Air Resources

OBJECTIVE: To monitor ambient air, air pollutants, and air quality related values (AQRV's), which assure minimal impact of air pollutants on ecosystems.

DATA SOURCE: Precipitation chemistry and atmospheric deposition at Lost Trail Pass; snowpack chemistry and atmospheric deposition at Chief Joseph Pass; lichen communities and tissue analysis as bio-indicators of atmospheric deposition in the class I Selway Bitterroot Wilderness and Anaconda Pintler Wilderness; visibility in the Selway Bitterroot Wilderness Area and in the Bitterroot Valley and Bitterroot Mountains from automated cameras located at Hell's Half Acre Lookout, Sula Peak Lookout, and Stevensville Ranger Station; atmospheric characterization with IMPROVE modules A, B, C, and D monitoring from Sula Peak; ambient air smoke particulate matter characterization at West Fork and Stevensville Ranger Stations; water chemistry of North Kootenai Lake in the Selway-Bitterroot; carbon dioxide cooperative study near Mill Creek; and road dust monitoring of Forest Road #739 and #739A near St Mary's Peak.

FREQUENCY: Annually

REPORTING PERIOD: 2001

VARIABILITY: Detection of change in management plans and project implementation, as discussed in more detail below.
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EVALUATION:

As data accumulate from our air quality monitoring, we are gaining a better understanding of smoke effects from wildfires, prescribed natural fires, and management-ignited burns. We are able to use the results of this monitoring to help predict the effects of specific prescribed burn projects on air quality. A smoke management coordinator is located in Missoula.

The Environmental Protection Agency (EPA) is implementing more stringent air quality requirements for particulate matter 2.5 microns or smaller (PM2.5). This may affect prescribed burning programs nationally as well as on the Bitterroot National Forest. Final regulatory changes will be incorporated into National Forest management plans and project implementation, as discussed in more detail below.

MONITORING RESULTS:

Monitoring will continue under the direction of the Bitterroot NF in coordination with local, state, regional, and national air resources programs. AQRV monitoring, such as alpine lake chemistry and visibility, will follow prescriptions in the Selway-Bitterroot Wilderness AQRV Management Plan and Anaconda-Pintler Wilderness AQRV Plan.

Dr. Charles Keeling of Scripps Oceanographic Institute in San Diego monitors carbon dioxide near Mill Creek. This long-term study is coordinated with the Intermountain Fire Sciences Laboratory. Prescribed burning occurred in this airshed in the spring of 1997 and 1998, and wildfires in 2000.

The Bitterroot NF initiated cooperative regional, state, and local interagency monitoring of particulate matter in 1994, to evaluate long-term ambient air and smoke effects of prescribed burning and wildfire in the Bitterroot

Valley. The particulate matter monitoring strategy for the Bitterroot Valley is documented by an interagency committee composed of: Montana College of Mineral Science and Technology Environmental Engineering, Forest Service Northern Region air quality specialist, Bitterroot NF fire management officer, Montana Department of Environmental Quality Air Quality Division monitoring specialist, Bitterroot NF air resource program coordinator, and EPA.

Water Chemistry of Wilderness Lakes

The 1994 AQRV monitoring plan for the Selway-Bitterroot Wilderness (SBW) provided the framework for lake monitoring on North Kootenai Lake. Lake chemistry monitoring from 1992 through 2001 shows very low levels of dissolved substances, limited buffering for atmospheric source acid deposition, and a diverse but sparse population of clean water algae species (phytoplankton). North Kootenai Lake was calibrated in 1998, for acid deposition sensitivity with the MAGIC/WAND model (Model of Acidification of Groundwater in Catchments with Aggregated Nitrogen Dynamics). The MAGIC/WAND model calibrates lake chemistry to atmospheric deposition and watershed, soil, and hydrology factors, enabling prediction of lake chemistry response to potential upwind changes in emissions such as nitrate and sulfate. North Kootenai Lake pH, conductivity, and acid neutralizing capacity from 1992 to 2001, average 6.1 for pH, which is slightly acid and typical for high elevation healthy lakes in the Selway Bitterroot, average 5.0 for conductivity, which is typical for dilute or low dissolved minerals lake chemistry, and average 20.9 microequivalents per liter for acid neutralizing capacity, which is typical for an acid rain sensitive lake with low buffering capacity. We anticipate monitoring North Kootenai Lake at least through 2005.

