperse emissions (see Figure 2). This dispersion information is included as part of the daily fire weather forecast. It describes the mixing height, transport wind speed and ventilation index for the peak or low conditions during the forecast period.

$$\frac{\text{Mixing Height x transport wind}}{100}$$

Figure 2: Ventilation Index

Prescribed fire managers who plan ignitions at other than the forecast time may request dispersion/ventilation criteria as part of the spot weather forecast from the NWS.

Table 4.3.1a

Ventilation Index	Dispersion Category
0 –130	Poor
131-299	Fair
300 – 599	Good
600+	Excellent Dispersal

> ***Note****: In using the ventilation index, exercise caution with high transport wind speed and low mixing height or low transport wind and high mixing height. Either combination may result in a false representation of an acceptable category, which can result in smoke dispersion problems and potential control problems.*

Guidance for Use of the Ventilation Index and Dispersion Tables

When utilizing the ventilation index it is important to consider the total fuel load being burned, both in terms of the fuel loading (tons of fuel per acre) and the total area to be treated (see section 3.3). The proximity of downwind smoke sensitive areas to the burn unit should also be considered, so that in general the lower the expected total fuel consumption and the farther away from smoke sensitive receptors, the lower the ventilation index can be.

Additionally, practices that reduce the total fuel load available for consumption can lower the acceptable dispersion category either by reduction of fuel, or acres to be treated. (see section 4.2.1)

Two methods that can be utilized for mitigation of smoke impacts during the burn planning process are as follows: Method A may be used as a general guide to use the Ventilation Index in combination with a smoke screening map to screen for sensitive downwind receptors. It is recommended for those burn units with low to moderate potential for smoke impacts.

1. From the Daily Burn Unit Size chart (chart 4.3.2.b) select the size of the planned burn unit in acres[1].
2. Determine the general fuel category which best represents the majority of the burn unit.
3. On a map of the area locate the sensitive downwind receptors that could be impacted by smoke produced by the burn unit.
4. Use the Dispersion Category charts (charts 4.3.2 c,d,e,f) and determine the minimum distance which a burn should take place upwind of a sensitive receptor on a certain Dispersion Category day.

   ***Note**: these guidelines may vary based on the local unit's definition of a sensitive receptor. There may be an ability to mitigate potential smoke problems by instituting traffic controls when smoke impact roads or other transportation corridors, or by burning when fuel moisture levels would limit consumption of heavy fuels.*

Table 4.3.2B – DAILY BURN UNIT SIZES[2]

Small	<50 acres
Medium	50 – 150 acres
Large	150-500 acres
Landscape	500 + acres

Table 4.3.2C – DISPERSION CATEGORY: POOR[3]:

PROXIMITY OF CLOSEST DOWNWIND SMOKE SENSITIVE AREAS	AVAILABLE FUEL LOADING DESCRIPTION
< 0.25 mile	No burns
>0.50 mile	Small burns of primarily grass fuels.
>1.00 mile	Single large pile or scattered small piled debris

Table 4.3.2.D – DISPERSION CATEGORY: FAIR

PROXIMITY OF CLOSEST DOWNWIND SMOKE SENSITIVE AREAS	AVAILABLE FUEL LOADING DESCRIPTION

[1] Assumes no more than one burn unit within a 5 mile radius.
[2] Assumes no more than one unit within a 5 mile radius

[3] In general, there should be no burning on Poor Category days. However, burning could occur under some situations, primarily in remote locations.

<0.25 mile	Small – Med burns in grass or leaf litter
>0.25 mile	Large burns in grass or leaf litter
>.5 mile	Small – Med burns in timber, slash, or piled fuels
>0.75 mile	Landscape burns in grass or leaf litter
>0.75 miles	Large burns in timber, slash or piled fuels
>1.0 mile	Landscape burns in timber, slash, or piled fuels

Table 4.3.2.E – DISPERSION CATEGORY: GOOD

PRIXIMITY OF CLOSEST DOWNWIND SMOKE SENSITIVE AREAS	AVAILABLE FUEL LOADING DESCRIPTION
<0.25 mile	Small – Large burns in grass or leaf litter
<0.25 mile	Small – Med burns in timber, slash, or piled fuels
>0.5 mile	Landscape burns in grass or leaf litter
>0.5 mile	Large burns in timber, slash, or piled fuels
>0.75 miles	Landscape burns in timber, slash or piled fuels

