Attachment 46 to PLA-6219
Ecology III, Inc. Effects of Simulated Salt Drift from the Susquehanna Steam Electric Station Cooling Towers on Field Crops-Summary Report. November 1987

(NRC Document Request 101)

EFFECTS OF SIMULATED SALT DRIFT

FROM THE SUSQUEHANNA STEAM ELECTRIC STATION

COOLING TOWERS ON FIELD CROPS

SUMMARY REPORT

Prepared by

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For

Pennsylvania Power and Light Company

Ecology III, Inc.
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Berwick, PA

November 1987

ABSTRACT

Studies were conducted in 1985 and 1986 to simulate the effects of salt drift from the Susquehanna SES cooling towers on agricultural crops grown in the vicinity of the power station. Field corn and beans were tested in two locations using a hand-propelled sprayer and salt solutions simulating water from the cooling tower basin. The 1985 program achieved spray dosages of 4.0 and 8.1 kg/ha/mo on the treated rows. The dosage rates in 1986, obtained from a solution slightly more concentrated and closer to actual cooling tower basin composition, were 10.7 and 21.4 kg/ha/mo. These dosages are equal to and nearly double the projected "worst case" of 4.08 kg/ha/mo.

No visible effects were found on either corn or beans in the fields in 1985 or 1986. Since these experiments used application levels that were at least double the estimated maximum salt drift deposition from the Susquehanna SES cooling towers without crop damage, it is concluded that damage to crops is highly unlikely.

Salt drift transects have also been established for observation of parasitic plant diseases and flowering plant phenology on a monthly basis during the growing year. Although more than 50 parasitic plant diseases have been observed on the transects, 1978-1987, occurrence and location of these do not indicate effects from the Susquehanna SES cooling towers.

INTRODUCTION

Studies were conducted in 1985 and 1986 to simulate the effects of salt drift from the Susquehanna SES cooling towers on agricultural crops grown in the vicinity of the power station. This report summarizes the results of these studies; detailed separate reports were made for each year (Montgomery 1986a, 1986b).

Studies summarized by Mulchi and associates have shown no effects of cooling tower salt drift on plants, except for cases where brackish water was used at Chalk Point, Maryland (Armbruster and Mulchi 1984, Mulchi and Armbruster 1981, Frances 1977). Symptoms of salt spray damage are given in Appendix, Question 1.

Dames and Moore (1983) estimated salt drift equal to 5.127 kg/mo when both SSES cooling towers were in full operation, yielding a deposition rate of 4.08 kg/ha/mo at a distance of 2 km from the towers. The 1985 studies at Susquehanna utilized this estimated maximum ("worst case") salt drift concentration on crops to determine if damage would occur. Questions regarding the composition of the 1985 spray resulted in experiments in 1986 using cooling tower water as a basis for the chemical composition of spray in a second season of studies in 1986.

In addition to these studies on agricultural crops, salt drift transects were established in 1977, and have been continued through 1987, to test the possible long term effects of salt drift and moisture

from the Susquehanna SES cooling towers on natural vegetation. Results of these studies have been presented in annual reports submitted to PP&L, and are summarized below.

METHODS

Field corn and beans were tested at two locations. The Chapin fields were located in the Susquehanna Riverlands, 1.7 km ENE from the Susquehanna SES cooling towers. The Karchner fields were located in Mifflin Township, 0.5 km E of Hetlerville, 12.5 km SE of the Susquehanna SES cooling towers. Field corn was available at both locations in both years. Soybeans were grown at Karchner and green beans at Chapin in both years; there is no reason to expect that the two types of beans would react differently to the spray (Montgomery 1986a).

Initially I expected to use water from the cooling towers for the 1985 experiments, but analysis indicated that multiple applications would be required to achieve the target rate of 4.1 km/ha/mo. A solution was therefore formulated that would approximate the cooling tower water in composition and achieve the "worst case" deposition rate (Table 1).

The 1986 experiments were similar except that chemical composition for the spray was improved by more complete analysis of the cooling tower water. The spray solution was formulated to equal five times the concentration of cooling tower water (Table 2).

In both years, spraying was done with a hand-propelled sprayer based on a design used at Chalk Point, MD (Frances 1977) and suggested by Dr. Charles Mulchi (personal communication). Details of construction and operation are given in Montgomery (1986a). The rate of deposition was controlled to yield approximately one ml/sec/nozzle, and either four or eight nozzles were used per application.

In 1985, two salt spray applications were used: single (1x) using four nozzles to deliver about 4 ml/sec and double (2x) using all eight nozzles to deliver about 8 ml/sec. In 1986, eight nozzles were used in all applications but treatment was made at five times cooling tower water concentration (5x) and ten times concentration (10x) by spraying the rows once or twice, respectively. A spring water control (0x), using all eight nozzles and one application was made in both years. Each treatment was replicated three times in each field. Order of treatments within each replica was randomly determined in each year.

Four crop rows 10 m long were used for each treatment (Fig. 1). The two center rows were treated with spray and an untreated row left as a buffer on each side (in effect, leaving two untreated rows between each pair of treated rows). The area treated, 2 rows each 36 in (0.91m) wide and 10 m long, was 1.8 m. Spraying was done each weekday except when rain or wind made spraying ineffective. Applications were made as early in the morning as possible to minimize wind effects.

All treatments were examined at approximately ten day intervals for signs of damage. A visual comparison was also made between the

treated areas of corn and beans and untreated adjacent areas of each field.

At the end of the 1986 spraying program, when corn was mature (dent stage), but not fully dry, samples were collected for comparison between treatments. Details of the methods for this study are given in Montgomery (1986b).