The 1995 AQRV monitoring plan for the Anaconda-Pintler Wilderness (APW) area has recommended no future lake monitoring, since APW lakes in limestone bedrock are insensitive to potential levels of acid deposition.

National Atmospheric Deposition Program (NADP)

The NADP network monitors geographical and temporal trends in acid rain and snow. The Bitterroot NF in conjunction with the Regional Air Resource Management Program installed a high elevation NADP site above the Lost Trail Pass Ski Area in 1990. Precipitation is measured year-round by the Sula Ranger District. NADP monitoring will continue in conjunction with lake chemistry monitoring through at least 2005.

Precipitation chemistry at Lost Trail Pass from 1990 to 2000, is slightly acidic, with pH average of 5.4, due to dissolution of atmospheric carbon dioxide. The main agents of acid rain are sulfate and nitrate. Sulfate and nitrate concentration and wet deposition from 1990 through 2000, average concentration of 0.18 milligrams per liter and 0.26 milligrams per liter respectively, and average deposition of 1.55 kilograms per hectare and 2.19 kilograms per hectare respectively. There are no signs of atmospheric pollution at Lost Trail NADP in terms of acid rain from sulfate and nitrate in the years 1990 through 2000.

Snowpack Chemistry Network

The US Geological Survey, Denver, conducts long term monitoring of snowpack chemistry to determine the quality of precipitation and to identify sources of air pollution in the Rocky Mountains. Monitoring began in 1993. Chief Joesph Pass along the Continental Divide, Granite Pass near Lolo Pass, and Snow Bowl near Missoula, are sampled snowpack chemistry sites representative of the Bitterroot watershed. Snowpacks contain an integrated record of chemicals deposited from the atmosphere. Snowmelt supplies most of the freshwater in mountain lakes, streams, and wetlands. Snowpacks are sampled at about the annual maximum snow depth in March before the onset of spring snowmelt. Results of the snowpack chemistry from 1993 to 1997, for the three sites of the Bitterroot watershed, show low sulfate and nitrate ion concentrations. There are no signs of atmospheric pollution at Chief Joseph Pass and Granite Pass. Snow Bowl nitrate and sulfate ion concentrations are slightly higher than at the two mentioned remote mountain passes, and Snow Bowl is downwind of nitrate and sulfate sources in Missoula. Reference for the snowpack chemistry is the US Geological Survey Open-File Report 10-466, “Rocky Mountain Snowpack Chemistry Network: History, Methods, and the Importance of Monitoring Mountain Ecosystems,” by George P. Ingersoll, John T. Turk, M. Alisa Mast, David W. Clow, Donald H. Campbell, and Zelda C. Bailey, 2002.

Visibility and IMPROVE Monitoring

The objective for the visibility AQRV in the SBW and APW is protection from human-caused pollutants. The Bitterroot NF and Regional Air Resource Management Program established a visibility monitoring site at Hell's Half Acre Lookout in June of 1992 to: 1) establish baseline data on existing visibility conditions; 2) identify trends of deterioration or improvement; 3) determine the sensitivity of view to variation in visual air quality or to specific events such as smoke from burning vegetation; and 4) identify potential areas of impairment. The Hell's Half Acre

Lookout had an automated camera that collected photographs three times daily from the first of July through mid-October. The Hell's Half Acre Lookout visibility camera was oriented northward along the Selway River. The visibility ranged from 78 miles to 194 miles with an average of approximately 122 miles. Variations in visibility are due to weather conditions, wildfire, and prescribed fire.