Table 4.3.2.F – DISPERSION CATEGORY: EXCELLENT

PROXIMITY OF CLOSEST DOWNWIND SMOKE SENSITIVE AREAS	AVAILABLE FUEL LOADING DESCRIPTION
<0.25 mile	Small – Large burns in grass or leaf litter
<0.25 mile	Small – Med burns in timber, slash, or piled fuels
>0.25 mile	Landscape burns in grass or leaf litter
>0.25 mile	Large burns in timber, slash, or piled fuels
>0.5 mile	Landscape burns in timber, slash, or piled fuels

4.4 Public Education and Awareness

Agencies and organizations will work to establish and maintain programs to stress the use and importance of fire for ecosystem and related land management goals. Public Health and Safety are intrinsic or intricate to this effort. The Michigan Prescribed Fire Council has been working towards this goal since 1998 with the backing of the agencies and private sector organizations involved in the council.

4.5 Surveillance and Enforcement

Prescribed burning on public lands in Michigan is done under the on-site supervision of an agency certified prescribed fire boss. These burn bosses follow a pre-burn go-no-go procedure to ensure that the burn day parameters meet the burn plan prescription that includes smoke management. Failing to follow the burn plan prescription would be subject to agency specific review protocols and possible disciplinary action. Private Sector burners

under the Certified Burn Manager program that fail to follow the burn plan could be assessed points. Repeat violations could lead to de-certification.

4.6 Program Evaluation

Michigan's SMP should be considered a work-in-progress with annual evaluation by the signatories of the plan to determine if it is preventing smoke intrusions and ensuring regional haze goals are met. A thorough review with the opportunity to update and improve the document should be considered on a biennial basis. Revisions to the SMP should be developed with input from all agencies/parties.

A web-based burn tracking system is needed to provide an annual emissions inventory, including any nuisance complaints or smoke intrusions. This should be available to meet the requirements of the Clean Air Act.

The tracking system should include burn date, fuels, project acres and some post burn estimation of black or completed acres.

4.7 Optional Air Quality Protection

Agencies should consider opportunities to establish specific, protection for those special areas requiring additional regulation in the interest of public health and safety. Recognition of these areas should be documented in site-specific burn unit plans, along with the steps to minimize impacts.

5.0 Glossary

Administrative Unit -- A unit of land (Forest, Refuge, Park, etc.) under the administration of a public land *management agency.*

Air Quality Manager -- The regulatory body responsible for managing the air quality protection program for a State, local or tribal government.

Air Quality -- The characteristics of the ambient air (all locations accessible to the general public) as indicated by concentrations of the six air pollutants for which national standards have been established [i.e., particulate matter (PM), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO) and lead], and by measurement of visibility in mandatory Federal Class I areas. For the purposes of this policy, concentrations of PM are taken as the primary indicators of ambient air quality.

Ambient Air -- That portion of the atmosphere, external to buildings, to which the general public has access.

Attainment area -- A geographic area in which levels of a criteria air pollutant meet the health-based primary standard (national ambient air quality standard, or NAAQS) for the

pollutant. An area may have on acceptable level for one criteria air pollutant, but may have unacceptable levels for others. Thus, an area could be both attainment and non-attainment at the same time. Attainment areas are defined using federal pollutant limits set by EPA.

Carbon monoxide (CO) -- A colorless, odorless, poisonous gas, produced by incomplete burning of carbon-based fuels, including gasoline, oil and wood. Carbon monoxide is also produced from incomplete combustion of many natural and synthetic products. For instance, cigarette smoke contains carbon monoxide. When carbon monoxide gets into the body, the carbon monoxide combines with chemicals in the blood and prevents the blood from bringing oxygen to cells, tissues and organs. The body's parts need oxygen for energy, so high-level exposures to carbon monoxide can cause serious health effects, with death possible from massive exposures. Symptoms of exposure to carbon monoxide can include vision problems, reduced alertness, and general reduction in mental and physical functions. Carbon monoxide exposures are especially harmful to people with heart, lung and circulatory system diseases.

Class I Area -- An area set aside under the Clean Air Act (CAA) to receive the most stringent protection from air quality degradation. Mandatory Class I Federal areas are (1) international parks, (2) national wilderness areas which exceed 5,000 acres in size, (3) national memorial parks which exceed 5,000 acres in size, and (4) national parks which exceed 6,000 acres and were in existence prior to the 1977 CAA Amendments. The extent of a mandatory Class I Federal area includes subsequent changes in boundaries, such as park expansions.

