

DRAFT
VISIBILITY MONITORING
FRANK CHURCH-RIVER OF NO RETURN WILDERNESS
SALMON-CHALLIS NATIONAL FOREST
SALMON, IDAHO

The Salmon-Challis National Forest lies in a transition zone between the maritime climate of Northern and Western Idaho and the continental climate of Southeastern and Eastern Idaho that contains strong pathways of air pollution from California, Southwest Idaho and Nevada. During the spring and summer seasons, most of the precipitation in Idaho results from high altitude convectional storms that moves northward from the Gulf of Mexico and the California coast. This includes the air mass movement from the south, southwest and west. At certain times, low pressure systems occasionally produces winds from the south and southeast, out of Northern Utah, Southeast Idaho and Southwest Wyoming. During the winter, the air mass is from the northern Pacific coastal area, which includes the northwest and north out of Oregon, Washington, Northern Idaho and Western Canada. Major pollution sources that impact central Idaho come from central and eastern Washington (coal-fired power plants). This includes the Pacific Power source region, (Centralia coal-fires power plant) which is estimated to produce 34 percent of the measured sulfur, and SO₂ emissions in excess of 65,000 tons per year. Vancouver Island, in western British Columbia and in the Puget Sound area produces approximately 35 percent of the ambient sulfur. Northern Washington is estimated to produce approximately 30 percent of ambient sulfur that comes from smaller sources that include; industrial boilers, mining and smelting activity, pulp and paper mill operations. Southern Utah produces emissions from the Navajo Generating Station, a large, coal-fires power plant, located near Page in Northern Arizona. In Northern Utah the Salt Lake City area and Wasatch Front produces emissions from steel and oil refining. Southern California produces emissions from oil refining activities, electric generating facilities, automobiles and diesel emissions

VISIBILITY

The Clean Air Act Amendments of 1977 declared, as national goal, “ the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class 1 federal areas which impairment results from manmade air pollution”. The Forest Service Class 1 areas are defined as Wilderness in existence as of August 7, 1977 and exceeding 5,000 acres, including their later additions. The Act requires the identification of Air Quality Related Values, which are the resources potentially affected by air pollution, including flora, fauna, water, cultural and geologic resources, soil, odor and visibility. The Class 1 Wilderness, surrounding the Frank Church-River of No Return Wilderness include: Sawtooth (South), Selway-Bitterroot (North), Hells Canyon (West), and the Anaconda-Pintler (Northeast). The Frank Church- River of No Return Wilderness is listed as a Class II area, since it was established after 1977. These lands are just as important as the Class I Wilderness and the protection are the same, except the mechanisms at our disposal for fulfilling this responsibility do differ.

An automated 35 mm camera was installed on July 16, 1989 at the Middle Fork Peak Lookout (elevation 9,127 feet) that would monitor visibility within the Salmon-Challis National Forest. The target site was Big Baldy Mountain located west of the site, approximately 30 miles on the Boise National Forest. The visibility is generally excellent during most of the year, except for a few times in the summer due to large forest fires. The air quality on the Salmon-Challis National Forest is characteristic of the Central Idaho Region.

Visibility is affected by suspended particles in the atmosphere that can be grouped into two categories: fine and coarse particles. Fine particles are less than 2.5 microns such as; sulfate, nitrate, organic carbon, elemental carbon (soot) and other materials and tend to be man made. It is this fine particle mass (PM 2.5) that is the primary size range that scatters light and impairs visibility. Fine particles are more efficient light scatters than large particles, since there are more of them in the air. The fine particles are what causes most of the visibility impairment and have the greatest adverse health effects. Sulfate and carbon species are the single largest contributors to visibility reduction at all monitoring sites throughout the United States. In the west, sulfate species make up for about 30 percent of the measured visibility impacts. Coarse particles are greater than 2.5 microns, which include soil dust and smoke from forest fires tend to be of natural origin. Sulfate is generally the major component of the fine mass throughout the United States, accounting for 20 to 40 percent of the mass in the west and 45 to 60 percent in the east. Sulfur primarily enters the atmosphere as sulfur dioxide gas, and mainly from electric utility industry (coal-fires power plants). The sulfur dioxide converts in the atmosphere to sulfuric acid, which reacts with ammonia gas to form ammonium sulfate. The rate of transformation and the size of the resulting particles depend on the relative humidity. This has a significant impact on visibility, because in high humidity, the sulfate particles are larger and scatter light more efficiently relative to the mass of sulfur. This growth can occur anytime during the lifetime of the particle. If the relative humidity later decreases, the particle will shrink, but not immediately. Therefore, the particle size and scattering efficiency depends on the relative humidity of the past as well as the present. Nitrogen oxides occur in the atmosphere from the result of any type of combustion such as coal-fired power plants and transportation sources.