On May 31, 1994, the Hell's Half Acre camera was relocated to a new site on Sula Peak, 13 miles east and downwind of the SBW, and 11 miles west and upwind of the APW. This relocation was done to provide electricity for Interagency Monitoring of Protected Visual Environments (IMPROVE). This includes the visibility of class I wilderness areas, the Selway Bitterroot and the Anaconda Pintler, as well as the class II wilderness, Frank Church River of No Return, and to better define mid-elevation visibility in the upper Bitterroot Valley as part of the particulate monitoring.

An IMPROVE Module A sampler was installed at Sula Peak in 1994. The Module A pumped 24-hour air samples through a filter twice weekly. These samples were measured for fine particulate chemistry and mass, as well as an absorption coefficient (an index of atmospheric particles' ability to absorb and scatter light). The sampler measures PM2.5, which has the most effect on atmospheric visibility. A new module A and additional modules B, C, and D were installed at Sula Peak in the summer 2000, to completely instrument this IMPROVE site for characterizing atmospheric visibility conditions with 24-hour samples being collected every three days from all four modules. Module A samples PM2.5, the fine mass elements. Module B samples ions like sulfate and nitrate. Module C samples carbon, and module D samples PM10. Wildfires caused closure and foil wrapping of the Sula Peak IMPROVE during August 2000 and, although Sula Peak Lookout burned, the air sampler was saved. IMPROVE data for Sula Peak is available by clicking on the Web site http://vista.cira.colostate.edu/improve/.

Baldy Mountain site on the Salmon NF, which is located at 9,149 feet elevation west of Salmon, Idaho, had an IMPROVE Module A characterizing long-range air transport over the Frank Church-River of No Return and SBW areas. Baldy Mountain IMPROVE was discontinued in 2000 due to the IMPROVE modules causing radio interference with airline control facilities at the site. The automated camera on Sula Peak was aimed at a SBW mountain target in upper Lost Horse Creek, and the automated camera on Baldy was aimed at West Pintler Peak in the APW.

Following is a summary of Sula Peak PM2.5 data from August 1994 to August 1999, measured every Wednesday and Saturday for 24 hours each. FY 2000 and FY2001 data are not yet available. The national PM2.5 standard is 65 micrograms per cubic meter measured over 24 hours.

Table 1 – Sula Peak PM2.5 data (data range per year)

Year	PM 2.5 (Micrograms per m^3 per 24 hrs.)		Year	PM 2.5 (Micrograms per m^3 per 24 hrs.)
1994	0.4 to 28.8		1997	0.5 to 8.4
1995	0.3 to 17.8		1998	0.4 to 27.9
1996	0.4 to 20.9		1999	0.4 to 12.0

Sula Peak IMPROVE data for 1994-1999, shows visibility impairment greater than ten percent above natural background exists in the Anaconda Pintler and Selway Bitterroot Class 1 Wilderness Areas. Estimated mean annual natural concentration (micrograms per cubic meter) of fine mass, PM2.5, is 1.47 for the western US, and 3.00 for Sula Peak. Estimated mean annual natural concentrations (micrograms per cubic meter) of ammonium sulfate is 0.10 for the western US, and 0.53 for Sula Peak. For comparison with IMPROVE samplers in Glacier National Park and Yellowstone National Park, fine mass is 5.38 and 3.09 respectively for those two sites, and ammonium sulfate is 0.93 and 0.60 respectively for those two sites. Relative to all class I wilderness areas and national parks, Sula Peak IMPROVE data for the Selway Bitterroot and Anaconda Pintler Wilderness Areas is in the cleaner air end of the spectrum of graphic visibility data for all class 1 areas. Regional haze is impairing visibility of most class-1 wilderness areas and national parks. Regional haze will be reassessed in two to three years with all of Sula Peak IMPROVE modules' data, and with three new IMPROVE sites for other Region 1 wilderness areas, near Helena, Trout Creek, and Ovando, Montana, as well as the Sawtooth near Stanley, Idaho.

