WATER RESOURCES STUDY

Metropolitan Spokane Region

APPENDIX E

Environment and [illegible]creation

JANUARY 1976

METROPOLITAN SPOKANE REGION
WATER RESOURCES STUDY

LIST OF REPORTS AND APPENDICES

REPORTS

Summary Report

Technical Report

APPENDIX	TITLE
A	Surface Water
B	Geology and Groundwater
C	Water Use
D	Wastewater Generation and Treatment
E	ENVIRONMENT AND RECREATION
F	Demographic and Economic Characteristics
G	Planning Criteria
H (Volume 1)	Plan Formulation and Evaluation
H (Volume 2)	Plan Formulation and Evaluation
I	Institutional Analysis
J	Water Quality Simulation Model

METROPOLITAN SPOKANE REGION WATER RESOURCES STUDY.

APPENDIX E.

ENVIRONMENT AND RECREATION.

JANUARY 1976

86p.

Department of the Army
Corps of Engineers, Seattle District

Kennedy-Tudor Consulting Engineers

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ACKNOWLEDGEMENTS

The Metropolitan Spokane Region Water Resources study was accomplished by the Seattle District, U.S. Army Corps of Engineers assisted by Kennedy-Tudor Consulting Engineers under sponsorship of the Spokane Regional Planning Conference. Technical guidance was provided by the Spokane River Basin Coordinating Committee, with general guidance from the study's citizens committee. Major cooperating agencies include Spokane City and County, and the Washington State Department of Ecology. The study was coordinated with appropriate Federal and State agencies and with the general public within the metropolitan Spokane area.

The summary report was prepared by the Seattle District Corps of Engineers. The technical report and appendices were prepared for the Seattle District, Corps of Engineers by Kennedy-Tudor Consulting Engineers.

PREFACE

With the enactment of the Federal Water Pollution Control Act Amendment of 1972 (Public Law 92-500), new national goals have been established for the elimination of pollution discharges into our streams and lakes. This appendix is a part of the report prepared to assist local government in satisfying State and Federal Requirements relating to Public Law 92-500. The suggestions contained in this report are for implementation by local interests with available assistance from other local, State and Federal agencies. The study suggests a regional wastewater management plan for the metropolitan Spokane urban area and provides major input to Washington State Department of Ecology Section 303e plans for the Spokane River Basin in Washington State. Also included in the study are planning suggestions for urban runoff and flood control, and the protection of the area's water supply resources.

As listed on the inside front cover, documentation for this study consists of a Summary Report and a Technical Report with supporting Appendices A through J.

The Technical Report summarizes Appendices A through J, which contain 58 individual task section reports prepared during the study. These task sections are listed by title in Attachment I of the Technical Report. Generally, the numbering of appendix task sections reflects the following system:

Study Task Sections	Type of Study Activity
300's	Data Collection
400's	Data Evaluation and Projection
500's	Identification of Unmet Needs
600's	Development of Alternative Plans
700's	Evaluation Comparison and Selection of Plans
800's	Institutional Arrangements

Pages within each appendix are numbered by task section, as illustrated below:

701.2 - 45

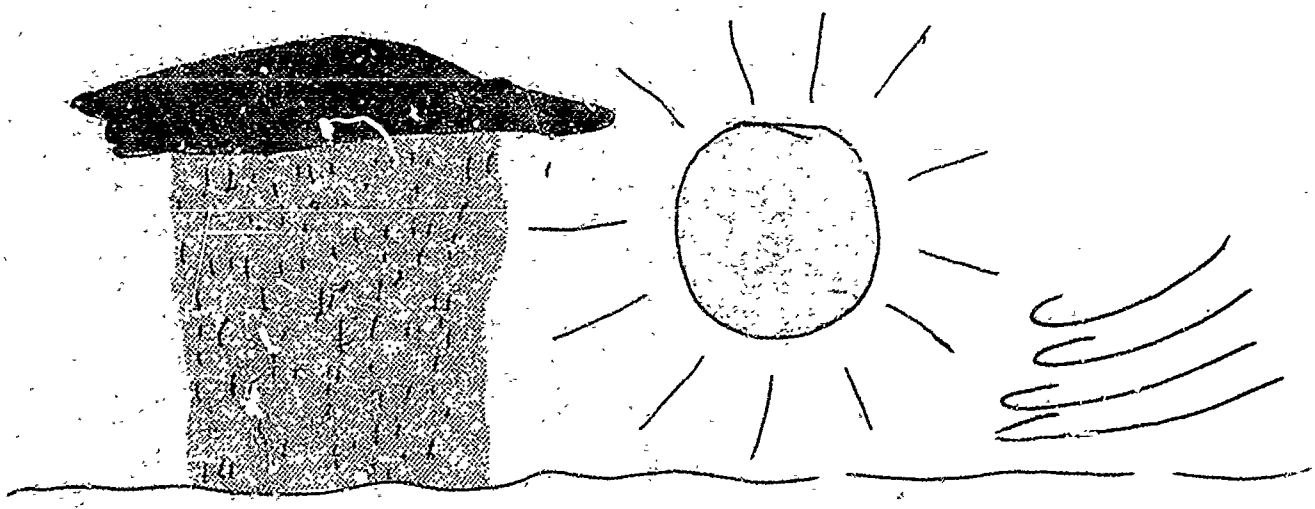
Task section identifier

Identifies page number, numbered consecutively from beginning of task section

APPENDIX E - ENVIRONMENT AND RECREATION

CONTENTS:

A detailed index for each task section precedes the respective section text.



SECTION 304

CLIMATE

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 304

CLIMATE

6 March 1974

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

CLIMATE

Index

INDEX TO TABLES

INDEX TO FIGURES

INDEX TO PLATES

(Large drawings are bound at the end of this section)

CLIMATE

Overview

The study area, limited on the east by the political boundary between Washington and Idaho, lies in the northeastern corner of the large inland basin between the Cascade and Rocky Mountains. Beyond the Washington-Idaho border, the hydrologic basin of the Spokane River extends eastward into the mountains to the watershed divide at the western boundary of Montana. Thus, the climate of the study area, particularly with regard to annual precipitation, is significantly different from that of the hydrologic basin which is the source of approximately 85 per cent of the water which flows through the study area.

The factors which influence the climate of the inland basin and the study area are:

(1) The prevailing westerly winds and motion of storm centers.

(2) The distance from the ocean.

(3) The elevation of the Cascade Mountains which lie in the path of the winds from the ocean.

(4) The continental influence of adjoining areas of Canada and southeastern Oregon.

(5) The elevation gradient within the study area.

This gradient is mapped in Plate 304-1 which shows that

the elevation ranges from 1400 feet at the western edge of the study area to over 5000 feet at Mount Spokane at the eastern edge. Most of the study area, particularly the urban and agricultural area, lies between elevations 1800 to 2500 feet.

> In an easterly and northerly direction, the Rocky Mountains shield the Inland Basin from the winter season's cold air masses traveling southward across Canada. In a westerly direction, the Cascade Range, elevation 4000 to 7000 feet with peaks in excess of 10,000 feet, forms a barrier to the easterly movement of moist and comparatively mild air in winter and cool marine air in summer. Air from each of these source regions reaches this section producing a climate with characteristics of both continental and marine types. Most of the weather systems crossing the Inland Basin advance under the influence of the prevailing westerly winds. Infrequently, dry continental air enters this region from the north, east or south. In summer, air from over the continent results in low relative humidity and high temperature, while in winter it produces clear, cold and dry weather. Extremes in both summer and winter temperatures generally occur when the basin is under the influence of air from over the continent. (Phillips p. 4, 1965).

In summer, easterly movement of cool marine air is restricted by the Cascade Mountains resulting in a climate that is warm, dry, and sunny. Occasionally, the area is dominated by continental air masses resulting in hot days of low humidity. These hot, dry periods do not persist for long. The clear skies and absence of large bodies of water result in cool nights throughout the summer.

In winter, the prevailing movement of storms from the west reaches the study area and creates a precipitation season that extends from October through March. In crossing the mountains, however, the storms loose a great deal of their moisture, creating a rain shadow which extends eastward into the study area. As a consequence, most of the study area has low annual precipitation with a west to east trend of increasing precipitation with elevation. The winter tempera-

tures are cool, around freezing, with occasional cold snaps due to air mass movements out of Canada.

General basin climate is characterized by data for the city of Spokane which are summarized in Table 1.

Data Availability

The availability of meteorological data is shown in Tables 2 and 3. Table 2 lists the meteorological stations within the study area. Table 3 lists precipitation stations in adjoining areas. The stations in adjoining areas are of significant interest in development of an isohyetal map. They can also provide additional data by correlation for specialized use in this report in connection with the simulation model. Plate 304-1 shows the location of stations within the study area and the immediate vicinity.

Data reproduced and summarized in this section of the report are from publications as shown in the "List of References" for this section. Most of the climatic data are reproduced from Climatological Handbook-Columbia Basin States, 1969, by Pacific Northwest River Basins Commission, and reports by Phillips (1965) and Phillips and Durkee (1972). Data for precipitation, relative humidity, and temperature were updated by adding current data published by U.S. National Oceanic and Atmospheric Administration, formerly called U.S. Weather Bureau.

In addition to data published in book form referred to above, data are also available in the form of magnetic tape or punch cards for computer input. Tapes and punch cards are available from the National

Weather Records Center in Asheville, North Carolina. No tape or punch card data were utilized for this section of the report. Extensive use is made of this form of meteorlogical data in connection with the simulation model. For further discussion of meteorlogical data used by the simulation model, refer to that section of the report.

There do not appear to be any snow pack data for the study area. This is probably because snow surveys were originated by the hydroelectric power companies and the streams of the study area are not significant tributaries to power generation. There are data for the Spokane watershed in Idaho and for areas immediately to the north of the study area (U.S. Department of Agriculture. Summary of Snow Survey Measurements for Washington, 1915-1969).

Temperature

General

Mean, mean maxima and minima, and extremes of temperature for both month and year for five locations are shown in Table 4. This table indicates that, with the exception of Mount Spokane which is 3000 feet higher than the other sites, the temperature regimen is quite uniform throughout the study area. The valley of the Little Spokane River appears to experience temperatures that are much lower than the rest of the area. The annual pattern of temperature is demonstrated graphically for one station, Spokane Weather Bureau Airport Station, as typical of most of the study area, in Figure A.

Therefore, the temperature characteristics for the area as a whole, except for the mountain peaks, are as described for the City of Spokane in Table 1. That is, the summers are characterized by daytime temperatures in the 80 to 90° F range and by nighttime minima of 45 to 60° F. The winters are characterized by daytime temperatures in the 25 to 40° F range and by nighttime minima from 15 to 25° F.

The entire area experiences extreme highs in the range of 95 to 105° F when the air masses from southwest occasionally dominate the area but these conditions usually last only a few days at a time before the cooler air from the west replaces the desert air.

Growing Season

The growing season is defined as the period between days where there is a 50 per cent chance of achieving a given low temperature, usually 28° F. For three locations in the study area, the growing season, as so defined, is as follows:

Locations	Latest date 50 per cent chance 28°F	Earliest Date 50 per cent chance 28°F	Length of Season Days
Cheney	April 29	October 15	169
Deer Park	May 19	September 20	124
Spokane WBAS	April 6	October 26	203

(Phillips, p. 58, 1965)

The growing degree days above 40° F are estimated to be of the order 4000 for Spokane and Cheney and about 3500 for Deer Park from March through October (Phillips, p. 61, 1965). (The length of period during which treated wastes could be disposed of by spray irrigation is not exactly defined by either the growing season or growing degree day data. The frost-free period would be a minimum and the period with

monthly mean above freezing would be an absolute maximum).

Degree Days

Heating degree days are given as follows for four locations in the study area

Cheney	6606
Deer Park	7374
Spokane WBAS	6762
Spokane	6655

(Phillips, p. 55, 1965)

Cooling degree days have been computed only for the city of Spokane area at 430.

Frost Penetration

With mean monthly temperature below freezing from December through February, there is frost penetration of the soil. This is highly variable depending upon the soil, soil cover, and snow cover. The estimated average frost penetration is from 15 to 20 inches for the areas exclusive of mountains (Phillips, p. 9 , 1965). Under extreme conditions of an exceptional cold season and little insulating ground cover the penetration can reach 36 inches.

Precipitation

General

The source of almost all precipitation is the moist air of frontal storms moving across the state from west to east. Thunder

storms do occur between March and October but they are small in extent and do not account for a significant amount of the total annual precipitation for the area. Available summaries and computations of mean annual precipitation are available through 1960 in U.S. Weather Bureau summaries for Washington 1931-1952, 1951-1960 and a summary for Idaho 1951-1960. These summaries were updated for the study to include data through 1971 which are shown as monthly and annual records for the five stations inside the study area in Table 5. Mean annual precipitation data for nine stations outside but adjoining the study area are shown in Table 3, likewise based on updated records through 1971.

Isohyetal Map

Isohyetal lines shown on Plate 304-1 are developed from the mean annual precipitation data from Tables 3 and 5 by interpolation between the available stations giving recognition to topography in the process. The areal distribution of rainfall as shown in Plate 304-1 clearly shows the consequences of the easterly moving air mass encountering the rising terrain which begins in the study area and rises more sharply in Idaho and Montana. The isohyetal lines reflect the topography, trending north-south in the southern half of the study area, which has low relief, and bulging westward in the northern half in response to the rising ground in Stevens and Pend Oreille Counties and the prominence of Mount Spokane. Mean annual precipitation ranges from 17 inches to over 45 inches on Mount Spokane. Mean annual precipitation in excess of 24 inches is, however, confined to a relatively small

portion of the study area in the vicinity of Mount Spokane.

Mean monthly precipitation data for all of the stations within the study area are shown in Table 5. The annual pattern is shown graphically for four representative stations in Figure B. The month to month variation shows a marked seasonal pattern with sparse precipitation in summer, increasing in the fall, and reaching a peak in winter, decreasing again in spring, but with a secondary peak in late May and early June before a sharp drop to the low of July.