Combustion -- Burning. Many important pollutants, such as sulfur dioxide, nitrogen oxides, and particulates (PM_{10}) are combustion products, often products of the burning of fuels such as coal, oil, gas and wood

Complexity—A system for rating the potential difficulty of a prescribed burn by analyzing the cumulative elements which may be involved in the burn such as safety, threats to boundaries, fuel types, values to be protected, organization needed, air quality values to be protected, etc. Complexity is usually rated as Low, Moderate and High. Qualifications of prescribed burn practitioners are usually specific to the different complexity levels.

Criteria air pollutants -- A group of very common air pollutants regulated by EPA on the basis of criteria (information on health and/or environmental effects of pollution) and for which NAAQS have been established. In general,. Criteria air pollutants are widely distributed all over the country. They are: particulate matter (PM), carbon monoxide (CO), sulfur dioxide (SO_2), ozone (0_3), Nitrogen Oxide (NOx) and lead (Pb).

Emission -- Release of pollutants into the air from a mobile source (e.g. vehicle), stationary source (e.g. industry), or area sources (e.g. gas stations, chimneys, vegetative burning). We say sources emit pollutants. Continuous emission monitoring systems (CEMS) are machines which some large sources are required to install, to make continuous measurements of pollutant release.

Equilibrium Moisture Content—The value that the actual moisture content approaches if the fuel is exposed to constant atmospheric conditions of temperature and relative humidity for

an infinite length of time. EMC determines the amount of water vapor that a specific piece of wood can hold.

Federal Land Manager (FLM) – With respect to any lands in the United States, the Secretary of the Federal department with managing authority over such lands. Generally, the Secretaries delegate their authority to specific elements within each department. For example, the National Park Service and the Fish and Wildlife Service manage those areas under the authority of the Department of the Interior.

Fire Management Plan (FMP) -- A plan which identifies and integrates all wildland fire management and related activities within the context of approved land/resource management plans. It defines a program to manage wildland fires (wildfire, prescribed fires, and wildland fire use). The plan is supplemented by operational plans, including but limited to preparedness plans, preplanned dispatch plans and prevention plans. Fire Management Plan's assure that wildland fire management goals and components are coordinated.

Fire Dependent Ecosystem -- A community of plants and animals that must experience recurring disturbances by fire, in order to sustain its natural plant succession, structure and composition of vegetation, and maintain appropriate fuel loading and nutrient cycling to ensure proper ecosystem function.

Fuel -- Includes combustible vegetative matter such as grass, trees, shrubs, limbs, branches, duff, and stumps.

Haze—A atmospheric aerosol of sufficient concentration to be visible. The particles are too small to see individually, but reduce visual range by scattering or absorbing light.

IMPROVE-- Interagency Monitoring of Protected Visual Environments is a program that uses air monitors in Class I areas or outside Class I areas (IMPROVE protocol) to measure visibility pollutants---sulfates, nitrates, organic and elemental carbon, and PM_{10}.

Inversion—A layer in the atmosphere where the temperature increases with altitude.

Land Use Plan --A broad scale, long range plan (e.g., forest plan, refuge plan or resource management plan) that identifies the scope of actions and goals for the land and resources administered by a land owner/manager.

Mobile sources -- moving objects that release pollution; mobile sources include cars, trucks, buses, planes, trains, motorcycles and gasoline-powered lawn mowers. Mobile sources are divided into two groups: road vehicles, which include cars, trucks and buses, and non-road vehicles that include trains, planes and lawn mowers.

Monitoring (monitor)-- Measurement of air pollution is referred to as monitoring. EPA, state and local agencies measure the types and amounts of pollutants in the ambient in community air. The 1990 Clean Air Act requires certain large polluters to perform enhanced monitoring to provide an accurate picture of their pollutant releases. Enhanced monitoring programs may include keeping records on materials used by the source, periodic inspections, and installation of continuous emission monitoring systems (CEMS).

Continuous emission monitoring systems will measure, on a continuous basis, how much pollution is being released into the air. The 1990 Clean Air Act requires states to monitor Community air in polluted areas to check on whether the areas are being cleaned up according to schedules set out in the law.

National Ambient Air Quality Standards (NAAQS) –National standards for maximum acceptable concentrations of "criteria" pollutants in the ambient air. Designed to protect public health with an adequate margin of safety (primary standard), and to protect public welfare from any known or anticipated adverse effects of such pollutants (e.g., visibility impairment, soiling, materials damage, etc.) in the ambient air (secondary standard).

Non-attainment area -- A geographic area in which the level of a criteria air pollutant is higher than the level allowed by the federal standards. A single geographic area may have levels that are acceptable of one criteria air pollutant but unacceptable levels of one or more other criteria air pollutants; thus, an area can be both attainment and non-attainment at the same time. It has been estimated that 60% of Americans live in non-attainment areas.