Salt drift transects were traversed monthly from March through October, 1978-1987. Observations were made on flowering plant phenology and parasitic plant diseases. Locations of transects and references to methods are given in Montgomery (1987).

RESULTS

In 1985, corn was sprayed from 10 June to 31 July, with a total of 28 spray treatments; in 1986, corn was sprayed from 25 June to 15 August, for a total of 31 spray treatments at Karchner and 33 at Chapin. In both years, at the conclusion of the experiments, the corn had finished flowering and fruit (ears) was in the dent stage of development. In 1985, beans at both locations were sprayed from 10 June to 31 July, a total of 20-21 treatments. In 1986, beans were sprayed from 25 June to 28 July at Chapin and 15 August at Karchner, a total of 19 and 31 times, respectively. Green beans were harvested by the farmer in both years at Chapin. Soybeans were setting fruit at the conclusion of the treatments at Karchner.

No visible effects were found on either corn or beans in the fields in 1985 or 1986 (Table 3). No differences were observed in stages of development or plant heights in either year. Comparison of plants in adjacent untreated areas of the fields also indicated that treated plants began to flower, set fruit, and maintained vegetative growth at the same rate as those in the field in general.

Results of the measurement of corn weights are presented in Montgomery (1986b). No differences were found between treatments. More than 50 parasitic plant diseases have been observed on the salt drift transects, 1978-87. Most of these diseases caused minor leaf necrosis, including leaf spots, rust diseases, and powdery mildews; a few, including leaf spot/dieback of flowering dogwood and chestnut blight caused more severe effects. Occurrence of diseases has varied from year to year, and with location (transect). These variations were related to host presence and weather conditions in each year. No effects have been observed that could be related to moisture or salt drift from the Susquehanna SES cooling towers.

DISCUSSION

The data reported here from studies at the Susquehanna SES used levels of salt application similar to those used in experiments at Chalk Point. The 1985 1x application level (4.0 kg/ha/mo) was applied to corn for eight weeks without visible effects, and approximated both the levels at which Mulchi and Armbruster (1981) found reductions in

yield and the estimated maximum salt drift deposition at Susquehanna SES. Green beans and soybeans were sprayed for six weeks or more; however, Mulchi and Armbruster (1981) found visible effects of the salt treatment at Chalk Point after one week. The 1985 2x level (8.1 kg/ha/mo) doubled this application level, again with no visible effects on crops.

The 1985 program, which used a rough chemical approximation of cooling tower water, achieved spray dosages of 4.0 and 8.1 kg/ha/mo on the treated rows. These dosages are equal to and nearly double the projected 4.08 kg/ha/mo considered a "worst case" in models by Dames and Moore (1983) and Mulchi (1984). The dosage rates in 1986, obtained from a solution slightly more concentrated and closer to actual cooling tower basin chemical composition, were 10.7 and 21.4 kg/ha/mo at 5x and 10x, respectively (the 8.1 rate in 1985 is equavalent to the 10.7 rate in 1986, in that both used all eight spray nozzles and one application treatment per row). The solution used in 1986 contained higher concentration of bicarbonate than used in 1985, but other concentrations were similar.

The effects of salt drift at the Susquehanna SES were expected to be different from those found at Chalk Point because the salts present in the cooling water derived from the Susquehanna River differ from the salts present at Chalk Point derived from brackish water in Chesapeake Bay (see Appendix, question 1). Sulfate and calcium, chief components

of Susquehanna SES cooling tower water, are plant macronutrients and are not likely to cause necrosis of plant tissue.

The 1986 experiments, using application levels approximately the same as 1985, and a chemical mixture reasonably close to cooling tower water, indicated no damage to crops at this composition and level of application. Since the 1985 and 1986 experiments utilized application levels that were at least double the "worst case" estimated to occur from the Susquehanna SES cooling towers without visible crop damage, it is concluded that damage to crops from cooling tower salt drift is highly unlikely.

REFERENCES

Armbruster, J. A. and C. L. Mulchi. 1984. Response of corn and soybeans to soil vs. foliar applied salts of cooling tower origin. J. Environ. Qual. 13:278-282.

Dames and Moore. 1983. Meeting to discuss salt drift modeling for Susquehanna Steam Electric Station, Report. Dames and Moore, Atlanta, GA.

Frances, B. A. 1977. Effects of simulated saline cooling tower drift on woody species. Chalk Point Cooling Tower Project No. PPSP-CPCTP-17. Md. Dept. Nat. Res. Power Plant Siting Program, Annapolis, MD.

Montgomery, J. D. 1986a. Effects of simulated salt drift from the Susquehanna Steam Electric Station cooling towers on field crops. Report to PP&L. Ecology III, Inc., Berwick, PA.

_____. 1986b. Effects of simulated salt drift from the Susquehanna Steam Electric Station cooling towers on field crops, Report of 1986 studies. Report to PP&L. Ecology III, Inc., Berwick, PA.

_____. 1987. Flora, vegetation, and meteorology. In: T. V. Jacobsen (ed.), Ecological studies of the Susquehanna River in the vicinity of the Susquehanna Steam Electric Station (1986 annual report). Ecology III, Inc., Berwick, PA (in press).

Mulchi, C. L. 1984. Review of natural draft cooling tower operations and saline aerosol emissions at the Susquehanna SES. Report to PP&L.

_____, and J. A. Armbruster. 1981. Responses of corn and soybeans to simulated saline aerosol drift from brackish water cooling towers. J. Environ. Qual. 10:541-547.

APPENDIX 1

This appendix contains answers to questions posed by the Environmental Advisory Committee.