Snowfall

Monthly snowfall records for the five stations in the study area are shown in Table 6. These data show that the mean annual snowfall throughout the area except for Mount Spokane is approximately 50 inches. They also show that most of the precipitation from December through February is in the form of snow. It should also be recognized that rain can and does occur throughout this same period. Barring occasional rains or thawing winds, the snowfall in depths up to eight or twelve inches can remain on the ground throughout this period during which the mean daily temperature is below freezing. The Mount Spokane summit experiences mean annual snowfall of 170 inches. The snows on the higher elevations begin about two months earlier than in the rest of the study area and persist to May or June. There are no available snow survey records of the average depth or water content of the pack.

Rainfall Intensity-Duration Relationship

Frequency analysis of precipitation data for the Spokane Weather Bureau Airport station, 1900 to 1946, is available in U.S. Weather Bureau Paper No. 25. This analysis, which gives the rainfall intensity duration relationship for return frequencies of 2, 5, 10, 25, 50, and 100 years, is reproduced in Figure C. Since the primary use of the data from Figure C is in storm drain runoff calculations for urban areas, the location of the Spokane Weather Bureau Airport station makes this data particularly appropriate.

It should be noted that the December, 1933 storm which caused the floods of record on the Spokane River, included intensities of five inches in 24 hours, equal to 0.21 inches per hour average which is double that shown for 100 year return frequency. This same storm had a five day total precipitation of eight inches.

Further, is should be recognized that the intensity-duration frequency-relations do not give an indication of the additional runoff that may be associated with melting snow.

Evaporation

Measured Pan Evaporation

Evaporation data are available for two stations in the study area, Deer Park 2E and Spokane Weather Bureau Airport Station. The data for Spokane Weather Bureau Airport Station are selected as most representative of the study area and are reproduced in Table 7. This brief

record indicates that the mean annual Class A pan evaporation is approximately 50 inches per year. Monthly amounts are as high as 13 inches. Maximum daily amounts are estimated at 0.5 inches. It should be recognized that pan evaporation is not a measure of actual full scale lake or reservoir evaporation. Lake or reservoir evaporation corresponding to 50 inches of pan evaporation is estimated at 36 inches (Phillips. P. 12, 1965).

Evapotranspiration

Calculated values for potential evapotranspiration and so-called actual evapotranspiration from soil with six inch holding capacity are available based on the Spokane Weather Bureau Airport Station pan evaporation records. These data are also reproduced on Table 7.

> Potential evapotranspiration is defined as the maximum amount of water which if available could be removed from the soil by the combined processes of evaporation and transpiration under conditions of average temperatures.
>
> The term actual evapotranspiration is defined as the computed amount of water lost under existing conditions of temperature and precipitation. A comparison of the actual and potential evapotranspiration gives an estimate of the additional moisture plants could use if a moisture deficit did not exist at any time. (Phillips, p. 13, 1965)

Sky Cover and Solar Radiation

Sky cover and solar radiation data are available only for the Spokane Weather Bureau Airport Station. These data are reproduced in Table 8 and 9, respectively. Table 9 also includes data

on per cent of possible sunshine.

From November through March the skies are predominantly cloudy with average sky cover of 0.7 or more on most days and throughout the day. Only in July, August and September does the opposite condition exist during which the skies are predominantly clear. The fall and spring seasons are transition periods in which sky cover is in the 0.5 range. The contrast between winter and summer sky cover is also demonstrated by the per cent of possible sunshine which ranges from only 20 per cent in December to 81 per cent in July. The low sun angle in winter combined with the high per cent of sky cover results in an even wider spread in solar radiation which ranges from only 75 Langley in December to 664 in July.

Wind

Wind data are available only for the Spokane Weather Bureau Airport Station. These data are summarized and reproduced in Table 10 and Figure D. As can be seen from Figure D, the predominant wind directions are northeast and southwest. The data in Table 10 indicate that southwest winds have a high frequency of occurence throughout the year and are associated with the winds of higher velocity. The northeast winds, although having significant year round occurence are more prevalent in winter.

Mean hourly wind speeds vary from 5 to 10 miles per hour in the summer and from 4 to 18 miles per hour in the winter, with mean annual values in the 5 to 11 miles per hour range. Winds of 3 miles per hour or less occur approximately 24 per cent of the

time. High speed winds are relatively rare with speeds of 50 miles per hour reached or exceeded once in 2 years and 80 miles per hour once in 50 years (Phillips, p. 10, 1965).

Relative Humidity and Wet Bulb Temperatures

Relative humidity data are available only for the Spokane Weather Bureau Airport Station. These data are reproduced in Table 11. Mean relative humidity in wintertime is high both day and night, ranging from 70 to 87 per cent. Mean relative humidity during midsummer is much lower, ranging from 24 to 58 per cent. Since the lower humidities occur during the afternoons in summertime, there are few periods of discomforting combinations of high temperatures and high humidities. The summer daytime highs are usually accompanied by the lower humidities in the range 20 to 30 per cent.

The area is characterized by low wet bulb temperatures in the summer season due to the prominence of dry continental air masses. The record high wet bulb temperature is 70° F. The design wet bulb condition, for the June through September period, is 62.6° F which would be exceeded 5 per cent or less of the time.

Climate in the Idaho Portion of the Hydrologic Basin

The hydrologic basin of the Spokane River extends into Idaho where the runoff from an area of 4345 square miles contributes most of the surface and groundwaters which flow through the study area. Because of this important relationship, the precipitation regimen of the Idaho portion of the hydrologic basin is described briefly below.

As stated above, the mean annual precipitation for the study area shows the beginnings of the west to east increase caused by the increasing elevation. Beyond the Idaho boundary, the increase in elevation is much more abrupt and continues to rise to the crest of the Coeur d'Alene and Bitterroot Mountains which form the east boundary of the basin. Mean annual precipitation increases from about 25 inches near the Washington boundary to 40, 50, and 60 inches within 30 miles and continues at these high levels throughout the basin.

Most of the precipitation occurs as snow. Snow surveys have been conducted in the area by the Washington Water Power Company and are published by the U.S. Soil Conservation Service.

The seasonal distribution of the precipitation is similar to the study area being largely in the season from October through May. Due to the higher elevations and consequent lower temperatures, an even larger part of the annual precipitation occurs as snow and remains on the ground throughout the winter until the spring thaw.

TABLE 1

GENERAL CLIMATIC CHARACTERISTICS
OF CITY OF SPOKANE AREA

Temperature:	Mean Annual 50° F	
	Typical Summer Afternoon	Maximum 80°-90° F
	Typical Summer Night	Minimum 45°-60° F
	Typical Winter Afternoon	Maximum 25°-40° F
	Typical Winter Night	Minimum 15°-25° F
Precipitation:	Mean Annual 17.01 inches	
	Occurance, 70% between October 1 & March 30.	
	One hour intensity with 10 year return frequency, 0.6"	
	Irrigation season, May through September	
	As snowfall, average season 55"	
	Snow on the ground, mid December to end February	
Evaporation:	50", 80% occuring April through October (class A pan)	
Growing Season:	Mid May to Mid September	
Frost Penetration:	15-20"	
Wind:	Direction summer, southwest	
	Direction winter, southwest	
	Speed mean hourly, 7 mph	
Sky cover & Sunshine:	Winter clear or partly cloudy	5-8 days*
	Spring & Fall clear or partly cloudy	15-20 days
	Summer clear or partly cloudy	25+ days
Heating Degree Days:	6655	
Cooling Degree Days:	430	

*days per month

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy - Tudor Consulting Engineers	GENERAL CLIMATIC CHARACTERISTICS OF CITY OF SPOKANE AREA	TABLE 1

TABLE 2

METEOROLOGICAL STATIONS WITHIN THE STUDY AREA

Station Name / Items	Deer Park 2E	Mount Spokane Summit	Spokane	Spokane WBAS	Tekoa	Wellpinit
Location lat.	47° 57'N	47° 55'N	47° 40'	47° 37'N	47° 13'N	47° 53'N
long.	117° 26'W	117° 07'W	117° 25'	117° 31'W	117° 05'W	117° 59'W
County	Spokane	Spokane	Spokane	Spokane	Whitman	Stevens
Elevation (ft. msl)	2114	5890	1875	2357	2610	2450
Precipitation Gage Type*	NR	NR	NR	B	NR	NR
Temperature	X	X	X	X		X
Evaporation	X			X		
Snowfall	X	X		X	X	X
Relative Humidity				X		
Avg. Solar Energy Radiation				X		
Sunshine			X			
Sky Cover				X		
Wind				X		

*NR:non-recording R:recording B:both X:availability of data

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy - Tudor Consulting Engineers	METEOROLOGICAL STATIONS WITHIN THE STUDY AREA	TABLE 2

TABLE 3

PRECIPITATION STATIONS ADJACENT TO
THE STUDY AREA

Station	Location (lat. & long.)	Elevation (ft)	Years of Record	Type of Gage*	Mean Annual Precipitation (")
Chewelah 2S, Wash.	48° 15' N 117° 43' W	1635	41	NR	20.05
Colfax 1 NW, Wash.	46° 53' N 117° 23' W	1955	83	NR	20.35
Davenport, Wash.	47° 39' N 118° 09' W	2450	65	NR	14.98
Inchelium 2NW, Wash.	48° 17' N 118° 13' W	1685	19	NR	16.85
Newport, Wash.	48° 11' N 117° 03' W	2135	56	NR	25.93
Potlach, Idaho	46° 55' N 116° 54' W	2520	57	NR	23.95
Rosalia, Wash.	47° 14' N 117° 22' W	2400	80	NR	18.12
Sprague, Wash.	47° 18' N 117° 59' W	1925	56	B	14.63
Coeur D'Alene RS, Idaho	47° 41' N 116° 45' W	2158	78	B	25.06

*NR: Non Recording R: Recording B: Both

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy – Tudor Consulting Engineers	PRECIPITATION STATIONS ADJACENT TO THE STUDY AREA	TABLE 3

TABLE 4

MONTHLY TEMPERATURES, MEANS AND EXTREMES

Station	Items	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
(yrs. of rec)	Mean Max.	32.3	39.4	47.5	59.3	69.2	75.3	86.0	84.4	73.9	61.1	42.4	34.7	58.8
Deer Park 2E	Mean Min.	16.4	19.7	25.3	31.4	38.2	44.0	46.1	43.9	39.0	32.1	26.4	21.4	32.0
(1931-1972)	MEAN	24.4	29.6	36.4	45.4	53.7	59.6	66.0	64.1	56.4	46.6	34.3	28.1	45.4
	Highest	53	62	71	87	95	96	107	100	99	89	64	56	107
	Lowest	-42	-40	-8	9	19	25	28	23	18	3	-19	-33	-42
	Mean Max.	24.0	26.3	29.9	40.1	49.9	56.8	67.6	64.9	56.6	43.6	33.0	27.5	43.4
Mt Spokane	Mean Min.	14.0	17.3	19.0	25.7	35.3	40.4	49.9	47.9	40.9	31.3	22.3	16.9	30.1
Summit	MEAN	19.0	21.8	24.4	32.9	42.6	48.6	58.8	56.4	48.8	37.4	27.7	22.2	36.8
(1931-1972)	Highest	51	50	54	72	77	83	89	89	81	68	59	48	89
	Lowest	-23	-10	-20	10	15	21	25	28	18	8	-17	-28	-28
	Mean Max.	35.9	44.2	50.4	59.2	70.2	77.6	86.6	86.6	74.6	61.0	44.8	36.5	60.6
	Mean Min.	24.7	29.4	31.3	36.9	44.6	51.4	55.8	55.1	47.0	38.5	32.9	27.0	39.6
Spokane	MEAN	30.3	36.8	40.8	48.0	57.4	64.4	71.2	70.8	60.8	49.7	38.8	31.7	50.1
(1962-1972)	Highest	58	62	75	82	93	101	104	109	96	85	65	56	109
	Lowest	-8	-4	10	22	27	37	42	30	30	19	13	-20	-20
	Mean Max.	31.6	38.0	46.9	57.3	68.5	74.6	85.2	82.9	73.9	59.5	42.5	35.1	58
	Mean Min.	19.7	23.6	29.0	35.1	42.9	49.4	55.2	53.3	46.6	37.5	28.7	23.7	37.1
Spokane	MEAN	25.7	30.9	37.9	46.2	55.6	62.0	70.2	68.1	60.4	48.6	35.7	29.5	47.6
WBAS	Highest	59	61	71	84	92	98	103	108	96	85	65	54	108
(1931-1972)	Lowest	-24	-12	-3	12	24	35	38	35	25	13	-11	-25	-25
	Mean Max.	29.8	37.1	45.1	55.6	66.1	75.5	87.4	86.2	72.2	57.4	41.6	32.3	57.2
	Mean Min.	17.5	23.3	26.3	32.4	40.8	43.2	52.4	51.6	42.5	34.2	29.1	21.3	34.6
Wellpinit	MEAN	23.7	30.2	35.7	44.0	53.4	59.3	69.9	68.9	57.5	45.8	35.4	26.8	45.9
(1962-1972)	Highest	51	57	67	79	87	95	101	105	100	80	61	47	105
	Lowest	-16	-6	4	15	21	32	31	33	23	12	6	-29	-29

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy – Tudor Consulting Engineers	MONTHLY TEMPERATURES, MEANS AND EXTREMES	TABLE 4