Nuisance Smoke -- Amounts of smoke in the ambient air, that interfere with a right or privilege common to members of the public, including the use or enjoyment of public or private resources.

Ozone- -A gas that is a variety of oxygen. The oxygen gas found in the air consists of two oxygen atoms stuck together; this is molecular oxygen. Ozone consists of three oxygen atoms stuck together into an ozone molecule. Ozone occurs in nature; it produces the sharp smell you notice near a lightning strike. High concentrations of ozone gas are found in a layer of the atmosphere -- the stratosphere -- high above the Earth. Stratospheric ozone shields the Earth against harmful rays from the sun, particularly ultraviolet B. Smog's main component is ozone; this ground-level ozone is a product of reactions among chemicals produced by burning coal, gasoline and other fuels, and chemicals found in products including solvents, paints, hair sprays, etc in the presence of sunlight.

Particulate Matter (PM) --Any airborne finely divided material mixture of very small particles that are suspended in the atmosphere, except uncombined water, which exists as a solid or liquid at standard conditions (e.g., dust, smoke, mist, fumes, or smog).

PM_{10} -- Particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (including $PM_{2.5}$). Concentrations in the air are measured as micrograms per cubic meter of air ($\mu g/m^3$).

$PM_{2.5}$ -- Particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers. Concentrations in the air are measured as micrograms per cubic meter of air ($\mu g/m^3$).

Prescription -- Measurable criteria that guide selection of appropriate management response and actions. Prescription criteria may include the meteorological conditions affecting the area under prescription, as well as factors related to the state of the area to be burned such as the fuel moisture condition and other physical parameters. Other criteria which may be considered include safety, economic, public health, environmental,

geographic, administrative, social or legal considerations, and ecological and land use objectives.

Prevention of Significant Deterioration (PSD) -- A requirement in the CAA, which establishes the maximum allowable increases in ambient air concentrations of selected air pollutants above baseline concentrations in areas designated as Class I, Class II, or Class III.

Project Plan -- A strategic plan for accomplishing specific actions and goals (objectives) established in a land use plan. A project may include several activities such as cutting and hauling trees and shrubs, planting trees, building trails, and fire treatment.

Regional Haze -- Generally, concentrations of fine particles in the atmosphere extending up to hundreds of miles across a region and causing, or promoting deteriorated visibility, noticeably hazy conditions; wide-spread visibility impairment, especially in mandatory Class I Federal areas where visibility is an important value.

Sensitive populations--Those populations to which smoke emissions may present particular health risks.

Sensitive Receptors--Locations where human population tend to concentrate and where smoke could impact the health of those population or significantly impact visibility that may be detrimental to either health or the enjoyment of scenic qualities of the landscape. These may be residential concentrations in the form of towns or cities, or locations where people tend gather in groups such as parks. Travel routes such as highways may be labeled as sensitive receptor sites where smoke can be a factor in potential motor vehicle accidents. Particular areas along highways or other locations may be more prone to being declared sensitive receptor sites because of topographic and microclimate features.
--Population centers such as towns and villages, camp grounds and trails, hospitals, nursing homes, schools, roads, airports, mandatory Class I Federal areas, etc. where smoke and air pollutants can adversely affect public health, safety and welfare.

Smoke Management Program -- Establishes a basic framework of procedures and requirements for managing smoke from fires that are managed for resource benefits. The purposes of SMPs are to mitigate the health, nuisance and public safety hazards (e.g., on roadways and at airports) posed by smoke intrusions into populated areas; to prevent deterioration of air quality and NAAQS violations; and to address visibility impacts in mandatory Class I Federal areas in accordance with the regional haze rules.

Source--any place or object from which *pollutants* are released. A source can be a power plant, factory, dry cleaning business, gas station or farm. Cars, trucks and other motor vehicles are sources, and consumer products and machines used in industry can be sources too. Sources that stay in one place are referred to as *stationary sources*; sources that move around, such as cars or planes, are called mobile sources.

State implementation plan (SIP)--a detailed description of the programs a state will use to carry out its responsibilities under the *Clean Air Act*. State implementation plans are collections of the regulations and emission reduction measures used by a state to reduce air *pollution* in order to attain and maintain NAAQS or to meet other requirements of the Act.

The Clean Air Act requires that EPA approve each state implementation plan. Members of the public are given opportunities to participate in review and approval of state implementation plans.

State Implementation Plan (SIP) -- CAA required document in which States adopt emission reduction measures necessary to attain and maintain NAAQS, and meet other requirements of the Act.