1. How does the deposition of salt spray from the Susquehanna SES cooling towers compare to natural salt deposition near the ocean?

   Water used in the Susquehanna SES towers is derived from the Susquehanna River, and so contains salts similar to those found in the river. The chief salts are sulfate, bicarbonate, and calcium, with smaller amounts of magnesium, sodium, iron, and chloride. Salt from sea spray or brackish water (such as the water used in the Chalk Point, MD, cooling towers, is high in sodium and chloride, with smaller amounts of potassium, calcium and magnesium (Frances 1977, Mulchi and Armbruster 1981).

2. Were the salts in solution sprayed on plants in equilibrium or not? If not, does this impact on test results?

   No chemical tests were run on the solutions; however, there was some evidence that some salts, especially iron, were at or near saturation as indicated by precipitate forming in the mixing container. The solution was agitated before being added to the sprayer, and the motion of the sprayer in the fields would have kept the solutions mixed

during spraying. We have no reason to expect that this would impact test results, since the ions would still be applied to the crops. Similar inequilibria presumably occur in the tower plume during mixing and evaporation in the atmosphere.

3. At what level of salt deposition should damage occur?

There may not be a level of salt deposition of the type of salts found in the Susquehanna cooling tower water that causes visible damage to crop plants, because of the types of salts found in the water. As indicated in the report, salts found are plant macronutrients, and unlikely to cause damage. For salts found in brackish water, Mulchi and Armbruster (1981) found damage and yield reductions at levels of 5.6 to 6.88 kg/ha/wk in soybeans and corn.

4. Where on the plant is damage expected from salt drift?

Damage is visible in the leaves of the plants in the form of leaf curling, marginal necrosis, and spotting of leaf tissue. Damage can also occur in reduced size and fruit yield (i.e. smaller fruits or fewer fruits per plant). Increased stress to the plant can also be detected in increased parasitic diseases and reduced flowering; the salt drift transects at Susquehanna SES are designed to detect this type of damage on natural vegetation.

Table 1

Salts added to five gallons of spring water to approximate cooling tower spray of 4.1 mg/ha/mo, 1985.

Salts	Amount (g)
Ferric chloride, $FeCl_3$	3.7
Calcium sulfate, $CaSO_4$	16.2
Magnesium sulfate, $MgSO_4$	15.3
Sodium sulfate, Na_2SO_4	3.7
Potassium sulfate, K_2SO_4	5.7

Table 2

Salts added to five gallons of spring water to simulate approximate cooling tower water and 5x cooling tower water, 1986

Salts	Amount (g) Added for 5x CT Water
Dipotassium hydrogen phosphate, K_2HPO_4	0.07
Potassium nitrate, KNO_3	0.77
Potassium bicarbonate, $KHCO_3$	0.68
Sodium bicarbonate, $NaHCO_3$	16.74
Magnesium chloride, $MgCl_2$	9.08
Magnesium sulfate, $MgSO_4.7H_2O$	7.95
Ferrous ammonium sulfate, $Fe(NH_4)_2(SO_4)_2.6H_2O$	1.80
Calcium sulfate, $CaSO_4$	40.17

Table 3

Results of spray program on corn and beans at Chapin and Karchner fields, 1985-86.

	Chapin						Karchner				
Date	Corn			Beans			Corn			Beans	
	Height	Maturity	Effects	Height	Maturity	Effects	Height	Maturity	Effects	Height	Maturity
1985											
10 June (start)	30	3-5 leaves	--	--	--	--	30	3-5 leaves	--	--	--
21 June	50	vegetative	none	--	--	--	55	vegetative	none	--	--
1 July	100	vegetative	none	20	vegetative	none	100	vegetative	none	20	vegetative
10 July	150	vegetative	none	30	vegetative	none	120-150	vegetative	none	30	vegetative
22 July	200-220	flowering	none	30	flowering & young fr.	none	200-250	flowering	none	35	flowering
6 Aug.	200+	young fruit	none	--	harvested	--	200+	young fruit	none	40	flowering & young fruit
1986											
25 June (start)	100	vegetative	--	12	vegetative	--	150	vegetative	--	10	vegetative
3 July	120	vegetative	none	15	buds	none	170-180	vegetative	none	10-12	vegetative
11 July	180-200	vegetative	none	30-40	flowering	none	200	buds	none	30	vegetative
24 July	200-220	flowering	none	60	flowers & young fruit	none	200-220	flowering	none	60	flowering
7 Aug	220	young fruit	none	--	harvested	none	200-220	young fruit	none	80	young fruit
15 Aug	220	fruit (dent stage)	none	--	--	--	200-220	fruit (dent stage)	none	80-90	young fruit