TABLE 5

MONTHLY PRECIPITATION MEANS AND EXTREMES

STATION	YEARS OF RECORD	ELEVATION	ITEMS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Deer Park 2E	1931-1971	2114	Mean	2.99	2.13	1.87	1.58	1.61	1.60	.52	.65	1.17	2.09	2.87	3.36	22.44
			Max.	5.59	5.94	4.91	4.12	5.94	4.11	1.54	2.48	3.35	6.37	7.25	7.23	29.95
			Min.	.48	.44	.20	.30	.17	.29	T	.00	.03	.11	.24	1.20	13.13
			Max. Day	1.49	1.92	2.18	2.24	1.24	1.87	.93	.94	1.34	1.42	1.53	1.97	2.24
Mt. Spokane Summit	1934-1971	5890	Mean	5.82	4.77	4.79	3.44	2.73	2.72	1.31	1.74	2.74	3.83	6.37	6.13	46.39
			Max.	10.10	13.20	9.35	7.50	7.19	6.78	3.76	5.64	9.64	7.16	13.26	14.01	57.64
			Min.	1.31	1.85	.35	.40	.55	.69	.00	.00	.24	.22	.90	1.98	35.03
			Max. Day	3.33	2.54	3.53	3.99	1.66	3.52	2.25	1.40	2.82	2.95	2.74	2.92	3.99
Spokane	1954-1971	1875	Mean	2.44	1.56	1.53	1.28	1.48	1.43	.48	.74	.85	1.37	2.26	2.36	17.78
			Max.	4.59	3.94	3.04	2.65	3.85	3.41	1.45	2.06	2.35	3.03	4.95	3.91	21.34
			Min.	.17	.34	.18	.12	.37	.14	.00	.00	.15	.04	.14	.89	14.18
			Max. Day*	1.07	1.18	1.85	1.69	1.07	2.58	.81	.76	.68	1.03	1.81	1.17	2.58
Spokane WB Airport	1931-1971	2357	Mean	2.42	1.77	1.50	1.00	1.17	1.48	.39	.47	.71	1.43	2.18	2.49	17.01
			Max.	4.96	3.94	3.75	3.08	5.71	3.06	1.29	1.73	2.05	4.05	4.64	5.13	26.07
			Min.	.50	.40	.31	.08	.45	.16	T	T	.06	.05	.34	1.21	10.65
			Max. Day	1.48	.96	1.72	1.71	1.67	1.52	.79	1.09	.92	.98	1.41	1.60	1.72
Tekoa	1937-1971	2610	Mean	2.52	1.93	1.87	1.51	1.84	1.95	.57	.74	1.36	1.95	2.55	2.79	21.58
			Max.	6.94	6.00	4.09	3.14	6.78	5.02	1.87	2.70	4.67	4.36	5.08	4.40	34.43
			Min.	.53	.31	.52	.37	.43	.36	.00	.00	.25	.12	.49	1.02	12.97
			Max. Day	1.64	1.20	1.15	.90	1.54	2.00	1.05	1.17	1.69	1.36	1.15	2.20	2.20
Wellpoint	1931-1971	2450	Mean	2.52	1.72	1.70	1.49	1.60	1.51	.54	.60	1.04	1.65	2.42	2.81	19.60
			Max.	4.57	6.37	3.88	3.61	6.65	5.05	2.27	2.73	2.97	4.31	5.42	5.24	27.39
			Min.	T	.42	.19	.28	.24	.00	.00	.00	T	.00	.09	1.17	14.67
			Max. Day	1.19	1.34	2.71	2.50	2.11	1.44	1.00	1.08	1.57	1.50	1.78	1.65	2.71

* 1961-1971 only

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy – Tudor Consulting Engineers	MONTHLY PRECIPITATION MEANS AND EXTREMES	TABLE 5

TABLE 6

MONTHLY SNOWFALL, MEANS AND EXTREMES (1931-1965)

Station	Elevation	Item*	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Deer Park 2E	2114	A	0	0	0	.6	4.5	14.1	15.7	12.7	2.3	.3	0	0	50.2
		D	0	0	.5	5.0	6.3	10.5	10.0	8.0	6.0	4.0	0	0	10.5
Mt Spokane Summit	5890	A	1.0	T	1.1	10.2	18.1	29.4	41.8	22.7	22.8	14.4	7.7	.9	170.1
		B	2.0	0	4.8	29.1	41.2	73.4	95.5	34.8	40.8	36.2	23.5	2.5	189.4
Spokane WBAS	2357	A	0	0	0	.5	5.5	14.9	19.0	9.3	5.7	.2	T	0	55.1
		B	0	0	0	6.1	24.7	42.0	56.9	26.3	15.3	6.6	.2	0	93.5
		C	0	0	0	0	T**	.5	1.0	.5	0	0	0	0	8.0
		D	0	0	0	5.9	6.6	11.1	12.7	7.7	6.0	3.8	.2	0	12.7
Tekoa	2610	A	0	0	0	2.8	4.0	14.1	16.5	8.1	5.2	.8	.1	0	51.6
		B	0	0	0	4.8	17.0	56.7	51.0	26.5	14.0	7.5	1.0	0	105.7
		C	0	0	0	0	0	0	T	1.5	0	0	0	0	11.4
Wellpinit	2450	A	0	0	0	.6	7.6	16.1	16.7	10.4	4.8	.7	T	0	56.9
		B	0	0	0	4.5	32.3	39.6	40.6	24.6	18.9	5.5	1.5	0	93.2
		C	0	0	0	0	0	0	.5	1.0	0	0	0	0	8.0

*Note: A: Mean B: Greatest Month & Annual C: Least Month & Annual D: Greatest Daily

** T: Trace

TABLE 7

PAN EVAPORATION AND EVAPOTRANSPIRATION
SPOKANE WBAS

PAN EVAPORATION

Calendar Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
1972	-	-	-	4.91	6.84	7.00	11.29B	10.04*	5.78	-	-	-	-
1971	-	-	-	4.72	7.69	6.68	11.37B	-	5.67*	-	-	-	-
1970	-	-	-	3.82	7.77	9.60	12.27	11.60	5.84	-	-	-	-
1969	-	-	-	-	7.32	9.26	10.91	11.36	6.09	-	-	-	-
1968	-	-	-	5.46	8.07	9.14	12.77	8.86	5.50	-	-	-	-
1967	-	-	-	4.12*	6.74	-	13.06	12.79	8.51	-	-	-	-
1966	-	-	-	-	8.71	8.35	11.68	11.43	6.82	-	-	-	-
Avg.	-	-	-	4.61	7.59	8.34	11.9	11.01	6.32	-	-	-	49.78

POTENTIAL AND ACTUAL EVAPOTRANSPIRATION

** Pet	.6	1.6	3.1	4.1	5.5	4.7	3.0	1.6	.2		24.4
*** Ea (6)	.6	1.6	2.0	2.6	1.8	1.0	1.1	1.3	.2		.2.2

* Incomplete date adjusted to full month
** Pet: Potential Evapotranspiration
*** Ea(6): Actual Evapotranspiration for the 6-inch waterholding capacity soil

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy - Tudor Consulting Engineers	PAN EVAPORATION AND EVAPOTRANSPIRATION SPOKANE WBAS	TABLE 7

TABLE 8

SKY COVER, SPOKANE WBAS

Mean Tenths of Total Covered in 3-Hour Time Incremets, by Months

Hours (PST)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
00-02	7.7	7.2	5.9	5.0	4.4	4.7	2.5	2.5	3.1	5.1	7.0	7.9	5.3
03-05	7.8	7.2	6.2	5.6	5.6	5.4	3.2	3.2	3.4	5.7	7.1	8.1	5.7
06-08	8.2	8.0	7.1	6.2	5.8	5.5	2.9	3.7	4.4	6.9	7.7	8.6	6.3
09-11	8.3	8.0	7.3	6.7	6.2	6.3	3.1	3.6	4.4	6.4	7.7	8.7	6.4
12-14	8.1	8.0	7.6	7.3	6.9	7.0	3.6	3.9	5.0	6.5	7.6	8.6	6.7
15-17	8.0	7.7	7.5	7.1	6.8	6.8	3.4	4.0	4.9	6.3	7.4	8.2	6.4
18-20	7.5	7.1	6.3	6.1	5.9	6.0	2.9	3.4	4.2	5.4	7.0	7.9	5.8
21-23	7.6	6.8	5.8	5.2	4.7	5.1	2.5	2.6	3.3	5.0	7.0	7.7	5.3
Average	7.9	7.5	6.7	6.1	5.8	5.9	3.0	3.4	4.1	5.9	7.3	8.2	6.0

WATER RESOURCES STUDY
METROPOLITAN SPOKANE REGION
Dept. of the Army, Seattle District
Corps of Engineers
Kennedy - Tudor Consulting Engineers

SKY COVER, SPOKANE WBAS

TABLE 3

TABLE 9

SOLAR RADIATION AND PER CENT OF POSSIBLE SUNSHINE
SPO'ANE WBAS

Items	No. Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Solar Radiation, Langleys *	10	115	212	317	451	555	624	664	546	402	228	120	75	359
Per Cent of possible sunshine	18	27	39	54	62	62	67	81	76	71	52	29	20	57

*Langley equals one gram calorie per square centimeter

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy – Tudor Consulting Engineers	SOLAR RADIATION AND PER CENT OF POSSIBLE SUNSHINE SPOKANE WBAS	TABLE 9

TABLE 10

WIND SPEED AND DIRECTION
SPOKANE WBAS

	MONTHS	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL	
		mph	%	mph	%	mph	%	mph	%	mph	%	mph	%	mph	%	mph	%	mph	%	mph	%	mph	%	mph	%	mph	%
WIND DIRECTION	N	3.8	2.0	4.1	1.6	5.3	1.0	4.9	1.4	4.7	2.0	5.2	2.2	5.5	1.6	4.4	1.8	4.9	2.6	4.4	1.5	4.1	1.7	3.6	1.5	4.6	1.7
	NNE	4.8	4.2	4.5	3.4	4.9	2.5	5.2	2.9	5.1	3.3	5.3	3.3	5.3	3.2	4.4	3.1	5.3	4.6	4.7	4.0	4.3	5.2	4.2	3.9	4.9	3.6
	NE	4.9	16.0	4.7	11.9	5.3	11.7	5.7	9.5	5.1	11.3	5.1	9.6	5.1	12.4	4.5	10.6	4.9	16.1	4.9	17.8	4.6	19.3	4.3	15.7	4.9	13.5
	ENE	5.0	7.1	5.4	8.6	6.0	10.2	5.8	9.3	5.4	7.3	5.5	7.8	5.4	8.3	4.8	5.6	5.4	9.1	5.2	10.4	4.7	9.0	5.2	9.4	5.3	8.3
	E	4.5	3.4	4.8	3.4	4.8	3.6	4.8	4.1	4.7	3.7	5.3	3.6	4.6	3.8	4.5	3.0	4.5	3.3	4.7	3.0	4.4	2.6	4.1	2.4	4.6	3.3
	ESE	5.2	3.4	5.2	3.5	5.8	3.5	5.1	3.1	4.6	2.7	4.9	2.9	4.5	3.4	4.5	3.5	4.4	2.7	5.0	2.7	5.2	3.3	5.2	2.5	5.0	3.1
	SE	7.2	7.7	6.7	7.3	6.5	6.9	6.2	5.7	5.6	5.2	5.8	5.4	5.9	5.7	6.0	6.8	6.0	6.1	6.2	6.5	6.5	6.7	7.2	6.9	6.3	6.4
	SSE	7.8	7.3	7.2	6.5	6.8	5.7	6.4	5.4	5.9	5.2	6.2	5.2	6.3	5.9	6.3	6.3	6.5	5.2	6.7	5.5	7.6	5.2	7.3	6.5	6.8	5.8
	S	8.2	7.2	7.8	6.4	7.7	7.3	7.0	5.6	6.7	7.0	7.3	7.8	7.1	7.1	7.2	7.6	6.9	5.8	7.6	7.2	8.1	5.8	8.2	7.8	7.5	6.9
	SSW	12.9	16.3	12.3	16.3	11.2	15.1	10.1	15.7	9.3	16.8	9.5	20.0	9.1	16.5	8.3	15.5	8.9	11.8	10.2	15.0	10.8	11.8	11.9	15.6	10.4	15.5
	SW	18.2	10.8	11.8	15.7	12.0	17.2	11.3	19.6	9.9	19.6	9.8	18.8	9.0	17.6	8.2	19.2	9.3	15.1	9.7	12.3	10.7	12.6	11.9	14.5	11.0	16.1
	WSW	7.3	2.5	8.7	3.9	10.2	5.8	9.8	7.3	9.0	5.9	8.8	6.0	8.4	5.4	8.3	6.7	8.8	6.6	9.4	3.9	8.8	4.0	9.5	3.4	8.9	5.1
	W	4.3	1.2	4.6	1.4	6.9	1.7	8.0	2.0	6.9	1.7	7.2	1.9	6.1	1.7	6.1	1.8	6.6	1.9	7.2	1.2	6.4	0.9	6.4	0.9	6.4	1.5
	WNW	4.0	0.8	5.6	1.6	7.4	1.9	7.5	2.3	6.1	1.4	7.2	2.0	6.0	1.7	6.2	1.9	6.2	1.7	5.6	1.1	6.4	0.9	5.2	0.7	6.1	1.5
	NW	3.8	1.1	5.4	1.6	5.3	1.2	5.9	1.5	5.0	1.7	5.9	1.3	5.5	1.4	5.6	1.7	5.5	1.8	4.3	1.1	4.8	1.3	3.6	0.9	5.1	1.4
	NNW	4.6	1.0	5.5	1.1	5.9	1.2	6.6	1.4	4.8	1.3	5.9	1.1	5.9	1.2	4.9	1.1	5.4	1.6	4.8	0.9	4.4	1.1	3.8	0.7	5.2	1.1
	CALM		7.9		6.0		3.3		3.3		3.8		2.7		3.0		3.9		4.6		5.9		8.6		6.5		5.0
	Weighted Average	7.0		7.5		7.5		7.8		7.0		7.4		6.8		6.4		6.4		6.6		6.4		7.3			

304-23

WATER RESOURCES STUDY
METROPOLITAN SPOKANE REGION
Dept. of the Army, Seattle District
Corps of Engineers