Air Resource Specialists (ARS) of Fort Collins is the contractor for automatic camera visibility data taken once daily at Sula Peak. Weather and uniform haze are the main causes of reduced visibility. Uniform haze is caused by pollutants from both near and distant sources mixing in the atmosphere so that no one source is discernable. These pollutants can travel great distances. Sula Peak visibility is affected by being near the top of valley inversion layers. The Sula Peak camera was operational until December 31, 1999, in order to correlate visibility photographically with IMPROVE data on atmospheric fine particle composition. Sula Peak visibility camera

monitoring was discontinued at the end of 1999. A digital photographic summary of the visibility spectrum of good, fair, and poor days for the five years of record, 1994 to 1999, is now on a CDROM and the Region 1 air resource web page for future visibility analysis reference. The Region 1 air resource web page includes lake and NADP and other reports and is http://www.fs.fed.us/r1/gallatin/resources/air/index.shtml. IMPROVE air quality data from Sula Peak is displayed on the Region 1 air resource web page, which also links to other air resource web sites for NADP, IMPROVE, Montana and Idaho DEQ, and EPA. The air resource web IMPROVE data from Sula Peak and other sites in the northern Rocky Mountains is shown as seasonal and annual clear, median, and hazy days fine mass budgets of sulfate, soil, organic mass, soot, and other aerosols affecting visibility.

An automated visibility monitoring camera station, called "Bitterroot Valley," photographed the St Joseph Peak area in the Selway Bitterroot Wilderness from the Stevensville Ranger Station from 1994 through 1997, in order to correlate visibility with PM10 data. Air Resources Service prepared a digital photographic summary of the visibility spectrum of good, fair, and poor days for the period of record, 1994 to 1997, which is now on a CDROM and the Region 1 air resource web page for future reference and visibility analysis. A web camera for continuously monitoring Stevensville Ranger Station visibility into the Selway Bitterroot Wilderness is planned for 2002, to be on an ARS web server for correlating visibility images with smoke concentrations and weather.

Particulate Monitoring

Particulate matter less than 10 microns in diameter is called PM10. PM10 is found in smoke and dust, and it can affect visibility and human health. Bitterroot NF PM10 monitoring is an effort to determine background ambient air concentrations reflecting primarily smoke, from both wildfire and prescribed fire. At Stevensville and West Fork Ranger Stations, PM10 monitoring began in July 1994, with samples collected year-round every six days as part of a national EPA network. The West Fork Ranger Station sampler filter was not changed after July, 2000, during wildfires, and the sampler was discontinued after that. The Stevensville Ranger Station high volume sampler was discontinued at the end of November 2000. A Tapered Element Oscillating Microbalance (TEOM), which is a continuous PM10 sampler, collects and stores data continuously at the Stevensville Ranger Station. The Stevensville Ranger Station TEOM remains in operation. Smoke from 2000 wildfires is reported on the Region 1 air resource web page.

The National Ambient Air Quality Standard for PM10 is 150 micrograms per cubic meter of air for a 24-hour period. PM10 is respired deeply into human lungs and can be a health risk. It also impairs visibility. The Missoula City/County Health Department issues "stage 1 alerts" with no wood burning allowed when concentrations are 80 micrograms per cubic meter or higher per 8 hour period. Relatively low PM10 daily concentrations can substantially reduce visibility causing public concerns even if there is no health risk. Our PM10 and visibility camera monitoring experience shows the following general guidelines:

0-15 micrograms/cubic meter/24 hours	-	clean air, good visibility, no complaints
15-30 micrograms/cubic meter/24 hours	-	some haze, inversions are common, a few complaints
30-60 micrograms/cubic meter/24 hours	-	reduced visibility, complaints increase
60+ micrograms/cubic meter/24 hours	-	vistas are obscured, many complaints

At Stevensville Ranger Station, the TEOM sampler provides PM10 sampling and data logging continuously all year long including recording of the 1-hour average, 8-hour average, and 24-hour average PM10 data. TEOM 24-hour PM10 concentrations exceeded 30 micrograms per cubic meter in a 24-hour period 33 times in 2001. Wood burning stoves or road dust were likely the cause of PM10 concentrations over 30 micrograms per cubic meter during winter inversion weather conditions. Maximum concentration of PM10 usually takes place in the evening when atmospheric inversion conditions occur after sunset, and in the mornings before inversion conditions dissipate. Following is a table showing days during 2001 that Stevensville concentrations exceeded 30 micrograms per cubic meter per 24 hours.