Stationary source -- a place or object from which *pollutants* are released and which does not move around. Stationary sources include power plants, gas stations, incinerators, houses etc.

Suppression -- A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Temperature inversion -- one of the weather conditions that are often associated with serious *smog* episodes in some portions of the country. In a temperature inversion, air doesn't rise because it is trapped near the ground by a layer of warmer air above it.

Concentrations of *pollutants* increase in the lower atmosphere, especially smog and smog-forming chemicals, including *volatile organic compounds*, are trapped close to the ground. As people continue driving, and sources other than motor vehicles continue to release smog-forming pollutants into the air, the smog level keeps getting worse.

Tribal Implementation Plan (TIP) -- A document authorized by the CAA in which eligible tribes adopt emission reduction measures necessary to attain and maintain NAAQS, and meets other requirements of the CAA for lands within tribal jurisdictions.

Violation of the PM NAAQS -- As revised in 1997, the daily PM_{10} standard is violated when the 99th percentile of the distribution of 24-hour concentrations for a period of 1 year (averaged over 3 calendar years) exceeds 150 $\mu g/m^3$ at any monitor within an area. The annual PM_{10} standard is violated when the arithmetic average of 24-hour concentrations for a period of 1 year (averaged over 3 calendar years) exceeds 50 $\mu g/m^3$ at any monitor within an area The new NAAQS levels for $PM_{2.5}$ are set at a daily concentration less than or equal to 35 $\mu g/m^3$, and an annual mean concentration of less than or equal to 15 $\mu g/m^{3.}$ For $PM_{2.5}$ the daily standard is violated when the 98th percentile of the distribution of the 24-hour concentrations for a period of 1 year (averaged over 3 calendar years) exceed 35 $\mu g/m^3$ at any monitor within an area. The annual standard is violated when the annual arithmetic mean of the 24-hour concentrations from a network of one or more population-oriented monitors (averaged over 3 calendar years) exceeds 15 $\mu g/m^3$.

Compliance with the annual $PM_{2.5}$ NAAQS is based on population-oriented monitors because the health information, upon which the standard is based, relates area-wide health statistics to area-wide air quality as measured by one or more monitors.

Volatile Organic Compounds (VOC) -- Any organic compound that participates in atmospheric photochemical reactions, which are measured by a reference method, an equivalent method, or an alternative method. Some compounds are specifically listed as

exempt due to their having negligible photochemical reactivity. [See 40 CFR 51.100.] Photochemical reactions of VOC's with oxides of nitrogen and sulfur can produce O_3 and PM.

Wildfire – See Wildland Fire

Wildland Fire -- Any non-structural fire that occurs in the wildland. Two distinct types of wildland fire have been defined and include wildfire, and prescribed fire.

Wildfire—An unplanned and unwanted wildland fire including unauthorized human-caused fire, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out.

Wildland Fire Use—The application of the Appropriate Management Response to naturally ignited wildfires to accomplish specific resource management objectives in predefined designated areas outlined in Fire Management Plans. As of 2009, the Federal Wildand Fire Policy no longer recognizes this term.

Prescribed Fire -- Any fire ignited by management actions to meet specific objectives. For federal agencies a written, approved prescribed fire plan must exist, and NEPA requirements (where applicable) must be met, prior to ignition

Wildland Fire Decision Support System (WFDSS) -- This decision support system is intended to assist wildland fire managers in assessing risks and fire behavior during an event. This system assists fire managers and analysts in making strategic and tactical decisions for fire incidents. It has replaced the WFSA (Wildland Fire Situation Analysis), Wildland Fire Implementation Plan (WFIP), and Long-Term Implementation Plan (LTIP) processes with a single process that is easier to use, more intuitive, linear, scalable, and progressively responsive to changing fire complexity. WFDSS integrates the various applications used to manage incidents into a single system, which streamlines the analysis and reporting processes.

Wildland Fire Situation Analysis (WFSA) – A real time decision-making process carried out by federal land management agencies to select an appropriate management response to wildland fire. This system has been replaced by WFDSS

Wildland/Urban Interface -- An area or zone where structures and other human development meet or intermix with the wildland.

Wildland --An area where development is generally limited to roads, railroads, power lines, and widely scattered structures. The land is not cultivated (i.e., the soil is disturbed less frequently than once in 10 years), is not fallow, and is not in the United States Department of Agriculture (USDA) Conservation Reserve Program. The land may be neglected altogether or managed for such purposes as wood or forage production, wildlife, recreation, wetlands or protective plant cover. [The distinction between wildlands, to which the recommendations in this document apply, and agricultural lands are subject to further discussion.]

6.0 References

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