WIND SPEED AND DIRECTION
SPOKANE WBAS

TABLE

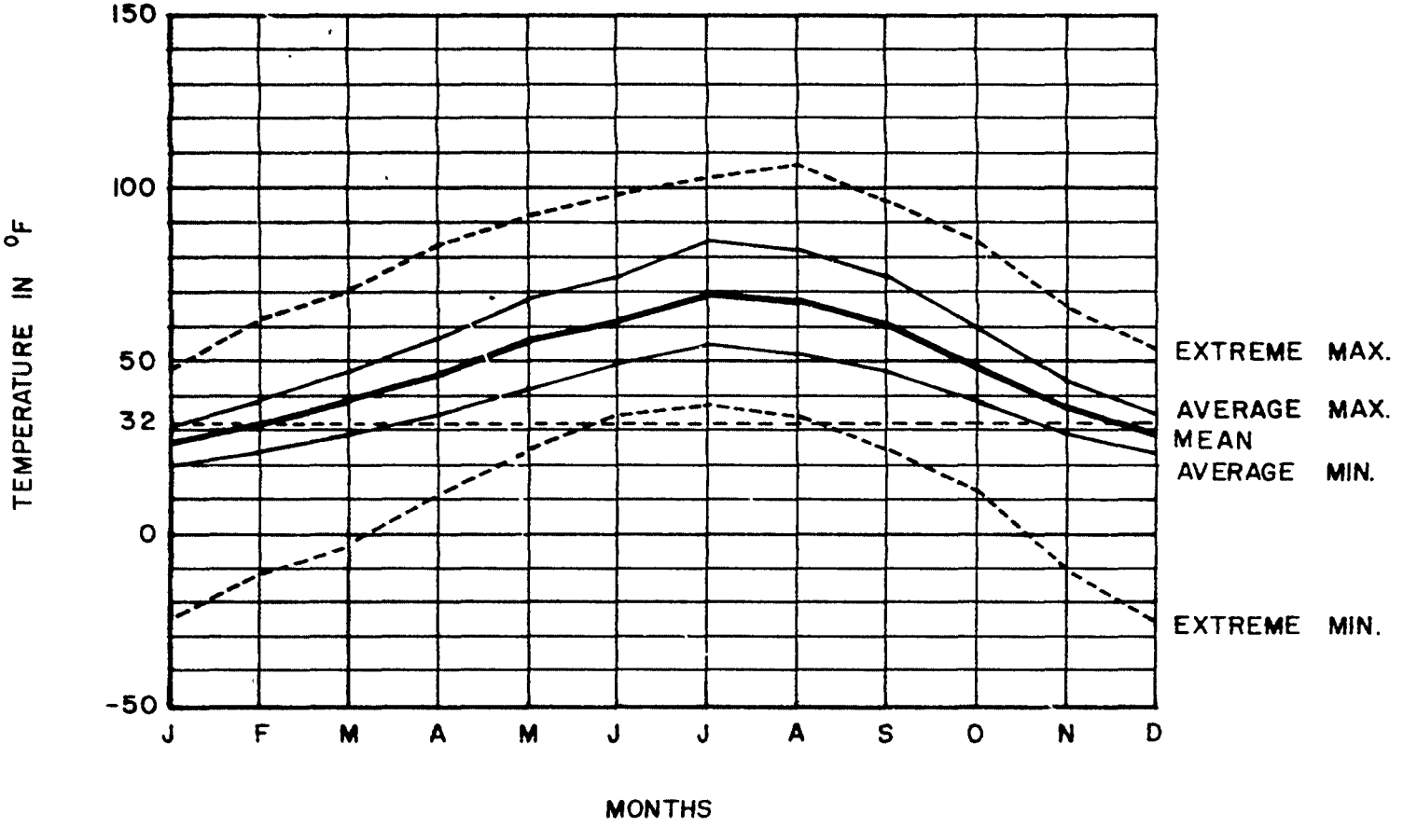
TABLE 11

RELATIVE HUMIDITY, SPOKANE WBAS

	PER CENT*												
Time (PST)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
4 a.m.	82	83	78	75	74	73	59	60	68	79	87	87	75
10 a.m.	81	79	67	56	51	48	37	44	49	67	82	82	62
4 p.m.	76	70	54	43	41	35	24	28	30	51	76	76	51
10 p.m.	81	79	72	65	62	57	41	46	54	72	83	83	66

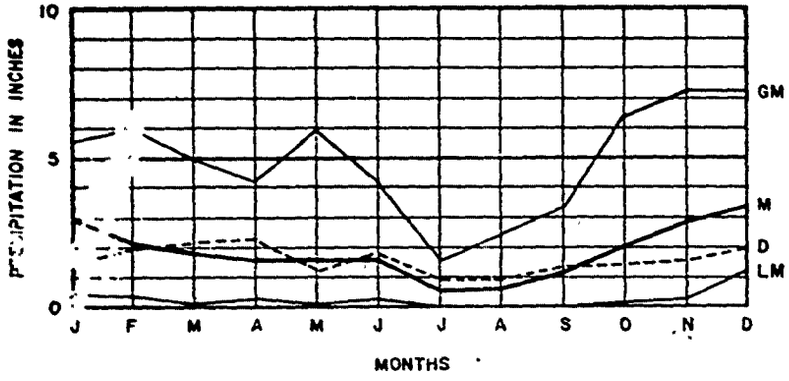
* Means 4:00 and 10:00 a.m. and p.m., by months, Spokane WB Airport, 1960-1972.

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy - Tudor Consulting Engineers	RELATIVE HUMIDITY, SPOKANE WBAS	TABLE 11

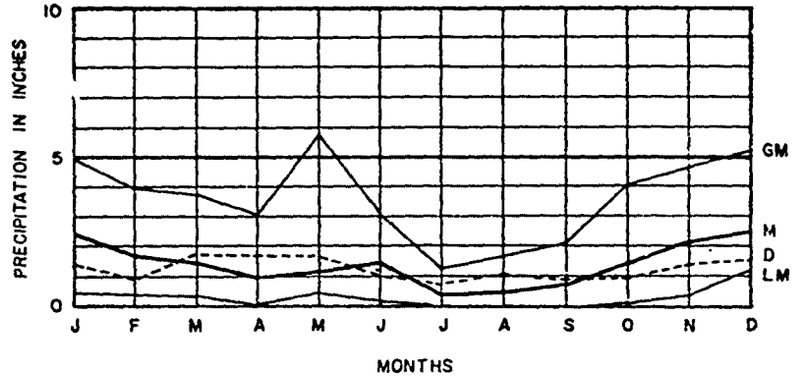


WATER RESOURCES STUDY [illegible]	MONTHLY TEMPERATURE, MEANS AND EXTREMES FOR SPOKANE WBAS	FIGURE A

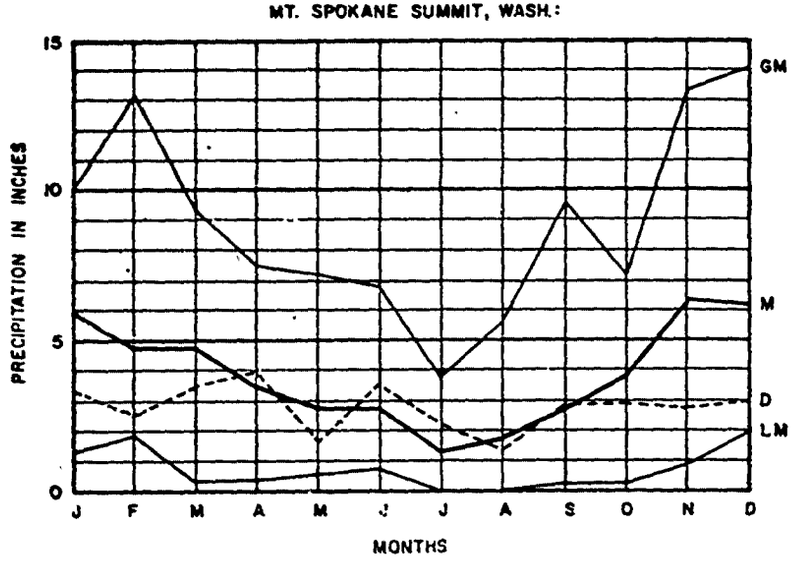
DEER PARK 2E, WASH.:



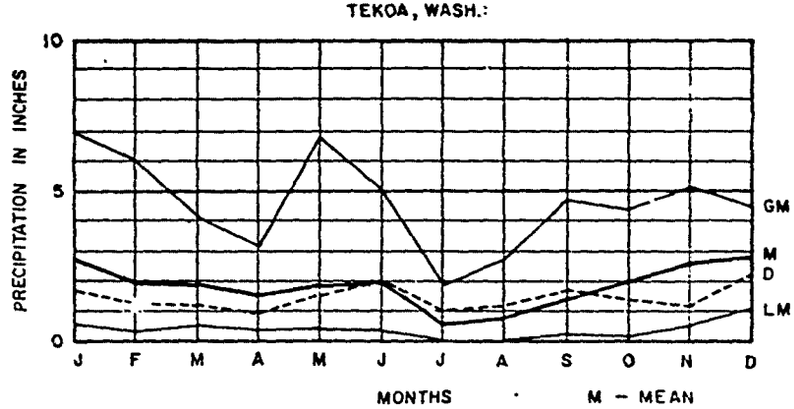
SPOKANE WB AIRPORT, WASH.:



MT. SPOKANE SUMMIT, WASH.:

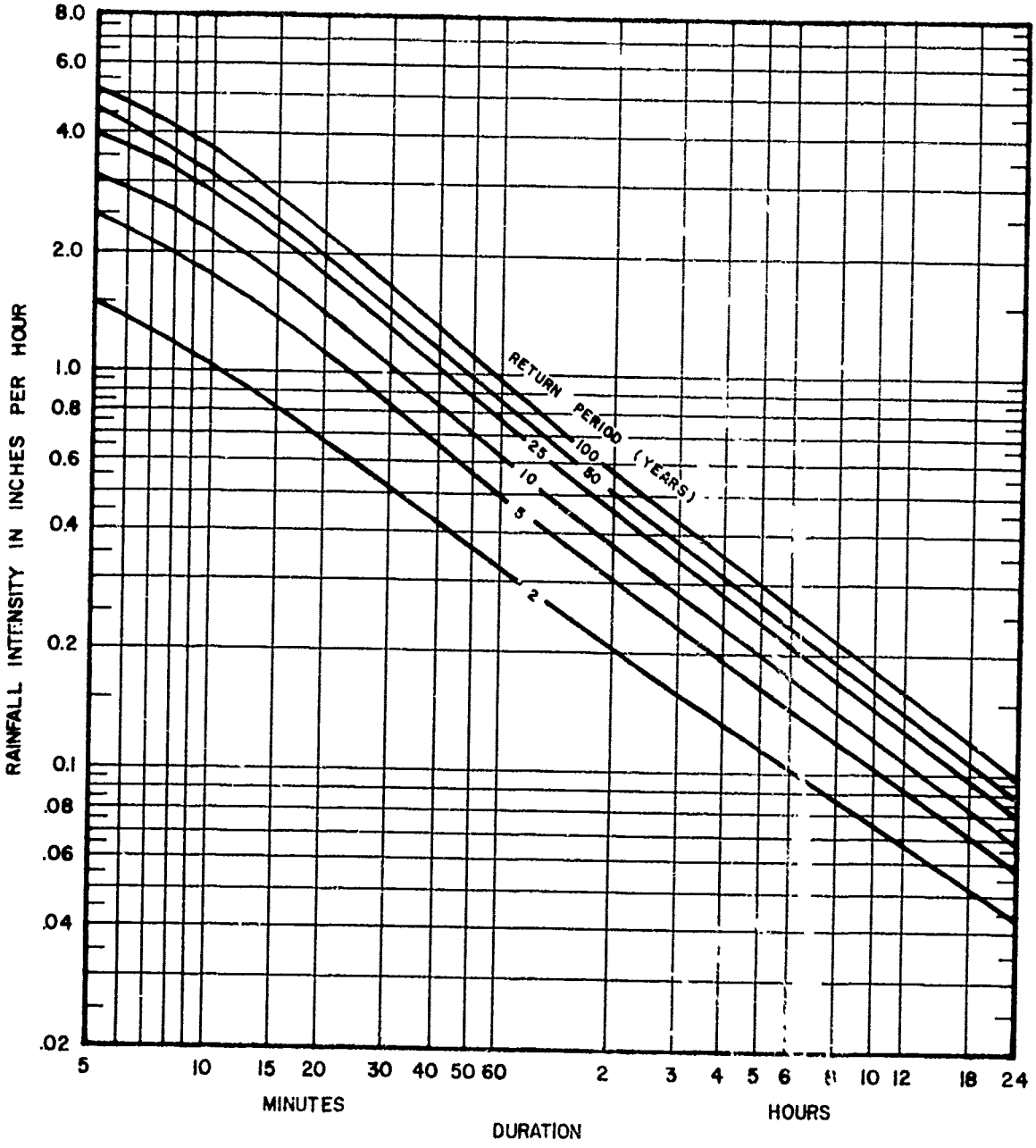


TEKOA, WASH.:



M – MEAN
D – GREATEST DAILY
GM – GREATEST MONTH
LM – LEAST MONTH

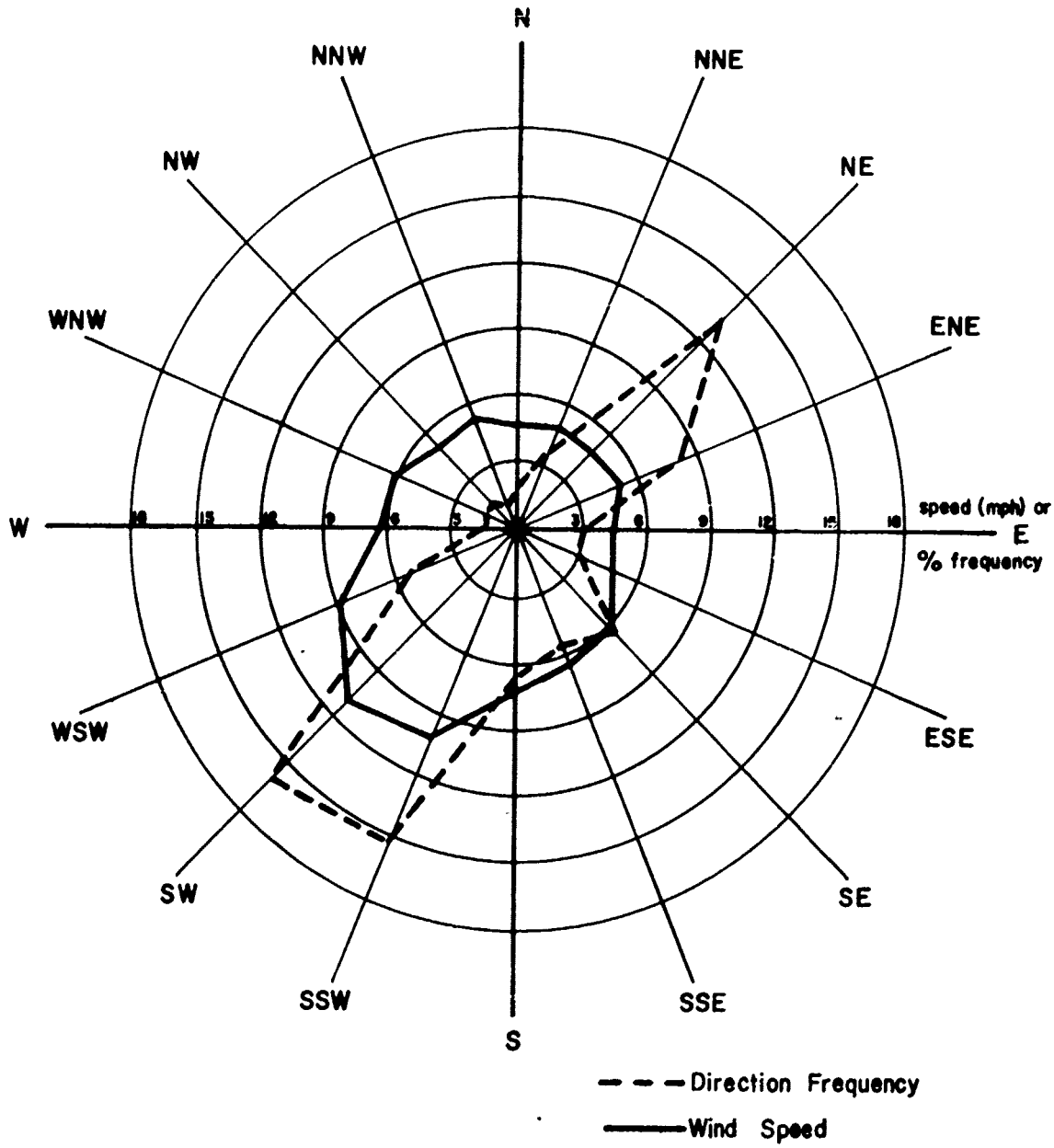
WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept of the Army, Seattle District Corps of Engineers Kennedy - Tudor Consulting Engineers	MONTHLY PRECIPITATION, MEANS AND EXTREMES	FIGURE B