Table 2

Stevensville Pm10 Daily Concentrations Exceeding 30 Ug/M^3 From Jan Thru Dec. 2001

Date	24 hr conc. ug/m3		Date	24 hr conc. ug/m3
1/8/01	32		8/14/01	40
2/7/01	54		8/15/01	40
2/8/01	33		8/16/01	40
2/9/01	42		8/17/01	40

Date	24 hr conc. ug/m3		Date	24 hr conc. ug/m3
3/5/01	33		8/18/01	32
3/7/01	31		8/29/01	31
3/8/01	34		8/31/01	37
4/16/01	35		9/4/01	35
4/17/01	35		9/21/01	44
4/25/01	33		9/24/01	42
4/26/01	31		9/25/01	53
5/11/01	32		10/1/01	33
5/13/01	31		10/5/01	31
5/14/01	34		10/6/01	40
7/4/01	46		11/9/01	33
7/10/01	32		11/10/01	35
8/13/01	34			

Year 2001 particulate matter monitoring at Stevensville Ranger Station reflects relatively minor amounts of smoke, rarely affecting visibility, and far less than National Ambient Air Quality Standards for PM10 of 150 micrograms per cubic meter per 24 hours.

A portable DataRAM particulate matter monitor was placed at the Florence Fire Station during spring burning of the Sweeney Creek mountain face, and that monitoring shows low concentrations about 3 miles downwind of the prescribed burn. The Sweeney Creek prescribed burn of 150 acres on April 26, and 50 acres on May 7, 2001, shows PM10 values of approximately 10 micrograms per cubic meter per 24 hours which is indicative of clean air such as occurs during rain showers and blustery winds.

The EPA is implementing regional haze rules to better protect visibility in wilderness areas and national parks. These haze rules will be related to a new standard for smaller particulate matter, less than 2.5 microns diameter, called PM2.5, which most affects haze and human health. Any of the new standards or rules could have significant impacts on forest burning since most of the particulates generated during burning are in the smaller size category. As the new standards are implemented by the states, they may look at alternatives to control emissions from wildfire. This may be accomplished through allowing more prescribed burning to offset emissions from wildfire or not allowing as much prescribed burning if the emissions contribute to violations of the standard. Federal land managers are actively involved in the implementation of these new standards.

Lichen Bio-monitoring

Lichens are bio-indicators of air quality because many species are sensitive to air pollution. Fifteen lichen air quality bio-monitoring sites were established in the SBW from 1992 to 1994, and ten sites were set up in or near the APW in 1992. Interpretative reports in 1994 and 1995 show healthy lichen communities unaffected by air pollution in the wilderness areas. In contrast, there is a lower lichen species diversity and reduced foliose and fruticose species along the eastern edge of the Anaconda Pintler Mountains near the former Anaconda smelter, where high levels of arsenic, lead, and copper are found in lichen tissue.

Arrangements were made for a contract to resurvey all 10 bio-monitoring sites of the Anaconda Pintler Wilderness in the summer of 2000. The 2000 field review of the lichen flora in the Anaconda Pintler Wilderness indicates that the flora is still diverse and healthy with minimal air pollution impact. Elemental analysis of lichen tissue from 2000 surveys is expected in March, 2002. Resurvey of the Selway Bitterroot Wilderness was arranged in the year 2001. 14 of the Selway Bitterroot Wilderness lichen air quality bio-monitoring sites were surveyed in 2001, and the remaining site on Carlton Ridge will be resurveyed in 2002. The 2001 field review of the lichen flora in the Selway Bitterroot Wilderness indicates that the flora is still diverse and healthy with minimal air pollution impact. Elemental analysis of the lichen tissue from the 2001 surveys is expected by June, 2002.