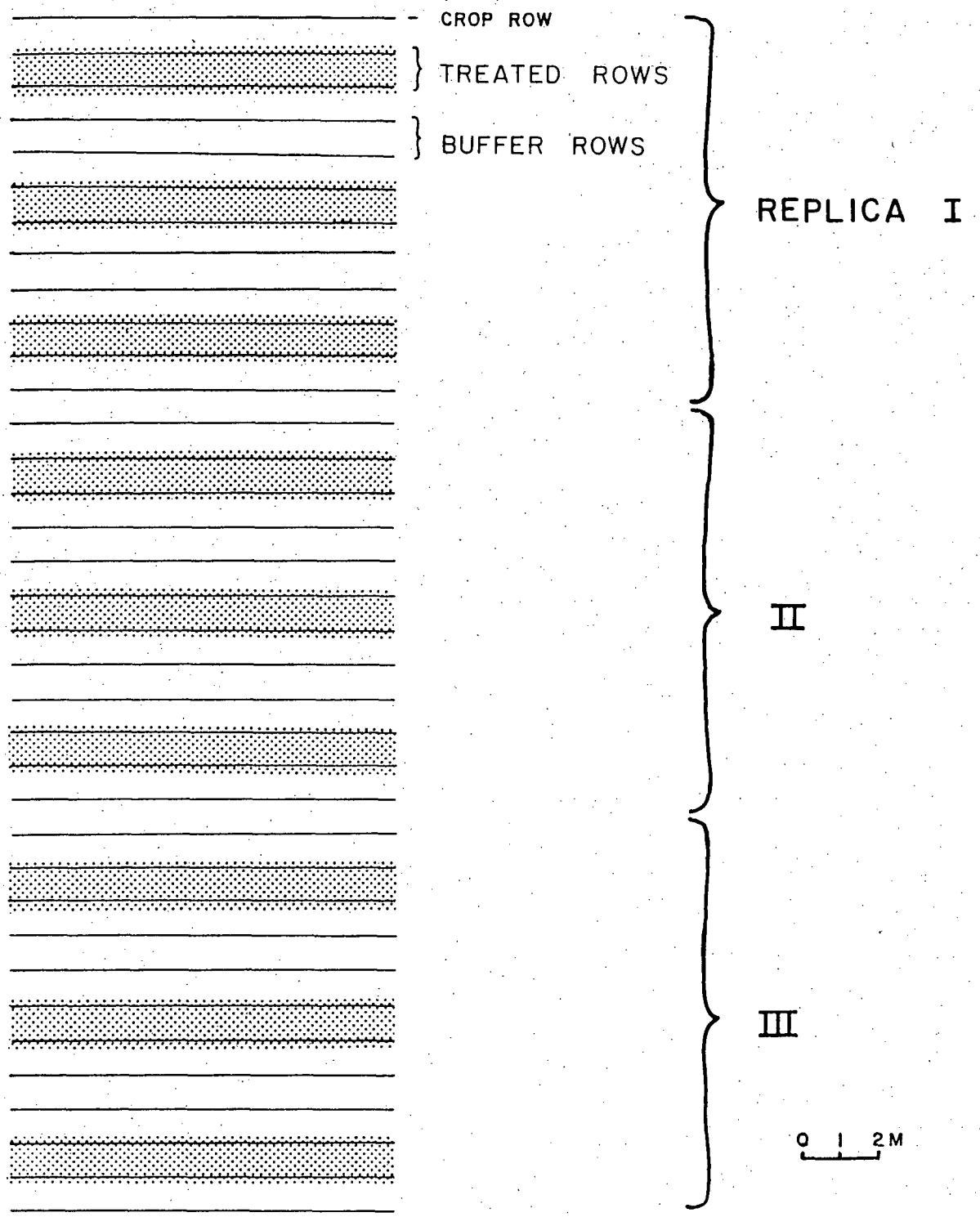

Fig. 1

Arrangement of 5x, 10x, and control treatments within each replica and replicas within each field.

Ecology III, Inc.

ENVIRONMENTAL CONSULTING SERVICES

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SUSQUEHANNA SES BIOLOGICAL LABORATORY

19 November 1987

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SUSQUEHANNA STEAM ELECTRIC STATION
CCN-741326 FILE R9-3
EIPL-197
SALT DRIFT SUMMARY REPORT

Dear Ken:

Enclosed please find the final report of "Effects of Simulated Salt Drift from the Susquehanna Steam Electric Station Cooling Towers on Field Crop, Summary Report." Six copies are included for the Environmental Advisory Committee. If further information is required, please contact me at your convenience.

Sincerely,

James D. Montgomery

James D. Montgomery, Ph.D.,
Environmental Studies Director, Terrestrial

JDM/msh

Enclosure

cc: J. S. Fields (A1-2)
T. V. Jacobsen (E-III)
SRMS File (A6-2)
EIPL File

Attachment 47 to PLA-6219
Title 40, Part 81, Subpart D – Identification of Mandatory Class I Federal Areas Where Visibility is an Important Value

(NRC Document Request 104)

Electronic Code of Federal Regulations (e-CFR)

e-CFR Data is current as of April 10, 2007

Title 40: Protection of Environment

PART 81—DESIGNATION OF AREAS FOR AIR QUALITY PLANNING PURPOSES

Browse Previous

Subpart D—Identification of Mandatory Class I Federal Areas Where Visibility Is an Important Value

Authority: Secs. 101(b)(1), 110, 169A(a)(2), and 301(a), Clean Air Act as amended (42 U.S.C. 7401(b), 7410, 7491(a)(2), 7601(a)).

Source: 44 FR 69124, Nov. 30, 1979, unless otherwise noted.

§ 81.400 Scope.

Subpart D, §§81.401 through 81.437, lists those mandatory Federal Class I areas, established under the Clean Air Act Amendments of 1977, where the Administrator, in consultation with the Secretary of the Interior, has determined visibility to be an important value. The following listing of areas where visibility is an important value represents an evaluation of all international parks (IP), national wilderness areas (Wild) exceeding 5,000 acres, national memorial parks (NMP) exceeding 5,000 acres, and national parks (NP) exceeding 6,000 acres, in existence on August 7, 1977. Consultation by EPA with the Federal Land Managers involved: The Department of Interior (USDI), National Park Service (NPS), and Fish and Wildlife Service (FWS); and the Department of Agriculture (USDA), Forest Service (FS).

§ 81.401 Alabama.

Area name	Acreage	Public Law establishing	Federal land manager
Sipsey Wild	12,646	93–622	USDA-FS

§ 81.402 Alaska.