Note: Frequency analysis by method of extreme values, after Gumbel, for record 1900-1946.

Reference: Weather Bureau Technical Paper No. 25

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy - Tudor Consulting Engineers	RAINFALL INTENSITY - DURATION - FREQUENCY FOR SPOKANE WBAS	FIGURE C



Note: Wind blows toward center of diagram.

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy - Tudor Consulting Engineers	WIND SPEED AND DIRECTION FOR SPOKANE WBAS	FIGURE D

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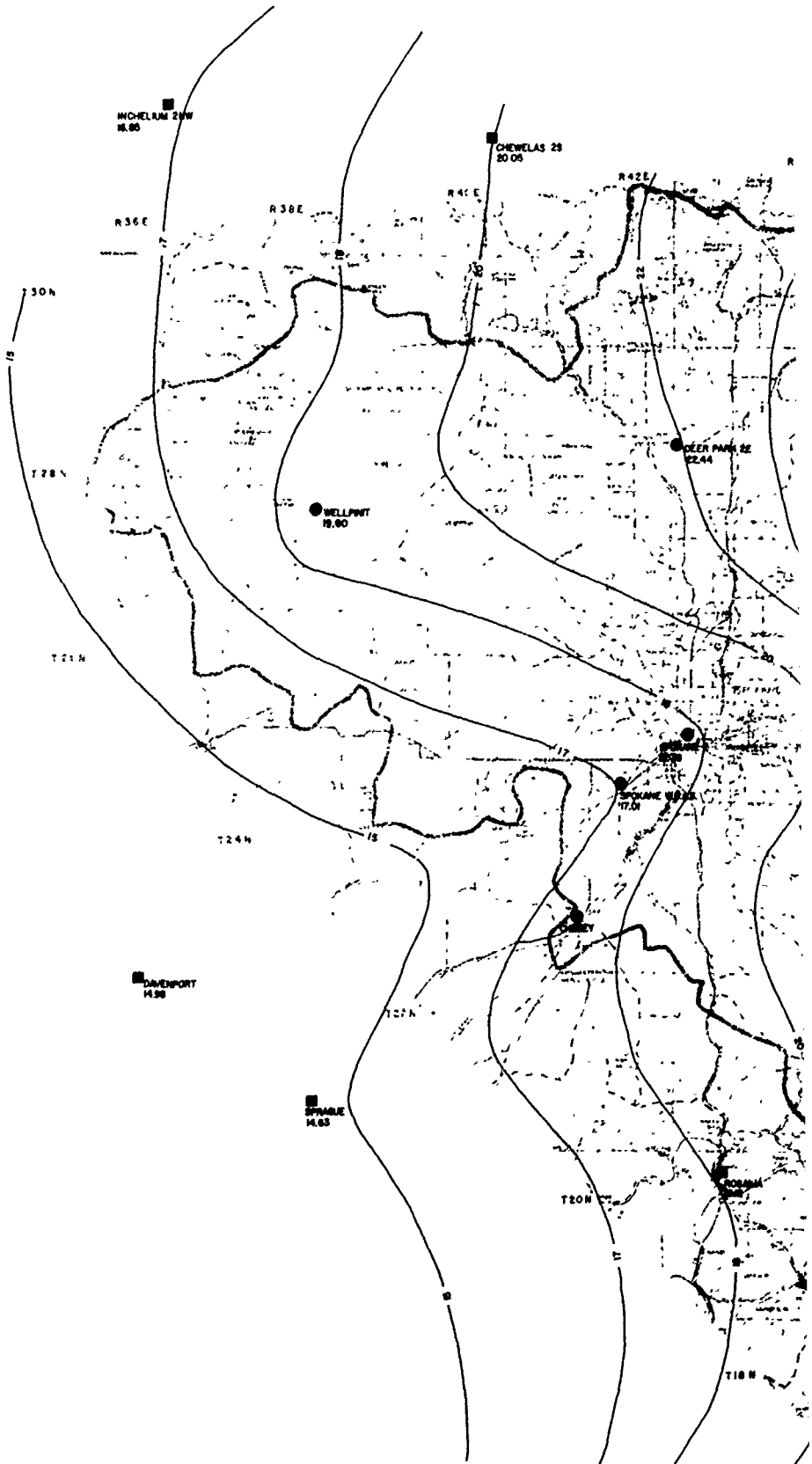
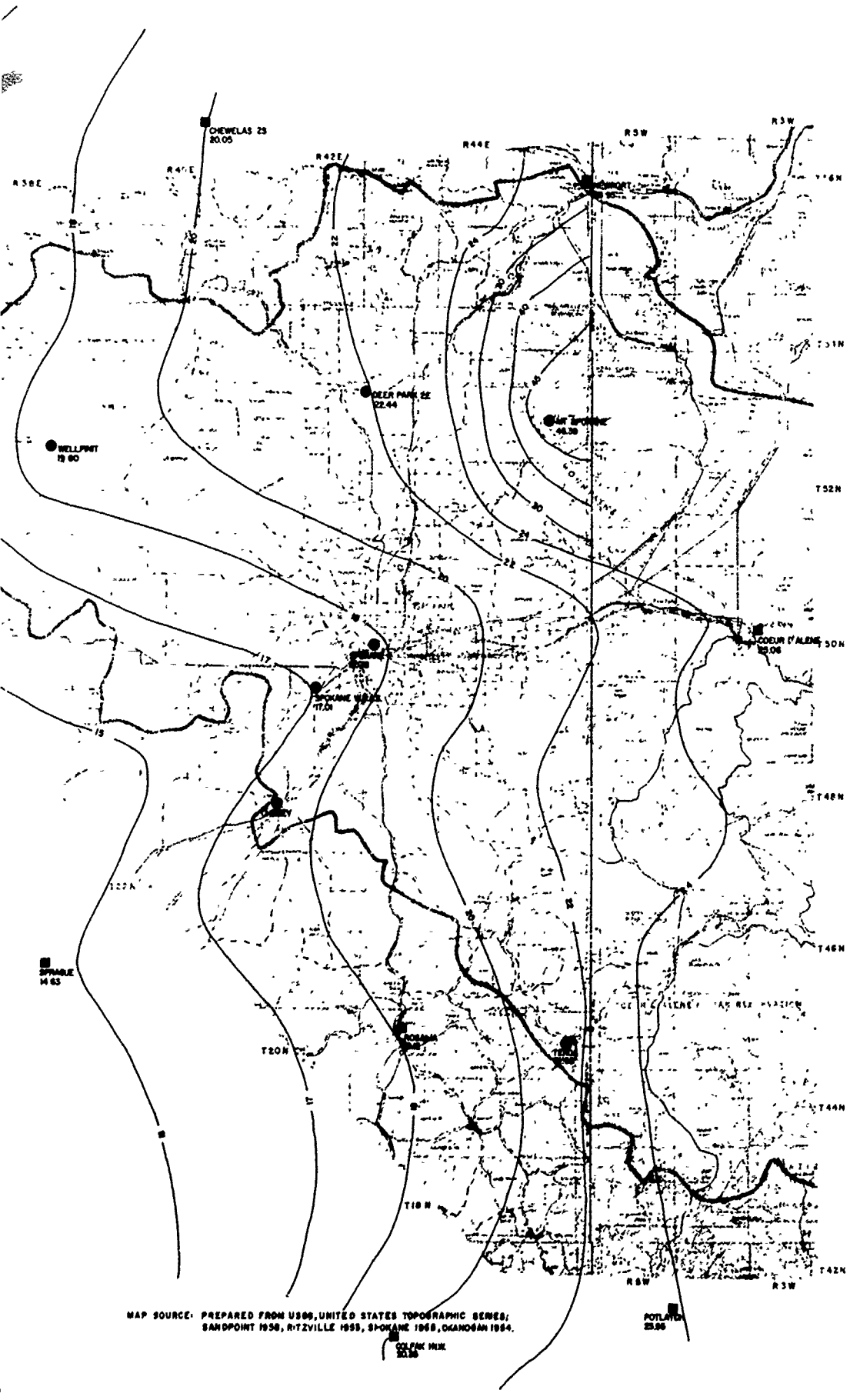


GRAPHIC SCALES

REVISIONS			
SYMBOL	DESCRIPTION	DATE	BY

MAP SOURCE: PREPARED FROM USGS, UNITED STATES TOPOGRAPHIC S
SANDPOINT 1956, RITZVILLE 1955, SPOKANE 1956, OKANOG



LEGEND

WELLPINT 19.60 — METEOROLOGICAL STATION INSIDE THE STUDY AREA. METEOROLOGICAL STATION NAME AND MEAN ANNUAL PRECIPITATION IN INCHES.

—17— METEOROLOGICAL STATION IN ADJOINING AREAS. ISOHYETAL LINE, MEAN ANNUAL PRECIPITATION IN INCHES

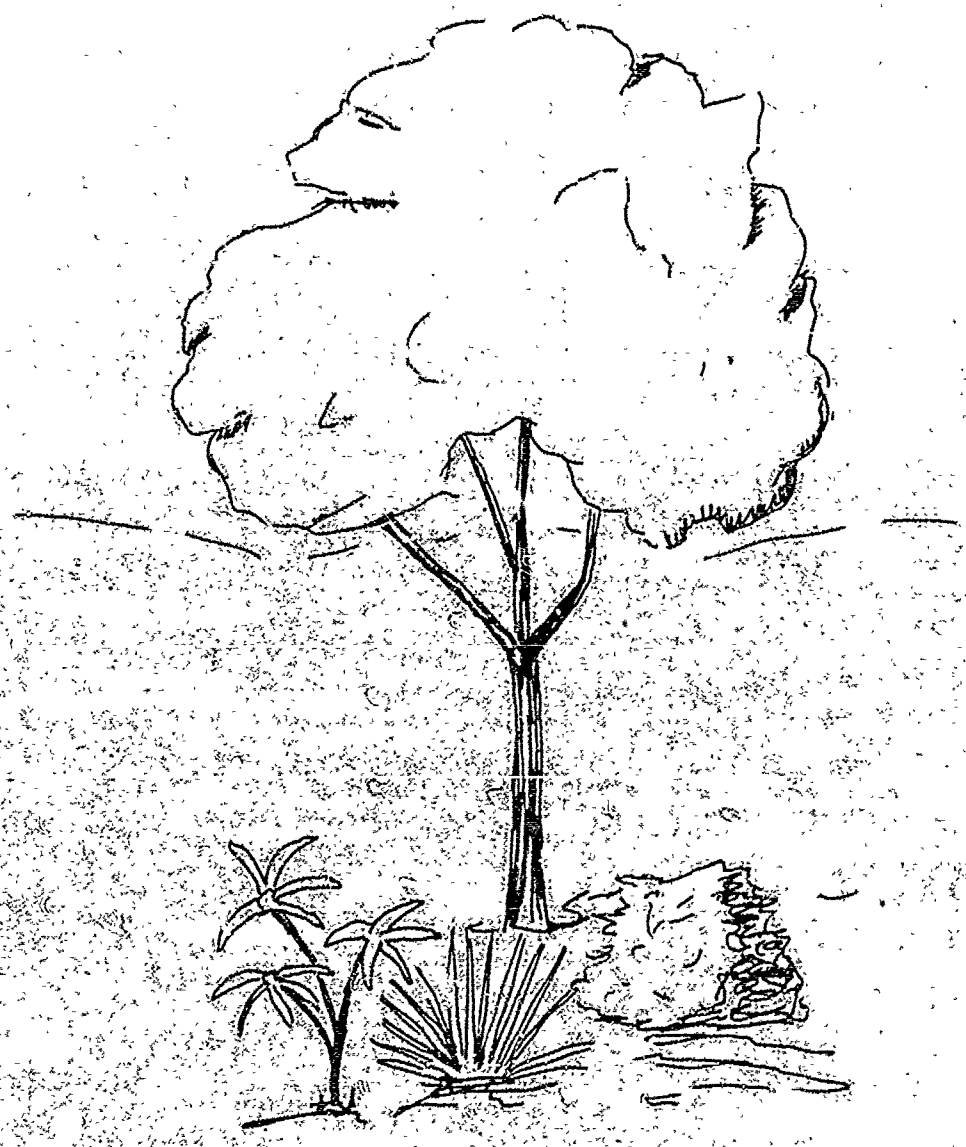
MAP SOURCE: PREPARED FROM USGS, UNITED STATES TOPOGRAPHIC SERIES; SANDPOINT 1958, RITZVILLE 1955, SPOKANE 1968, OKANOGAN 1964.