The visibility was measured in Standard Visual Range (SVR) and is defined as "the greatest distance at which an observer can just see a black object viewed against the horizon sky" and is expressed in kilometers (km). For this report, kilometers were also converted to "miles" and added for a better understanding of distance. A graph is used to plot the possible SVR estimates and a 10th, 50th and 90th percentile cumulative frequency values are derived. The 10th percentile value represents the visibility conditions found at a particular monitoring site at least 90% of the time, meaning that value is not reached on 10% of the days during the analysis period. The 10% value is to represent **Poor** visibility conditions. The 50th percentile is the median value and is representative of **Medium** visibility conditions. This value is exceeded on half of the days in the analysis period. The 90th

percentile is representative of **Good** visibility conditions. This value is only exceeded on 10% of the days in the analysis period. Five years of camera monitoring data consistently show background (50th percentile) summer and fall Standard Visual Ranges of about 108 miles (174 km) and 133 miles (215 km), respectively. The nature of camera-based SVR measurements tends to overestimate these numbers somewhat; however, the aerosol data suggest that summer and fall are the two dirtiest seasons annually and that spring and winter are cleaner than fall. (True error in each slide measurement is dependent on the characteristics of the scene and target, weather conditions, sun angle, uniformity of the air quality in the sight path, film exposure, measurement error, and the accuracy of the instrument used to obtain direct slide contrast measurements). During the early summer, before forest fires and early to middle fall after the fires, visibility can be up to 232 miles. All photograph slides were analyzed for Standard Visual Range (SVR) in kilometers (km), by Air Resource Specialists, Inc., Fort Collins, Colorado.

The 10% value is to represent **Poor** visibility conditions. The 50th percentile is representative of **Medium** visibility conditions. The 90th percentile is representative of **Good** visibility conditions. Minimum estimated error varies from 10 to 30 percent.

VISIBILITY DATA RESULTS: Reported in miles

<u>Summer</u>	<u>50 percent SVR</u>	<u>90 percent SVR</u>
1989 7/09-8/31	101 miles	205 miles
1990 7/16-8/31	87	148
1991 7/03-8/31	115	163
1992 6/30-8/31	122	180
1993 7/03-8/31	114	178

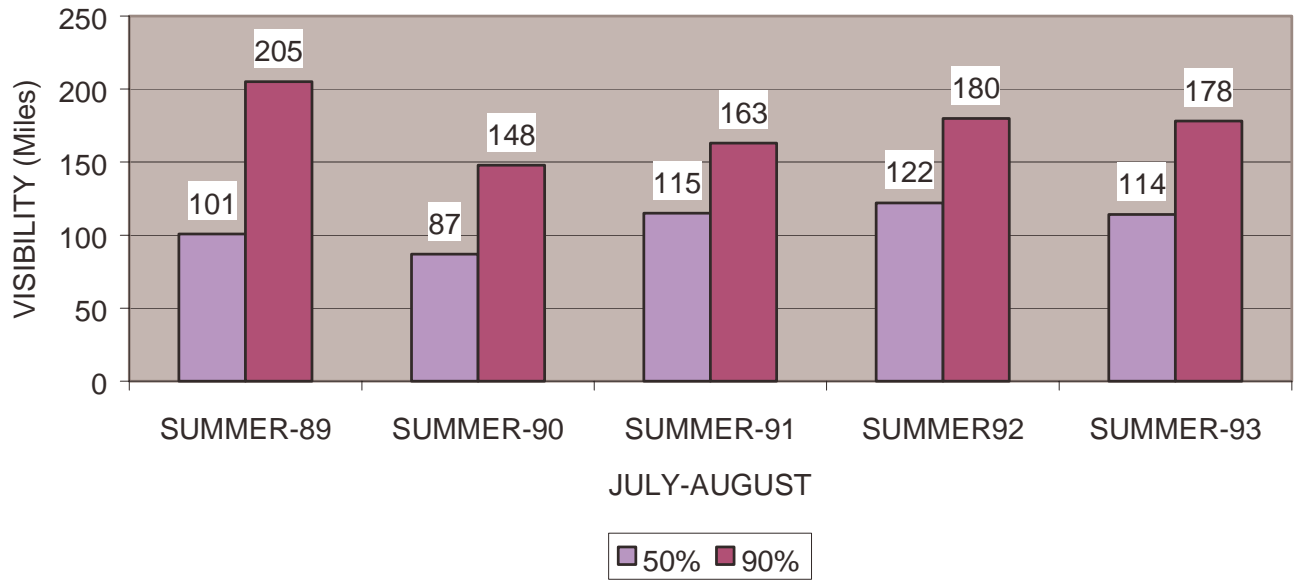
Summer Average for five years @ 50 %= 108 miles