Area name	Acreage	Public Law establishing	Federal land manager
Bering Sea Wild	41,113	91–622	USDI-FWS
Mount McKinley NP	1,949,493	64–353	USDI-NPS
Simeonof Wild	25,141	94–557	USDI-FWS
Tuxedni Wild	6,402	91–504	USDI-FWS

§ 81.403 Arizona.

Area name	Acreage	Public Law establishing	Federal land manager
Chiricahua National Monument Wild	9,440	94–567	USDI-NPS
Chiricahua Wild	18,000	88–577	USDA-FS
Galiuro Wild	52,717	88–577	USDA-FS

Grand Canyon NP	1,176,913	65–277	USDI-NPS
Mazatzal Wild	205,137	88–577	USDA-FS
Mount Baldy Wild	6,975	91–504	USDA-FS
Petrified Forest NP	93,493	85–358	USDI-NPS
Pine Mountain Wild	20,061	92–230	USDA-FS
Saguaro Wild	71,400	94–567	USDI-FS
Sierra Ancha Wild	20,850	88–577	USDA-FS
Superstition Wild	124,117	88–577	USDA-FS
Sycamore Canyon Wild	47,757	92–241	USDA-FS

§ 81.404 Arkansas.

Area name	Acreage	Public Law establishing	Federal land manager
Caney Creek Wild	14,344	93–622	USDA-FS
Upper Buffalo Wild	9,912	93–622	USDA-FS

§ 81.405 California.

Area name	Acreage	Public Law establishing	Federal land manager
Agua Tibia Wild	15,934	93–632	USDA-FS
Caribou Wild	19,080	88–577	USDA-FS
Cucamonga Wild	9,022	88–577	USDA-FS
Desolation Wild	63,469	91–82	USDA-FS
Dome Land Wild	62,206	88–577	USDA-FS
Emigrant Wild	104,311	93–632	USDA-FS
Hoover Wild	47,916	88–577	USDY-FS
John Muir Wild	484,673	8–577	USDA-FS
Joshua Tree Wild	429,690	94–567	USDI-NPS
Kaiser Wild	22,500	94–577	USDA-FS
Kings Canyon NP	459,994	76–424	USDI-NPS
Lassen Volcanic NP	105,800	64–184	USDI-NPS
Lava Beds Wild	28,640	92–493	USDI-NPS
Marble Mountain Wild	213,743	88–577	USDA-FS
Minarets Wild	109,484	88–577	USDA-FS
Mokelumme Wild	50,400	88–577	USDA-FS
Pinnacles Wild	12,952	94–567	USDI-NPS
Point Reyes Wild	25,370	94–544, 94–567	USDI-NPS
Redwood NP	27,792	90–545	USDI-NPS
San Gabriel Wild	36,137	90–318	USDA-FS
San Gorgonio Wild	34,644	88–577	USDA-FS
San Jacinto Wild	20,564	88–577	USDA-FS

San Rafael Wild	142,722	90–271	USDA-FS
Sequoia NP	386,642	([1])	USDI-NPS
South Warner Wild	68,507	88–577	USDA-FS
Thousand Lakes Wild	15,695	88–577	USDA-FS
Ventana Wild	95,152	91–58	USDA-FS
Yolla-Bolly-Middle-Eel Wild	109,091	88–577	USDA-FS
Yosemite NP	759,172	58–49	USDI-NPS

[1]26 Stat. 478 (51st Cong.)

§ 81.406 Colorado.

Area name	Acreage	Public Law establishing	Federal land manager
Black Canyon of the Gunnison Wild	11,180	94–567	USDI-NPS
Eagles Nest Wild	133,910	94–352	USDA-FS
Flat Tops Wild	235,230	94–146	USDA-FS
Great Sand Dunes Wild	33,450	94–567	USDI-NPS
La Garita Wild	48,486	88–577	USDA-FS
Maroon Bells-Snowmass Wild	71,060	88–577	USDA-FS
Mesa Verde NP	51,488	59–353	USDI-NPS
Mount Zirkel Wild	72,472	88–577	USDA-FS
Rawah Wild	26,674	88–577	USDA-FS
Rocky Mountain NP	263,138	63–238	USDI-NPS
Weminuche Wild	400,907	93–632	USDA-FS
West Elk Wild	61,412	88–577	USDA-FS

§ 81.407 Florida.

Area name	Acreage	Public Law establishing	Federal land manager
Chassahowitzka Wild	23,360	94–557	USDI-FWS
Everglades NP	1,397,429	73–267	USDI-NPS
St. Marks Wild	17,745	93–632	USDI-FWS

§ 81.408 Georgia.

Area name	Acreage	Public Law establishing	Federal land manager
Cohotta Wild	33,776	93–622	USDA-FS
Okefenokee Wild	343,850	93–429	USDI-FWS
Wolf Island Wild	5,126	93–632	USDI-FWS

§ 81.409 Hawaii.

Area name	Acreage	Public Law establishing	Federal land manager
Haleakala NP	27,208	87–744	USDI-NPS
Hawaii Volcanoes	217,029	64–171	USDI-NPS

§ 81.410 Idaho.

Area name	Acreage	Public Law establishing	Federal land manager
Craters of the Moon Wild	43,243	91–504	USDI-NPS
Hells Canyon Wild[1]	83,800	94–199	USDA-FS
Sawtooth Wild	216,383	92–400	USDA-FS
Selway-Bitterroot Wild[2]	988,770	88–577	USDA-FS
Yellowstone NP[3]	31,488	([4])	USDI-NPS

[1]Hells Canyon Wilderness, 192,700 acres overall, of which 108,900 acres are in Oregon and 83,800 acres are in Idaho.