KENNEDY - TUDOR
CONSULTING ENGINEERS
SEATTLE, WASHINGTON

WATER RESOURCES STUDY
METROPOLITAN SPOKANE REGION

METEOROLOGICAL STATIONS AND ISOHYETAL MAP

DACW 67-73-C-0090



SECTION 315.4

VEGETATION

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 315.4

VEGETATION

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19 March 1974

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

INDEX

VEGETATION

Introduction

The Study Area is covered by a complex pattern of vegetation types. The complexity is due to differences in topography, associated climate and soils, and history of disturbance. The area southwest of the Spokane River and Hangman Creek is typical of the arid Columbia plateau. North of the Spokane River and surrounding the valley of the Little Spokane River are cooler and wetter highlands. South along Hangman Creek and to the east of Hangman Creek, the ground rises but the rainfall remains relatively low as compared with the area north of the Spokane River. These general climate zones interact with the three main soil types which dominate the Study Area to form a variety of vegetal habitats. South of the Spokane River and along Hangman Creek, the deep Palouse soils are mixed with basalt cap rock which frequently has only a thin overlayer of soil, poor in fertility and moisture. The valley of the Spokane River from its junction with the Little Spokane to the Idaho border is filled with glacial outwash gravel topped with a thin gravelly soil. Mountainous areas are covered with soil mantles of various thicknesses derived from weathering of the basic rock materials.

Within the Study Area, vegetation types reflect the characteristics of three of the "life zones" recognized by Meriam: Upper Sonoran,

Arid Timbered Transition and Arid Grassland Transition. With the exception of portions in the southwest corner of the Study Area, the Spokane River watershed within Washington lies within the Arid Timbered Transition life zone. Typically, vegetation in this zone consists principally of coniferous forests in the mountains and deciduous woods in the valleys. Among the interesting features of vegetation are the extensive stands of almost pure larch. In most respects, the flora closely resembles that of the Blue Mountains, where coniferous forests of the type of arid regions form the principal tree cover. Typical plant species include the white fir, alpine fir, larch and spruce, and such shrubs as fool huckleberry, Oregon boxwood, dogwood, wild currant, mountain mohogany, spirea, lupines of several species, maple, buckbrush, sticky brush (Snowbrush ceanothus), and big huckleberry.

The southern boundary of the Study Area, west of the upper reaches of Deep Creek, is located on the fringe of the Arid Grassland Transition, in which the open pine forests of the eastern Cascades give way to grasslands. Grasses of several species are common but the bunchgrass (bluebunch wheatgrass) is most important. Other plants include the primrose, lupines and Mertensia. In ravines and near watercourses such shrubs as hawthorn, serviceberry, aspen, syringa, snowberry, chokecherry and elderberry form thickets. Lower in the valley, the vegetation is xerophytic, similar to that of the Columbia Plateau. Sagebrush is dominant. Other shrubs include rabbit brush, hopsage, bitterbrush, and black greasewood.

The lower reaches of the Spokane River lie within the Upper Sonoran life zone which is characteristic of the Columbia River valley. Within this life zone, vegetation is generally of the desert type. A few pines and junipers grow in favored places. Along streams, the cottonwood and several species of willow are common. Typical grasses and shrubs include bunchgrass, foxtail, cheatgrass, saltbrush, greasewood, rockcress, sagebrush, rabbitbrush and pricklypear.

If soil conditions were not a limiting factor, the vegetation would be distributed along a climatic gradient which would change with elevation: grasslands and steppe vegetation on the arid plateau; ponderosa pine forests on slightly higher ground; Douglas fir forests from about 2,000 to 3,000 feet; and grand fir above 3,000. The differences in the moisture-holding capacities of the soil tend to modify this pattern. Before the area was settled by white men, there were frequent fires at 8 to 20 year intervals (Franklin and Dyrness, 1973.) These fires favored the establishment of the more fire resistant ponderosa pine at the expense of Douglas fir and grand fir in forests at higher elevations. Repeated burns and logging at these altitudes have resulted in these species being better represented in mixed stands. Because the understory species are adapted to recurrent fires, their distribution is not influenced significantly by this variable. Grazing, however, increases the shrubs at the expense of the grasses and also increases the coverage of introduced and nonpalatable grasses.

Plate 315.4-1 shows the area distribution of the various vegetation types and associations in the study area. The unshaded

portions represent cultivated land, pasture, native grasslands, or steppe vegetation and sparsely vegetated areas of sand or bedrock. The grasslands support the same species of grasses and other flowering plants that are found under the canopy of mature ponderosa pine forests. Bitterbush is occasionally interspersed with the grasses. Snowberry is a prevalent though stunted member of the steppe association of Idaho fescue and snowberry. Bluebunch wheatgrass and needle and thread, are the other two important grass species here and in the ponderosa pine forests.

The following paragraphs describe the vegetation associations found in the various watersheds within the Study Area.

Spokane River - Mouth to Nine Mile Falls

Pure stands of ponderosa pine alternate with grass and steppe vegetation along this stretch of the Spokane River. The understory vegetation contains many of the species found in the surrounding grass and steppe. Bitterbush dominates the shrub layer. The herbaceous layer is dominated by a number of perennial grasses including bluebunch wheatgrass, Idaho fescue, and needle and thread (Franklin and Dyrness, 1973). Daubenmire and Daubenmire (1968) refer to this community type as the ponderosa pine/bitterbrush association. A large number of perennial forbs and annuals occur in this association; some of the more abundant being western yarrow, western gromwell, yellow goat's beard, arrowleaf balsomroot, sagebrush buttercup, Holboell rockcress, littleflower collinsia, cheatgrass, willowweed, Nuttall's

fescue and hairy brome. The other shrubs found in this understory type are serviceberry, chokecherry, snowberry and wild rose.

This area was logged extensively in the past and has continued to be used for timber production. Few stands contain trees over one hundred years old. Areas covered by dense pine reproduction have an impoverished understory. The older, more open stands are used for grazing. Some timbered areas have been replaced by orchards.

Mill Canyon

Young stands of ponderosa pines outline the upper end of this canyon. The understory vegetation lacks a shrub layer, being composed of perennial grasses, forbs and annuals. Both associations found here, bluebunch wheatgrass and needle and thread, are named for the grass which dominates the understory (Daubenmire and Daubenmire, 1968). The difference between the two associations is one of species abundance rather than species composition. The following perennials are common to both the ponderosa pine/bluebunch wheatgrass and ponderosa pine/needle and thread associations: Sandberg's bluegrass; arrowleaf balsomroot; sagebrush buttercup; western yarrow; yellow goat's beard; purple-eyed grass; low pussytoes; fleabane and slender fringecup. The most abundant annuals are collinsia, cheatgrass, Japanese brome, narrow-leaved montia, vernal draba, pink annual phlox, common and jagged chickweed.

The upper slopes at the head of the canyon extend above 2,000 feet into the Douglas fir zone. Because ponderosa pine as well as

Douglas fir colonize sites at this elevation, both are represented in this stand.

Spring Creek

The lower portion of this drainage basin is covered by the ponderosa pine/bitterbrush association. The pine forests continued up the creek earlier but were cleared for wheat farms. A few scattered Douglas fir remain on the slopes above the agricultural lands.

Coulee Creek

Ponderosa pine forests dominate most of the drainage. Douglas fir occurs along the northern bank near the mouth of Coulee Creek and midway up the stream on soil derived from some fine sandy material. The ponderosa pine/bluebunch wheatgrass association grows primarily on the steep south-facing slopes with shallow stony soil, the ponderosa pine/needle and thread association grows on the gravelly soils of gentler slopes. There is a small stand of old growth Douglas fir on this site. The community type found here is named the Douglas fir/snowberry association for the dominant shrub (Daubenmire 1952, Daubenmire and Daubenmire, 1968). The shrub layer also includes shinyleaf spirea, woods rose and Nootka rose. Many of the same perennials and annuals found in the ponderosa pine associations are also found here.

Deep Creek

The ponderosa pine/bluebunch wheatgrass association dominates

the low ground near the mouth of Deep Creek. This association also occurs in conjunction with the ponderosa pine/needle and thread association at higher elevations in the drainage basin. Reproduction of ponderosa pine in the grass-dominated understory habitat type is episodic (Daubenmire and Daubenmire, 1968); so that some stands of young trees may be too dense to allow the establishment of an herbaceous understory. Because of extensive logging and forest fires, most trees along the southern tributaries to the Spokane River are less than one hundred years old. The headwaters of Deep Creek have been cleared for wheat farming and other forms of agriculture.

A sandy soil adjacent to the last bend in Deep Creek supports a stand of mature ponderosa pine over 200 years old with an understory dominated by Idaho fescue. Bluebunch wheatgrass, prairie junegrass and Sandberg's bluegrass are also important perennial grasses in this association. Abundant flowering perennials are western yarrow, purple-eyed grass, arrowleaf balsomroot, western gromwell, yellow goat's beard, sagebrush buttercup, low pussytoes and slender fringecup. The annuals in the abundant category are cheatgrass, collinsia, narrow-leaved montia, smallflowered forget-me-not, autumn willowweed and chickweed. Like the other ponderosa pine associations dominated by perennial grasses, the ponderosa pine/Idaho fescue association is used for grazing cattle and sheep. The main perennial grasses are palatable. Grazing pressure is reflected in the abundance of cheatgrass, and the presence of other unpalatable annuals and grasses.

Spokane River - Nine Mile Falls to Spokane

Stands of ponderosa pine up to a hundred and fifty years old border the stretch of the Spokane River between Nine Mile Falls and the City of Spokane. The soils are thin causing the understory of the forests to be dominated by bluebunch wheatgrass. Douglas fir is found occasionally on pockets of silty loam soils with higher water holding capacity. A few of the species normally associated with Douglas fir at higher elevations also probably occur here, including snowberry, shinyleaf spirea, and elk sedge being the most likely.

Marshall and Minnie Creeks

Ponderosa pine under a hundred years of age, associated with Idaho fescue, forms the main component of the forests along Marshall Creek and the lower part of Minnie Creek. An old growth stand fitting Daubenmire's Douglas fir/mallow ninebark association can be located just above Fish Lake on an isolated patch of Moscow loam. Further up the drainage, young stands of ponderosa pine and native grasses again dominate the hillsides. An old stand of ponderosa pine/bluebunch wheatgrass remains just south of Cheney, Washington. It is likely that the bluebunch wheatgrass association is the most prevalent at the headwaters of Minnie Creek.

The Douglas fir/mallow ninebark association contains species which require a more mesic environment than afforded by the ponderosa pine forests along the southern tributaries. Oceanspray, Douglas' hawthorn, chokecherry and serviceberry (Daubenmire and Daubenmire, 1968)

form a tall shrub layer. Mallow ninebark dominates the medium shrub layer which includes snowberry, woods rose, Nootka rose, and shinyleaf spirea. Creeping western barberry is the sole constituent of the low shrub layer. Pinegrass is the most abundant perennial grass; the other perennial graminoids being elk sedge, Columbia brome, bluebunch wheatgrass, western fescue and blue wildrye.

Hangman Creek (Latah Creek)

Ponderosa/pine Idaho fescue association coverage extends from the mouth of Hangman Creek to above Rock Creek. Several mature stands containing trees up to 250 years old exist in the area immediately south of Spokane, though most stands are composed of trees less than 150 years old. Mixed forests of ponderosa pine and Douglas fir occur on the upper slopes of the valley. From above Rock Creek to Tekoa the forests have been replaced by agricultural lands for raising grains and cattle.

Rock Creek

Rock Creek vegetation resembles Hangman Creek in that the main association on its banks is the ponderosa pine/Idaho fescue association. Mixed stands of ponderosa pine and Douglas fir also occur in this drainage area. An old growth stand of Douglas fir of the Douglas fir/mallow ninebark association is near Sylvan School just below Rockford. The forest is growing on an area of silty loam soil, whereas the surrounding soil has a coarser texture.

Spokane River - Spokane to Idaho Border

From the east city boundary eastward to the Idaho border, the river flows through an area that has been cleared to agriculture for many years and is now experiencing another conversion to urban development. There are only a few scattered stands of ponderosa pine left. Saltese Creek used to flow through a peat-bog but this was drained. The area is now used for truck farming.

Little Chamokane Creek (Spokane Indian Reservation)

Little Chamokane Creek heads in a mixed forest of ponderosa pine and Douglas fir. The ponderosa pine is probably represented by the older age class while the Douglas fir dominates the reproduction. Ponderosa pine/Idaho fescue is the main vegetation type although the ponderosa pine/bitterbrush association occurs near the mouth of Little Chamokane Creek. There is a sizeable logging operation on the Spokane Indian Reservation. The logging has been operated as a managed forestry under the guidance of the Bureau of Indian Affairs for many years. A report prepared by the Bureau of Indian Affairs in 1965 identified management problems including both overstocking and understocking as well as fire control. The report indicated that much higher sustained yields were possible under improved management conditions.

Chamokane Creek

The lower half of Chamokane Creek is all below 2,000 feet. The area has been cut over so that most ponderosa pine stands are less

than a hundred years old. The ponderosa pine/Idaho fescue association alternates with unforested areas dominated by essentially the same perennial grasses and annuals found in the association. At the 2,000 foot level, the ponderosa pine/snowberry association becomes the most prevalent vegetation. At even higher elevations the forest composition becomes mixed. Douglas fir, western larch and occasionally grand fir and lodgepole pine are found growing under older ponderosa pine. Several old growth stands of mixed composition may still exist along the upper part of Chamokane Creek. However, its headwaters drain an area converted to agricultural land for raising cattle and hay.

The ponderosa pine/snowberry association is intermediate between the ponderosa pine and native grass associations and the Douglas fir/snowberry association in its moisture requirements. The major understory constituents of both snowberry associations are almost the same so that they will only be listed here once. The tall and low shrub layers are, for the most part, absent. The medium shrub layer consists of snowberry, shinyleaf spirea, woods rose and Nootka rose. The important perennial grasses are bluebunch wheatgrass, western fescue, pinegrass, blue wildrye and Canada bluegrass. The abundant flowering perennials and annuals are: western yarrow, western gromwell, yellow goat's beard, large flowered brodiaea, cinquefoil, purple-eyed grass, collinsia, Miner's lettuce, bedstraw and cheatgrass.