Fall

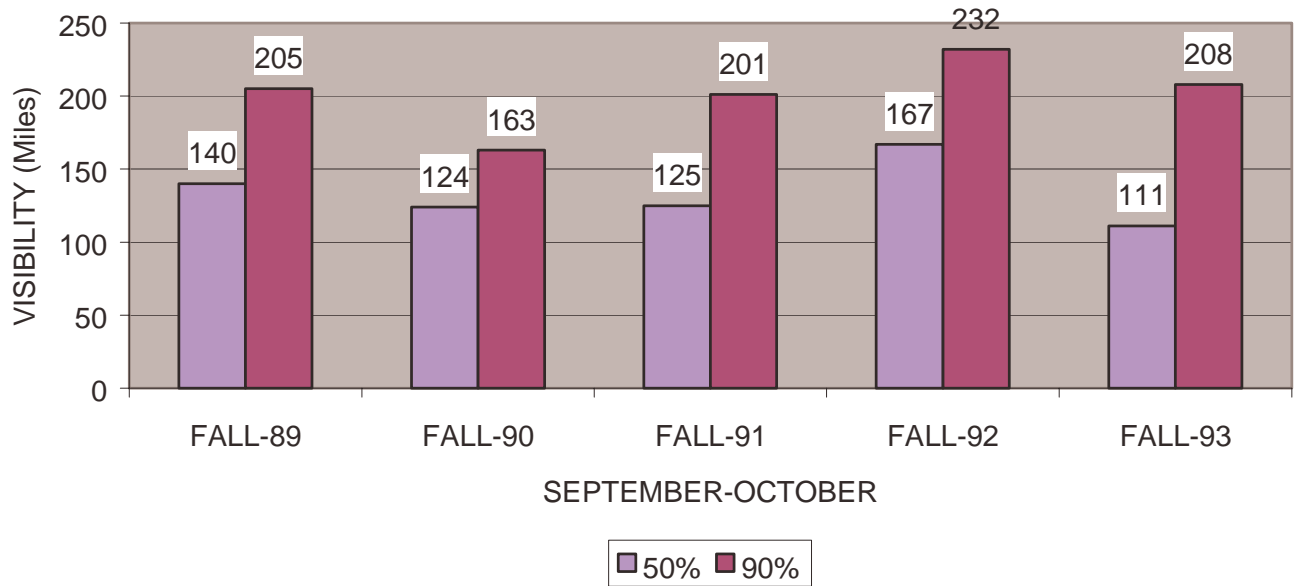
1989 9/1-10/06	140 miles	205 miles
1990 9/1-10/18	124	163
1991 9/1-10/25	125	201
1992 9/1-10/23	167	232
1993 9/1-10/01	111	208

Fall Average for five years @ 50 %= 133 miles

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Visibility Monitoring Measured in Kilometers (Km).