[2]Selway Bitterroot Wilderness, 1,240,700 acres overall, of which 988,700 acres are in Idaho and 251,930 acres are in Montana.

[3]Yellowstone National Park, 2,219,737 acres overall, of which 2,020,625 acres are in Wyoming, 167,624 acres are in Montana, and 31,488 acres are in Idaho.

[4]17 Stat. 32 (42nd Cong.).

§ 81.411 Kentucky.

Area name	Acreage	Public Law establishing	Federal land manager
Mammoth Cave NP	51,303	69–283	USDI-NPS

§ 81.412 Louisiana.

Area name	Acreage	Public Law establishing	Federal land manager
Breton Wild	5,000+	93–632	USDI-FWS

§ 81.413 Maine.

Area name	Acreage	Public Law establishing	Federal land manager
Acadia NP	37,503	65–278	USDI-NPS
Moosehorn Wild	7,501		USDI-FWS
(Edmunds Unit)	(2,782)	91–504	

(Baring Unit)	(4,719)	93–632	

§ 81.414 Michigan.

Area name	Acreage	Public Law establishing	Federal land manager
Isle Royale NP	542,428	71–835	USDI-NPS
Seney Wild	25,150	91–504	USDI-FWS

§ 81.415 Minnesota.

Area name	Acreage	Public Law establishing	Federal land manager
Boundary Waters Canoe Area Wild	747,840	99–577	USDA-FS
Voyageurs NP	114,964	99–261	USDI-NPS

§ 81.416 Missouri.

Area name	Acreage	Public Law establishing	Federal land manager
Hercules-Glades Wild	12,315	94–557	USDA-FS
Mingo Wild	8,000	94–557	USDI-FWS

§ 81.417 Montana.

Area name	Acreage	Public Law establishing	Federal land manager
Anaconda-Pintlar Wild	157,803	88–577	USDA-FS
Bob Marshall Wild	950,000	88–577	USDA-FS
Cabinet Mountains Wild	94,272	88–577	USDA-FS
Gates of the Mtn Wild	28,562	88–577	USDA-FS
Glacier NP	1,012,599	61–171	USDI-NPS
Medicine Lake Wild	11,366	94–557	USDI-FWS
Mission Mountain Wild	73,877	93–632	USDA-FS
Red Rock Lakes Wild	32,350	94–557	USDI-FWS
Scapegoat Wild	239,295	92–395	USDA-FS
Selway-Bitterroot Wild[1]	251,930	88–577	USDA-FS
U. L. Bend Wild	20,890	94–557	USDI-FWS
Yellowstone NP[2]	167,624	([3])	USDI-NPS

[1]Selway-Bitterroot Wilderness, 1,240,700 acres overall, of which 988,770 acres are in Idaho and

251,930 acres are in Montana.

[2]Yellowstone National Park, 2,219,737 acres overall, of which 2,020,625 acres are in Wyoming, 167,624 acres are in Montana, and 31,488 acres are in Idaho.

[3]17 Stat. 32 (42nd Cong.)

[44 FR 69124, Nov. 30, 1979; 45 FR 6103, Jan. 25, 1980]

§ 81.418 Nevada.

Area name	Acreage	Public Law establishing	Federal land manager
Jarbidge Wild	64,667	88–577	USDA-FS

§ 81.419 New Hampshire.

Area name	Acreage	Public Law establishing	Federal land manager
Great Gulf Wild	5,552	88–577	USDA-FS
Presidential Range-Dry River Wild	20,000	93–622	USDA-FS

§ 81.420 New Jersey.

Area name	Acreage	Public Law establishing	Federal land manager
Brigantine Wild	6,603	93–632	USDI-FWS

§ 81.421 New Mexico.

Area name	Acreage	Public Law establishing	Federal land manager
Bandelier Wild	23,267	94–567	USDI-NPS
Bosque del Apache Wild	80,850	93–632	USDI-FWS
Carlsbad Caverns NP	46,435	71–216	USDI-NPS
Gila Wild	433,690	88–577	USDA-FS
Pecos Wild	167,416	88–577	USDA-FS
Salt Creek Wild	8,500	91–504	USDI-FWS
San Pedro Parks Wild	41,132	88–577	USDA-FS
Wheeler Peak Wild	6,027	88–577	USDA-FS
White Mountain Wild	31,171	88–577	USDA-FS

§ 81.422 North Carolina.

Area name	Acreage	Public Law establishing	Federal land manager
Great Smoky Mountains NP[1]	273,551	69–268	USDI-NPS
Joyce Kilmer-Slickrock	10,201	93–622	USDA-FS

Wild[2]			
Linville Gorge Wild	7,575	88–577	USDA-FS
Shining Rock Wild	13,350	88–577	USDA-FS
Swanguarter Wild	9,000	94–557	USDI-FWS

[1]Great Smoky Mountains National Park, 514,758 acres overall, of which 273,551 acres are in North Carolina, and 241,207 acres are in Tennessee.

[2]Joyce Kilmer-Slickrock Wilderness, 14,033 acres overall, of which 10,201 acres are in North Carolina, and 3,832 acres are in Tennessee.

§ 81.423 North Dakota.

Area name	Acreage	Public Law establishing	Federal land manager
Lostwood Wild	5,557	93–632	USDI-FWS.
Theodore Roosevelt, NP	69,675	80–38	USDI-NPS.

[54 FR 41098, Oct. 5, 1989]

§ 81.424 Oklahoma.

Area name	Acreage	Public Law establishing	Federal land manager
Wichita Mountains Wild	8,900	91–504	USDI-FWS

§ 81.425 Oregon.