Mouth of Little Spokane River to Dragoon Creek, and Dragoon Creek

Quaking aspen, black cottonwood and alder are found along the

lower banks of the Little Spokane River. Ponderosa pine forest with understories dominated by either needle and thread or Idaho fescue grow on the slopes just above the aspen and cottonwood. About half way up Dragoon Creek are a few pure stands of lodgepole pine. These are probably the result of repeated fires or heavy logging (Franklin et al., 1972). Beyond the half way point of Dragoon Creek, snowberry begins to dominate the understory of both ponderosa pine and Douglas fir. Western larch and grand fir are sometimes subordinate members of these forests.

Little Spokane River Above Dragoon Creek

The section of the river between its junction with Dragoon Creek and the junction of its west and east forks has little forested vegetation along its banks. Again, quaking aspen, black cottonwood and alder are the main tree types. Some pure stands of lodgepole pine are growing on the western bank of Eloika Lake. Mixed stands of lodgepole pine and ponderosa pine, with some pure stands of ponderosa pine are found above Eloika Lake. Douglas fir, western larch and grand fir form part of the forest above Horseshoe Lake. The east fork of the Little Spokane River has some pure stands of lodgepole pine along its banks as well as mixed stands of ponderosa pine, Douglas fir, western larch, grand fir, and lodgepole pine.

Deer Creek and Deep Creek

The lower section of these two creeks flow through grasslands

dominated by Idaho fescue. They enter forested lands about a third of the way up their length. These are forests of ponderosa pine with snowberry dominated understories. Douglas fir occurs here on protected Northern slopes. Further up the creeks, Douglas fir forests begin to be more prevalent. Western larch is abundant in this area because of the influence of past fires. Western white pine can be found in the gullies. Above 3,000 feet grand fir becomes the main species.

Vegetational Resources of Special Significance

Very little of the original steppe vegetation remains. Grazing, cultivation, and irrigation have affected most of the land, but a recent intensive study of the dwindling fragments revealed no less than 41 distinctive climax types on the uplands. Marshes, islands, ponds and some types of dune vegetation have not yet been studied in detail. As of of today, samples of scarcely half a dozen of these vegetation types are protected. (Daubenmire, 1973, in special material prepared for the U. S. Corps of Engineers).

The most comprehensive effort yet undertaken in inventorying the environmental resources of the State of Washington is that sponsored by the U. S. Army Corps of Engineers. The accompanying Figure A is a map of the Study Area, showing the location of botanical species and communities of special importance. Identification of the resources is listed in Table 1.

The listing includes examples of rare marsh community, camas meadow, and virgin stands of timber. Within the Study Area, some tracts have been set aside for research and preservation in their natural state.

Of particular interest are the following sites which have been set aside:

Turbull - Pine Creek Research Natural Area.

This area exemplifies nearly pristine ponderosa pine savanna at the transition from forest to grassland and a series of freewater potholes characteristic of the channelled seablands found on the plateau of east-centeral Washington.

Camas Meadow.

This is the only known remnant of Camas meadow left relatively intact in Washington. Camas was one of the two important foods of the native Indians.

Dishman Hills

This area consists of eighty acres owned by Nature Conservancy. supporting Ponderosa Pine and Douglas Fir forests with associated biota, including over 200 species of ferns, conifers and flowering plants.

TABLE 1

VEGETATION RESOURCES OF SPECIAL SIGNIFICANCE

Climax Community

10 Morgans Marsh

Vegetation Type Unusual to Region

7 Spokane River South banks

Species Stand or Community

50 Camas Meadow

Virgin Stand

15 Pine Creek Research Natural Area
16 Turnbull Pine Creek Research Natural Area
68 Trout Lake Pines

Habitat of Important Native Plants

55 Ponderosa Pine Covered Scablands
87 3-tip Sagebrush-Idaho Fescue (Artemisia tripartita-Festuca idahoensis)

Meadow-Steppe Community

105 Idaho Fescue - Common Snowberry (Festuca idahoensis - symphoricarpos albus)
106 Idaho Fescue - Common Snowberry (Festuca idahoensis - symphoricarpos albus)
107 Idaho Fescue - Common Snowberry (Festuca idahoensis - symphoricarpos albus)

Lower Parkland Community

129 Idahoe Fescue-Wyeth Buckwheat (Festuca idahoensis - Eriogonum heracleoides)

Special Soil (edaphic) Communities

191 Ponderosa Pine - Idaho Fescue
(Pinus ponderosa - Festuca idahoensis)
192 Ponderosa Pine - Idaho Fescue
(Pinus ponderosa - Festuca idahoensis)
193 Ponderosa Pine-Idaho Fescue
(Pinus ponderosa - Festuca idahoensis)
194 Ponderosa Pine - Idaho Fescue
(Pinus ponderosa - Festuca idahoensis)
195 Ponderosa Pine - Bluebunch Wheatgrass
(Pinus ponderosa - Agropyon spicatum)
196 Ponderosa Pine - Bluebunch Wheatgrass
(Pinus ponderosa - Agropyon spicatum)
197 Ponderosa Pine - Needle and Thread
(Pinus ponderosa - Stipa comata)
198 Ponderosa Pine - Needle and Thread
(Pinus ponderosa - Stipa comata)
199 Ponderosa Pine - Needle and Thread
(Pinus ponderosa - Stipa comata)
200 Ponderosa Pine - Thurber Needlegrass
(Pinus ponderosa - Stipa thurberiana)
201 Ponderosa Pine - Lemmon Needlegrass
(Pinus ponderosa - Stipa lemmonii)
202 Ponderosa Pine - Western Needlegrass
(Pinus ponderosa - Stipa occidentalus)
203 Ponderosa Pine - Bitterbrush
(Pinus ponderosa - Purshia tridentata)

Needleleaved Evergreen Communities

217 Ponderosa Pine - Common Snowberry
(Pinus ponderosa - Symphoricarpos albus)
218 Ponderosa Pine - Common Snowberry
(Pinus ponderosa - Symphoricarpos albus)
221 Ponderosa Pine - Common Snowberry
(Pinus ponderosa - Symphoricarpos albus)
227 Douglas Fir - Common Snowberry
(Pseudotsugi menziesii - symphoricarpos albus)
229 Douglas Fir - Mallow Winebark
(Pseudotsugi menziesii - Physocarpus malvaceus)
233 Douglas Fir - Mallow Winebark
(Pseudotsugi menziesii - Physocarpus malvaceus)

TABLE 2

SPECIES LIST

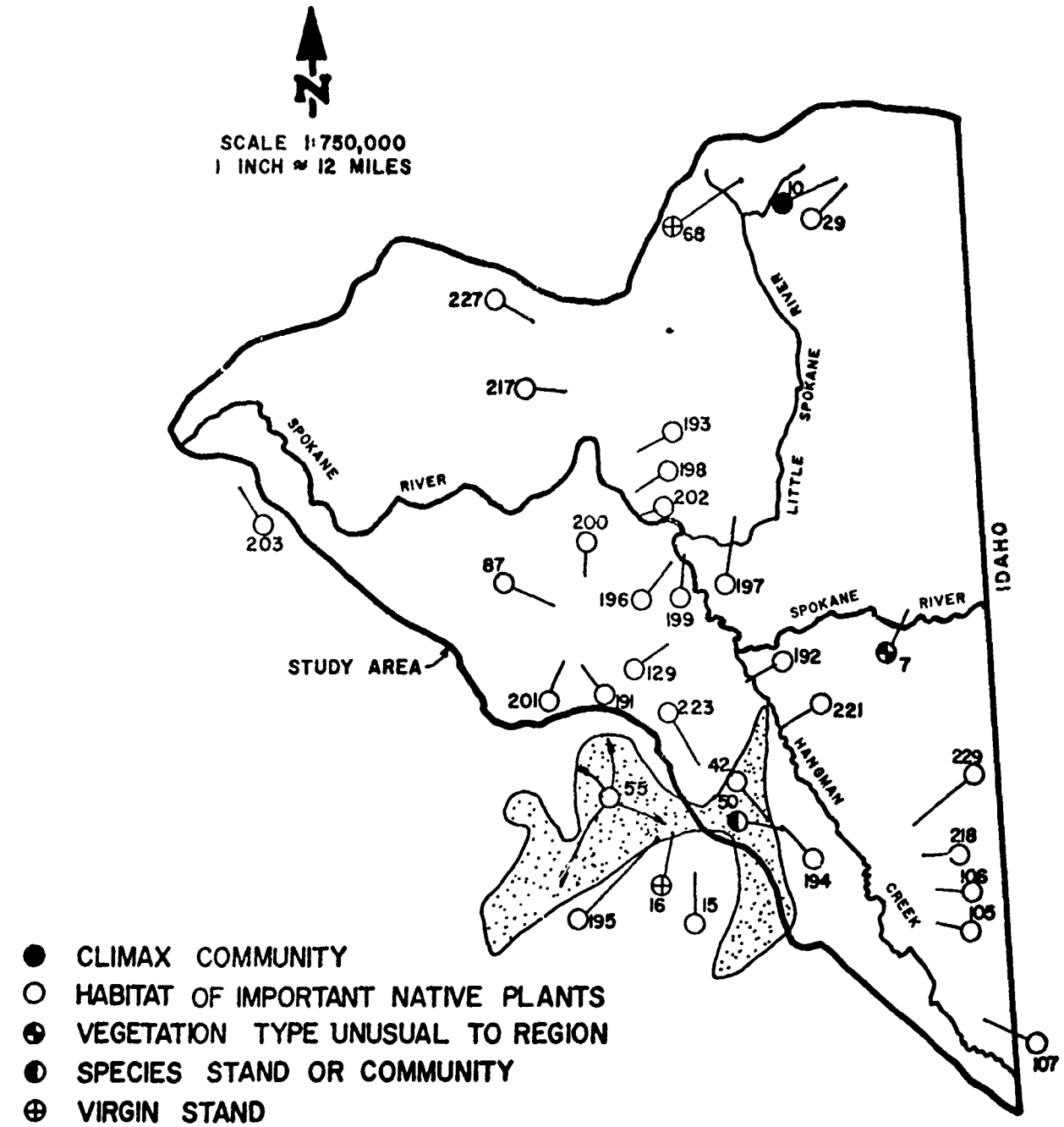
Understory Plants

Common Name	Scientific Name
American vetch	Vicia americana
Arrowleaf balsomroot	Balsomorhiza sagittata
Autumn willowweed	Epilobium paniculatum
Beauty cinquefoil	Patentilla gracilis
Big huckleberry	Vaccinium membranaceum
Bitterbrush	Purshia tridentata
Black greasewood	Sarcobatus vermiculatus
Bluebunch wheatgrass	Agropyron spicatum
Blue elderberry	Sambucus cerulea
Blue wildrye	Elymus glaucus
Buckbrush	Ceanothus sanguineus
California needlegrass	Stipa occidentalis californica
Canada bluegrass	Poa compressa
Cheatgrass	Bromus tectorum
Chokecherry	Prunus virginiana melanocarpa
Cleavers bedstraw	Galium aparine
Columbia brome	Bromus vulgaris
Common chickweed	Stellaria media
Creeping western barberry	Berberis repens
Dogwood	Cornus canadensis
Douglas' hawthorn	Crataegus douglasii
Douglas' lotus	Lotus nevadensis
Dwarf mountain fleabane	Erigeron compositus
Elk Sedge	Carex geyeri
Fool huckleberry	Menziesia ferruginea
Hairy brome	Bromus commutatus
Holboell rockcress	Arabis holboellii pendulocarpa
Hopsage	Grayia spinosa
Idaho fescue	Festuca idahoensis
Jagged chickweed	Holosteum umbellatum
Japanese brome	Bromus japonicus
Lamstongue fawnlily	Erythronium grandiflorum
Large-flowered brodiaea	Brodiaea douglasii
Littleflower collinsia	Collinsia parviflora
Little tarweed	Madia exigua
Low pussytoes	Antennaria dimorpha
Mallow ninebark	Physocarpus malvaceus
Marsh foxtail	Alopecums geniculatus
Miner's lettuce	Montia perfoliata
Mountain mahogany	Cercocarpus Ledifolius
Mountain sweetroot	Osmorhiza chilensis
Narrow-leaved montia	Montia linearis
Needle and thread	Stipa comata

Northern bedstraw	Galium boreale
Nuttall's fescue	Festuca microstachys
Nootka rose	Rosa nutkana
Oceanspray	Holodiscus discolor
Oregon boxwood	Pachistima myrsinites
Pinegrass	Calamagrostis rubescens
Pink annual phlox	Microsteris gracilis
Prairie junegrass	Koeleria cristata
Prickly pear	Opuntia polyacantha
Primrose	Oenothera pallida
Purple-eyed grass	Sisyrinchium inflatum
Red osier dogwood	Cornus stolonifera
Rocky Mountain maple	Acer glabnum Douglasii
Sagebrush	Artemisia tridentata
Sagebrush buttercup	Ranunculus glaberrimus
Saltbrush	Atriplex truncata
Sandberg's bluegrass	Poa sandbergii
Service berry	Amelanchier alnifolia
Shinyleaf spirea	Spiraea betulifolia lucida
Slender fringecup	Lithophragma bulbifera
Smallflower forget-me-not	Myosotis micrantha
Snowberry	Symphoricarpus albus
Snowbrush ceanothus	Ceanothus velutinus
Snow eriogonum	Eriogonum niveum
Spreading dogbane	Apocynum androsaemifolium
Syringa	Philadelphus Lewisii
Tall gray rabbitbrush	Chrysothamius nauseosus
Tall green rabbitbrush	Chrysothamius viscidifloris
Vernal draba	Draba verna
Western fescue	Festuca occidentalis
Western gromwell	Lithospermum ruderale
Western yarrow	Achillea millefolium lanulosa
White-stemmed swertia	Frasera albicaulis
White sweetclover	Melilotus alba
Wild currant	Ribes petiolare
Wild Strawberry	Fragaria
Woods rose	Rosa woodsii
Yellow goat's beard	Fragopogon dubius

Tree Species

Alpine fir	Abies lasiocarpa
Black cottonwood	Populus trichocarpa
Douglas fir	Pseudotsuga menziesii
Grand fir	Abies grandis
Lodgepole pine	Pinus contorta
Mountain alder	Alnus incana
Ponderosa Pine	Pinus ponderosa
Quaking aspen	Populus tremuloides
Sitka alder	Alnus sinuata
Spruce	Picea columbiana
Western Larch	Larix occidentalis
Western white pine	Pinus monticola
White fir	Abies grandis



- ● CLIMAX COMMUNITY
- ○ HABITAT OF IMPORTANT NATIVE PLANTS
- ◒ VEGETATION TYPE UNUSUAL TO REGION
- ◐ SPECIES STAND OR COMMUNITY
- ⊕ VIRGIN STAND
- TURNBULL PINE CREEK RESEARCH NATURAL AREA

REFER TO TABLE 2 FOR IDENTIFICATION OF NUMBERED LOCATIONS.