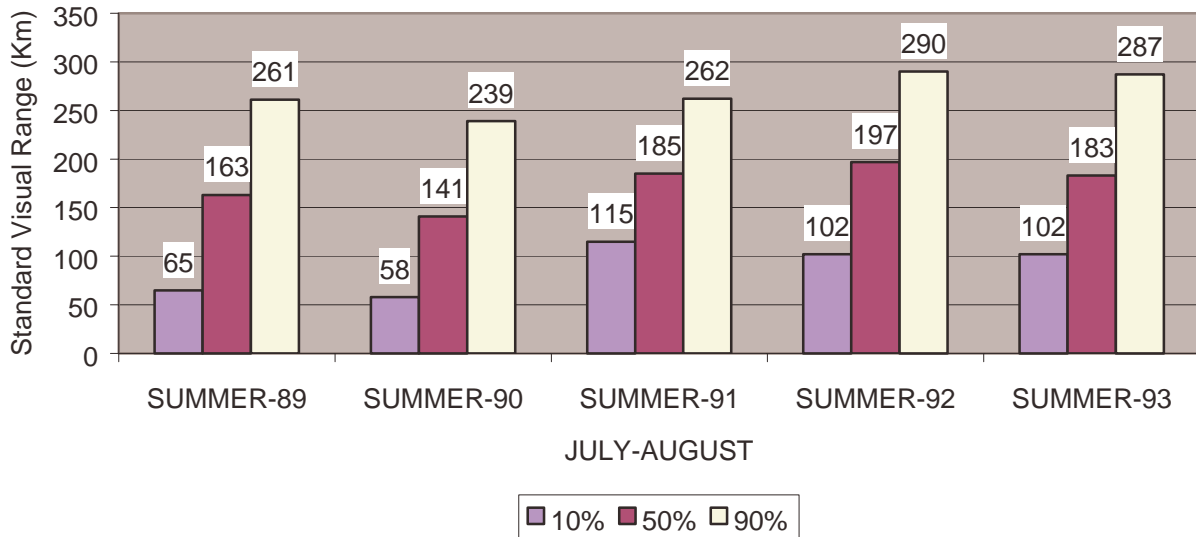
The 10% value is to represent **Poor** visibility conditions. The 50th percentile is representative of **Medium** visibility conditions. The 90th percentile is representative of **Good** visibility conditions. Minimum estimated error varies from 10 to 30 percent.

	<u>Value</u>	<u>SVR Average</u>
1989 - Summer: July 9 to August 31:	10%	65 Km +/- 30%
	50%	163 Km +/- 10%
	90%	261 Km +/- 10%
1989 - Fall: September 1 to October 6:	10%	134 Km +/- 10%
	50%	225 Km +/- 10%
	90%	330 Km +/- 10-16%
1990 - Summer: July 16 to August 31:	10%	58 Km +/- 30%
	50%	141 Km +/- 10%
	90%	239 Km +/- 10%
1990 - Fall: September 1 to October 18:	10%	135 Km +/- 10%
	50%	200 Km +/- 10%
	90%	262 Km +/- 10%
1991 - Summer: July 3 to August 31:	10%	115 Km +/- 10%
	50%	185 Km +/- 10%
	90%	262 Km +/- 10%
1991 - Fall: September 1 to October 25:	10%	94 Km +/- 10 %
	50%	201 Km +/-10%
	90%	324 Km +/- 10-16%
1992 - Summer: June 30 to August 31	10%	102 Km +/- 10%
	50%	197 Km +/- 10%
	90%	290 Km +/- 10%
1992 - Fall: September 1 to October 23:	10%	143 Km +/- 10%
	50%	269 Km +/- 10%
	90%	374 Km +/- 10-16%