Area name	Acreage	Public Law establishing	Federal land manager
Crater Lake NP	160,290	57–121	USDA-NPS
Diamond Peak Wild	36,637	88–577	USDA-FS
Eagle Cap Wild	293,476	88–577	USDA-FS
Gearhart Mountain Wild	18,709	88–577	USDA-FS
Hells Canyon Wild[1]	108,900	94–199	USDA-FS
Kalmiopsis Wild	76,900	88–577	USDA-FS
Mountain Lakes Wild	23,071	88–577	USDA-FS
Mount Hood Wild	14,160	88–577	USDA-FS
Mount Jefferson Wild	100,208	90–548	USDA-FS
Mount Washington Wild	46,116	88–577	USDA-FS
Strawberry Mountain Wild	33,003	88–577	USDA-FS
Three Sisters Wild	199,902	88–577	USDA-FS

[1]Hells Canyon Wilderness, 192,700 acres overall, of which 108,900 acres are in Oregon, and 83,800 acres are in Idaho.

§ 81.426 South Carolina.

Area name	Acreage	Public Law establishing	Federal land manager
Cape Romain Wild	28,000	93–632	USDI-FWS

§ 81.427 South Dakota.

Area name	Acreage	Public Law establishing	Federal land manager
Badlands Wild	64,250	94–567	USDI-NPS
Wind Cave NP	28,060	57–16	USDI-NPS

§ 81.428 Tennessee.

Area name	Acreage	Public Law establishing	Federal land manager
Great Smoky Mountains NP[1]	241,207	69–268	USDI-NPS
Joyce Kilmer-Slickrock Wild[2]	3,832	93–622	USDA-FS

[1]Great Smoky Mountains National Park, 514,758 acres overall, of which 273,551 acres are in North Carolina, and 241,207 acres are in Tennessee.

[2]Joyce Kilmer Slickrock Wilderness, 14,033 acres overall, of which 10,201 acres are in North Carolina, and 3,832 acres are in Tennessee.

[44 FR 69124, Nov. 30, 1979; 45 FR 6103, Jan. 25, 1980]

§ 81.429 Texas.

Area name	Acreage	Public Law establishing	Federal land manager
Big Bend NP	708,118	74–157	USDI-NPS
Guadalupe Mountains NP	76,292	89–667	USDI-NPS

§ 81.430 Utah.

Area name	Acreage	Public Law establishing	Federal land manager
Arches NP	65,098	92–155	USDI-NPS
Bryce Canyon NP	35,832	68–277	USDI-NPS
Canyonlands NP	337,570	88–590	USDI-NPS
Capitol Reef NP	221,896	92–507	USDI-NPS

Zion NP	142,462	68–83	USDI-NPS

§ 81.431 Vermont.

Area name	Acreage	Public Law establishing	Federal land manager
Lye Brook Wild	12,430	93–622	USDA-FS

§ 81.432 Virgin Islands.

Area name	Acreage	Public Law establishing	Federal land manager
Virgin Islands NP	12,295	84–925	USDI-NPS

§ 81.433 Virginia.

Area name	Acreage	Public Law establishing	Federal land manager
James River Face Wild	8,703	93–622	USDA-FS
Shenandoah NP	190,535	69–268	USDI-NPS

§ 81.434 Washington.

Area name	Acreage	Public Law establishing	Federal land manager
Alpine Lakes Wild	303,508	94–357	USDA-FS
Glacier Peak Wild	464,258	88–577	USDA-FS
Goat Rocks Wild	82,680	88–577	USDA-FS
Mount Adams Wild	32,356	88–577	USDA-FS
Mount Rainer NP	235,239	([1])	USDI-NPS
North Cascades NP	503,277	90–554	USDI-NPS
Olympic NP	892,578	75–778	USDI-NPS
Pasayten Wild	505,524	90–544	USDA-FS

[1]30 Stat. 993 (55th Cong.).

§ 81.435 West Virginia.

Area name	Acreage	Public Law establishing	Federal land manager
Dolly Sods Wild	10,215	93–622	USDA-FS
Otter Creek Wild	20,000	93–622	USDA-FS

§ 81.436 Wyoming.

Area name	Acreage	Public Law establishing	Federal land manager
Bridger Wild	392,160	88–577	USDA-FS

Fitzpatrick Wild	191,103	94–567	USDA-FS
Grand Teton NP	305,504	81–787	USDI-NPS
North Absaroka Wild	351,104	88–577	USDA-FS
Teton Wild	557,311	88–577	USDA-FS
Washakie Wild	686,584	92–476	USDA-FS
Yellowstone NP[1]	2,020,625	([2])	USDI-NPS

[1]Yellowstone National Park, 2,219,737 acres overall, of which 2,020,625 acres are in Wyoming, 167,624 acres are in Montana, and 31,488 acres are in Idaho.

[2]17 Stat. 32 (42nd Cong.).

§ 81.437 New Brunswick, Canada.

Table 1

Area name	Acreage	Public law establishing	Federal land manager
Roosevelt Campobello International Park	2,721	88–363	([1])

[1]Chairman, RCIP Commission.

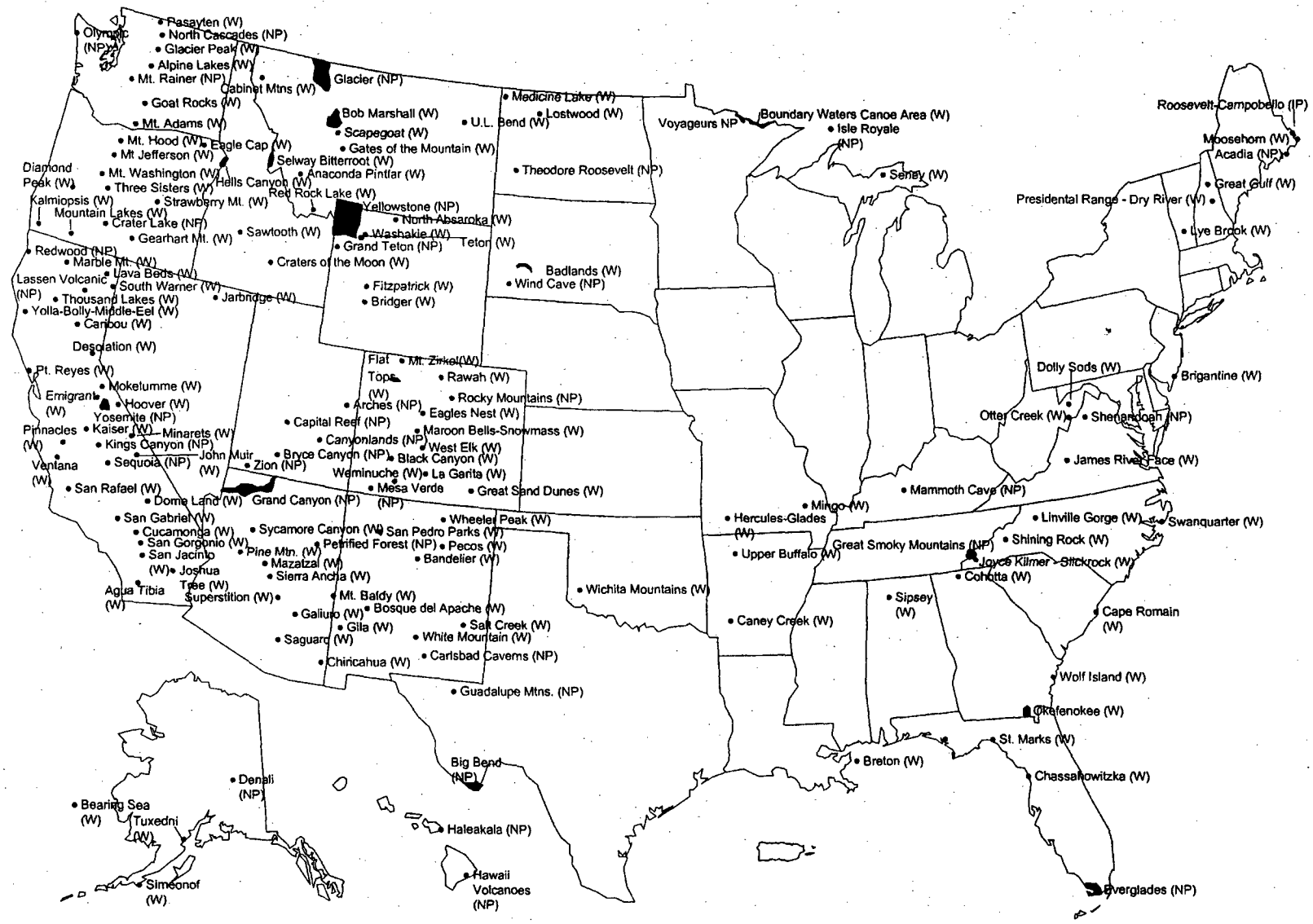
Table 2—Integral Vistas Associated With Mandatory Class I Areas

Park	Observation point	View angle	Key features	Also viewed from—
Roosevelt Campobello International Park	Roosevelt Cottage and Beach Area	244°–56°	Estes head* Eastport* North Lubec* Cobscook Bay* Shackford Head* St. Andrews* Friar's Head* Treat's Island* Passamaquoddy Bay* Deer Island* Indian Island* Rouen Island* Cherry Island* Thrumcap Island* Owen House* Welshpool*	*Features viewed from Friar's Head.
	Friar's Head	154°–94°	Roosevelt Cottage* Campobello Island* Weir*	*Features viewed from Roosevelt Cottage and Beach Area.

			Friar's Bay* Welshpool* Wilson's Beach* North Road* Head Harbour Passage* Casco Island* Green Island* Pope Island* Thrumcap Island* Cherry Island* Rouen Island* Indian Island* Deer Island* Passamaquoddy Bay* Old Sow Whirlpool* St. Andrews* Eastport* Friar Roads* Estes Head* Perry* Shackford Head* Pembroke* Cobscook Bay* Treat's Island* Major's Island North Lubec* Passamaquoddy Dam, portion of* Roger's Island Dudley Island* Johnson's Bay* Pope's Folly* Cutler Naval Radio Station Lubec Mulholland Point Lighthouse FDR Memorial Bridge South Lubec Grand Manan Island*	
	Con Robinson's Point	308°–150°	Herring Cove Beach Provincial Park Eastern Head Herring Cove Mainland New Brunswick* Point La Preau*	*Features viewed from Liberty Point.*

			Wolf Islands* Atlantic Ocean* Grand Manan Island	
	Liberty Point	34°–236°	Ragged Point Mainland New Brunswick* Atlantic Ocean* Wolf Islands* Grand Manan Island* Sail Rock West Quoddy Head Lighthouse South Lubec	*Features viewed from Con Robinson's Points.

[54 FR 21906, May 19, 1989]



Legend
NP= National Park
W = Wildemess
IP = International Park

Map of 156 Mandatory Class I Federal Areas

See 40 CFR 81.401-437 for a listing of these areas by State.

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