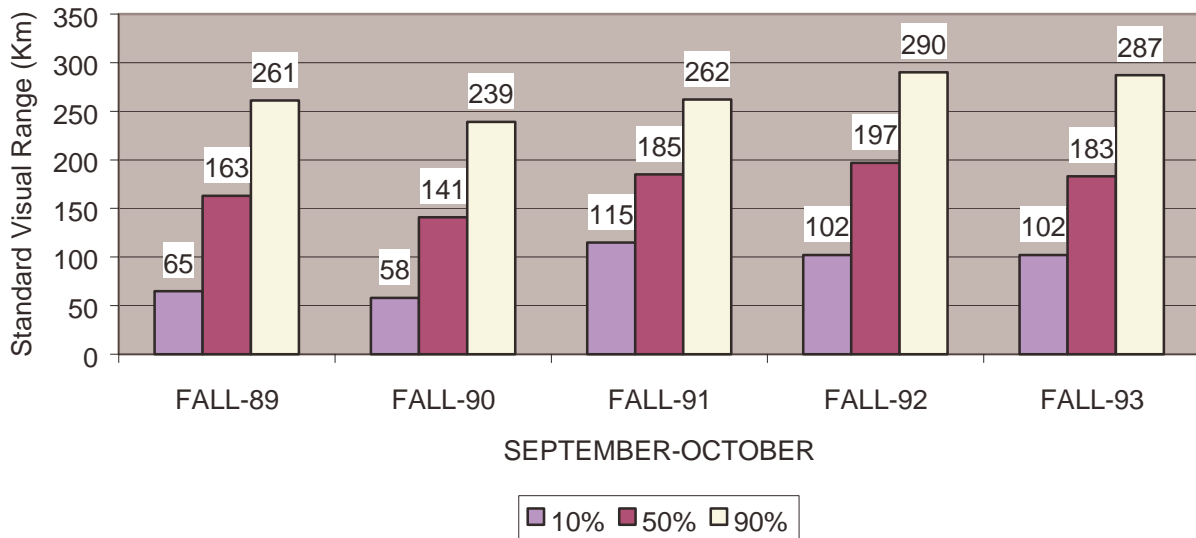
1993 - Summer: July 3 to August 31	10%	102 Km +/- 10%
	50%	183 Km +/- 10%
	90%	287 Km +/- 10%
1993 - Fall: September 1 to September 30:	10%	100 Km +/- 10%
	50%	179 Km +/- 10%
	90%	335 Km +/- 10-16%

The visibility at the Middle Fork Peak Lookout, from September 3, 1991 through October 21, 1991, (in the fall), ranged from good to poor, depending on the wind direction, and this was also during the Rush Creek fire, that was located within the Frank Church-River of No Return Wilderness on the Payette National Forest. This lookout is located on the east side of the Frank Church-River of No Return Wilderness and was occupied from June 17, 1992 until October 4, 1992. The time between August 10, 1992 and August 22, 1992, when the forest fires were burning on the Boise and Payette National Forests, the Middle Fork Peak Lookout could not see more than a few hundred yards due to thick smoke. During this period, there was 83 days of recorded weather with regional haze at 66 percent of that time and with smoke at 34 percent. On August 22, 1992, there was zero visibility as described by the Middle Fork Peak Lookout, and that was the same day the aerosol sampler on South Baldy Mountain (33 miles northeast at similar elevation) recorded a PM-10 value of 64 micrograms per cubic meter and the visibility was estimated to be less than 1 mile. Also on this same day, the Salmon Valley and other main drainages within the wilderness had a good visibility range of about 1 mile, fair from 1 to 3 miles, and poor beyond 3 to 5 miles.

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CONCLUSION OF VISIBILITY MONITORING

The overall air quality on the Salmon-Challis National Forest in Idaho is generally excellent with only short time impacts due to dusty dirt roads or specific projects, such as mining operations and prescribed fires. Natural forest fire smoke can either be for a short or a long duration, and that is due to local climate conditions, size of the fire and distance to the fire. The maximum documented visibility has been 242 miles and has occurred 12 times between July and November of each year from 1989 through 1993. **The summer averages from July to November was 108 miles and the fall averages for the same time was 133 miles.** The PM-10 equivalent value (South Baldy Mountain PM-10 site) for the period between June and November of 1989 to 1993 was 9 micrograms per cubic meter. The yearly average over 5.5 years for the PM-2.5 value from 1994 to the middle of 1999 was 3 micrograms per cubic meter. **These very low PM-2.5 values represent the very good visibility of Central Idaho most of the years, except for specific fire occurrences.**

Trends

Though a five year monitoring project represents a significant effort, it is generally not enough to measure statistically significant trends. This is due to large year-to-year differences that occur normally, and tend to overshadow gradual trends. The camera trends to date, shows that fine particles from fires in the summer is the major cause of decreased visibility in Central Idaho during the summer months.

It is important to understand that one aspect of visibility monitoring program is inherently long-term. Having inventoried visibility conditions for 5 years, a permanent, statistically sound record now exists which can be compared against conditions in 10 or even 100 years.

In the fall of 1993, the visibility monitoring site in the Frank Church-River of No Return Wilderness was terminated after obtaining 5 years of summer and fall data.

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