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy - Tudor Consulting Engineers	VEGETATIONAL RESOURCES OF SPECIAL SIGNIFICANCE	FIGURE A

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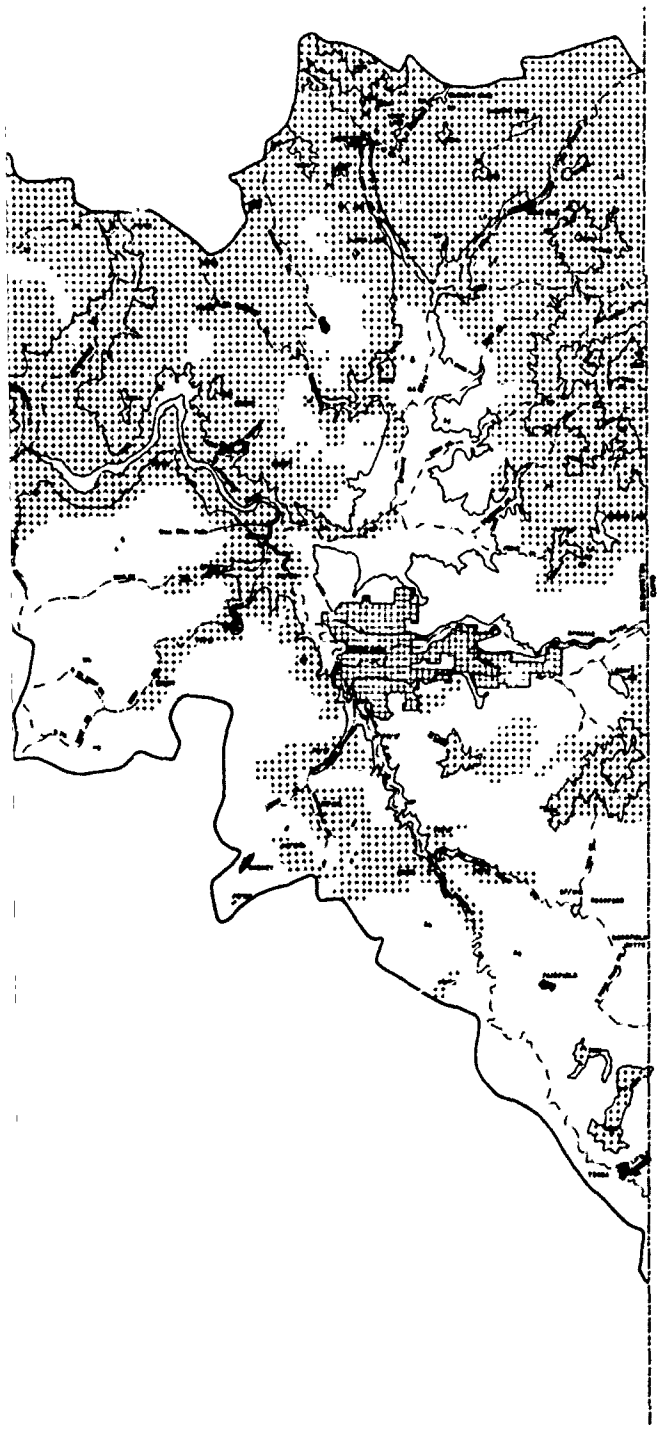
REVISIONS			
	DESCRIPTION	DATE	BY

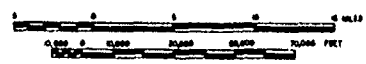


LEGEND

———	STUDY BOUNDARY
———	STATE BOUNDARY AND STUDY BOUNDARY
———	STREAMS AND RIVERS
—2000—	CONTOURS, GROUND ELEVATION IN FEET
	FOREST AND UNDERSTORY COMMUNITY
	CULTIVATED LAND
	URBAN DEVELOPMENT

DF/MN	DOUGLAS FIR/MALLOW NINEBARK
DF/SN	DOUGLAS FIR/SNOWBERRY
PP/BT	PONDEROSA PINE/BITTERBRUSH
PP/IF	PONDEROSA PINE/IDAHO FESCUE
PP/NT	PONDEROSA PINE/NEEDLE AND THREAD
PP/SN	PONDEROSA PINE/SNOWBERRY
PP/WG	PONDEROSA PINE/BLUEBUNCH WHEATGRASS

Ag	AGRICULTURE
DF	DOULAS FIR (MIXED WITH PP)
GF	GRAND FIR
LA	LARCH
LP	LODGEPOLE PINE
PP	PONDEROSA PINE
QA	QUAKING ASPEN (WITH BLACK COTTONWOOD & ALDER)
WA	WHEAT
WP	WESTERN WHITE PINE



GRAPHIC SCALES

KENNEDY - TUDOR CONSULTING ENGINEERS SEATTLE, WASHINGTON	U S ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON

WATER RESOURCES STUDY
METROPOLITAN SPOKANE REGION

VEGETATION

		PLATE
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2

SECTION 315.51

FISHERY RESOURCES

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 315.51

FISHERY RESOURCES

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in cooperation with Kennedy-Tudor
Consulting Engineers

25 March 1974

Department of the Army, Seattle, District
Corps of Engineers
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INDEX

FISHERY RESOURCES

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Introduction

The fishery resources of the study area exist in their present form because of man's alteration of the natural habitant. Spokane Falls existed as the only natural barrier on the Spokane River prior to white settlement and marked the upstream limit of the migration of anadromous salmonids. A succession of dams has created additional downstream barriers since 1908 culminating in Grand Coulee Dam in 1941 which completely cut off all anadromous migration from the study area. In addition to creating barriers, the succession of dams within the study areas has changed the habitat from free flowing conditions to a succession of impoundments. The 96 miles of Spokane River within the study area is now made up approximately of 75 percent of length in impoundments and 25 percent free flowing.

Other factors effecting the habitat are the regulation of flow of the Spokane River for power production, diversion of surface flows in the Little Spokane River watershed for irrigation and the change in use of the lands adjoining streams and lakes.

Except for Hangman Creek, one of the least significant streams from a fishery standpoint, there have been no detailed scientific inventories of the present fishery resources of the study area. There are generalized descriptions for the entire Spokane River Basin, including Idaho, in the Plan for Action developed by the Spokane River Basin Depollution Policy Committee. The Plan for Action also contains generalized discussion of changes that have been wrought in the habitat and what

should be done to improve fish habitats. Certain specific locations are treated in general terms in the Corps of Engineers unpublished study covering all environmental features of the State of Washington. Only for Hangman Creek is there an inventory of fish life based on a scientific sampling (Laumeyer and Maughan, 1973.).

For this study, the following discussion of fishery resources on a stream by stream basis, was prepared by Dr. Max Katz, based on personal communications with Don Earnest, retired fisheries biologist.

Spokane River

Mouth to Little Falls Dam

The lower Spokane River from Little Falls Dam to its confluence with Roosevelt Lake, especially around the campground at Porcupine Bay, maintains a small but productive fishery for walleye pike and large mouth bass. The principal fishery is for walleye pike which takes place in the late spring and early summer. Bass are taken mostly as an incidental fishery.

Little Falls Reservoir

In the reach between Little Falls Dam and Long Lake Dam, the major species are carp and suckers which are not fished. There is no access for boats.

Competent observers have reported small numbers of kokanee trying to ascend Long Lake Dam which has no fish ladder. There are sufficient fish each year to attract about ten eagles which feed upon them during their futile effort to migrate upstream. There is nothing known about this

kokanee population except the presence of the adults. The origin and potential for development as a fishery are matters of speculation.

Long Lake Reservoir

Long Lake Reservoir, which extends almost to the foot of Nine Mile Dam, provides a productive sports fishery for perch, black and yellow bullhead, large mouth bass, crappies, bluegill, pumkinseed, and green sunfish. All of these species have been introduced into the watershed. These fish species have grown in sufficient number and size to be attractive to enough sportsmen to support four small resorts on the lake.

Long Lake also has a population of large carp which are said to attain a weight of 35 pounds. In addition, the following cyprinids are abundant: tench, chiselmouth and peamouth chubs.

Nine Mile Dam and Spokane Dam

The section from Nine Mile Dam to Seven Mile Bridge, about four river miles, had received raw sewage from the City of Spokane up to 1958 and since that date has received primary treated sewage effluent. There is no fishery in this reach of the river.

From the Seven Mile Bridge through the State Park and Bowl and Pitcher areas to Monroe Street is a pool and riffle area with a good potential for fish productinn. At present, the population is comprised of squawfish, suckers and chubs. There are also some large rainbows which are believed to be derived from upstream populations. Brown trout, which can tolerate water quality conditions that cannot sustain rainbows,

have been planted in this area by the Game Department. It is believed that they cannot get upstream through the power dam barriers to become competitors with the desirable upstream rainbow populations.

There are two falls on the Spokane River which are utilized by Washington Water Power Company as hydroelectric sites. The lower falls are at Monroe Street and the upper falls are at Division Street. Between Division Street and Spokane Dam, the Spokane River is a pool and riffle area with a fair trout population. The fishing pressure in this area is light and is restricted to fishermen who live adjacent to the area.

Spokane Dam to Stateline

From above Spokane Dam to the vicinity of Millwood, there is no active fishery. From Millwood to the Idaho Boundary, the stream is a free-flowing pool and riffle area. Throughout this reach, the summer flow of the river is augmented by significant inflow of ground-water which lowers the temperature of the river by about 10 degrees to that suitable for the rainbow trout found in this section.

Little Spokane River and Tributaries

Little Spokane River, Mouth to branches

Before construction of Grand Coulee Dam, the Little Spokane was a spawning stream for chinook salmon. Today the Little Spokane River from its confluence with the Spokane River to the mouth of Deadman Creek is a pleasant, meandering stream inhabited primarily with non-game species such as carp, squaw-fish and suckers. The stream topography is comprised mostly

of long pools with little current separated by riffles.

Up to the junction of the East and West Branches of the Little Spokane, non-game species predominate. There are some large trout to be found in the riffles where the current velocity is greater than average, but the stream is not regarded as a productive or attractive trout stream. Furthermore, the lower section of the Little Spokane River is closed by property owners to trespassing fishermen.

East Branch

From Chain Lakes downstream non-game species continue to be predominant. Above the Chain Lakes are impassable falls. The East Branch above Chain Lakes is dry in many sections during the summer. In the few sections of the stream which are fed by springs, Eastern brook trout persist.

Before Grand Coulee Dam and other dams were built, Chain Lakes had a sockeye salmon population which is believed to have developed into a small residual population of kokanee.

West Branch

The West Branch of the Little Spokane River has a series of small lakes as part of the river system. The stream below Eloika Lake is populated by small spiny ray species derived from the lake. The population of the lake is dominated by black bass, small perch, crappie and sunfish. The principal sport fishery in Eloika Lake is a fairly productive one for bass.

Above Eloika Lake to Horseshoe Lake, the stream is not very accessible, It is characterized by slow flowing waters through swamp

areas. The little fishing done there yields spiny ray fish.

Above Horseshoe Lake to Trout Lake, the stream is interrupted by a series of beaver ponds which are inhabited by Eastern brook trout. The stream in general is quite inaccessible. Where it can be reached it yields good Eastern brook trout fishing.

Horseshoe Lake is a deep lake to which kokanee have been introduced. This population reproduces and is self-sustaining.

Trout Lake is inhabited by spiny ray species, principally sunfish, bass and bullheads.

Deadman Creek (Peone Creek)

Deadman Creek is a small stream with a sparse population of small rainbow trout which is not utilized as a fishery except by juveniles. The State Department of Game does not usually plant streams but restricts its efforts to lakes from which the returns to the fishermen are better. Hence, the trout populations in the streams, whenever present, are necessarily self-sustaining and recruitment is by natural spawning and from fish that migrate out of the planted lakes.

Dragoon Creek

Dragoon Creek at one time had an excellent trout fishery which has been lost due to the change in character of the watershed brought about by logging and the replacemett of forest by agricultural land. After the land was logged off, the land was developed for dry alfalfa farming and dairying. Although there are still spawning areas on Dragoon Creek, the agricultural land use patterns do not provide an environment conducive to the maintenance of an optimum trout habitat. Today the lower portions of

Dragoon creek are inhabited principally by bridge lip suckers.

The small tributaries of Dragoon Creek, especially in the areas with beaver ponds, have populations of Eastern brook trout. Witney Creek and Mud Creek, which are above Deer Park, have good populations of Eastern brook trout as do Spring Creek and Frog Creek.

Upstream from Trout Lake, the stream is interrupted by beaver dam ponds that hold Eastern brook trout.

Between Trout Lake and Sacheen Lake the stream is interrupted by a barrier dam. Sacheen Lake has been stocked with Eastern brook trout but it still contains green sunfish which the State Department of Game's Lake Rehabilitation program has not been able to eliminate. The green sunfish compete with the larger trout for food and feed on the smaller salmonids.

Tributary to Sacheen Lake is Moon Creek with an Eastern brook trout population.

Deer Creek

Deer Creek, which flows into the Little Spokane just above Dragoon Creek, is a very small creek which is dry in its lower section during the summer. It has a remnant population of small rainbows in its headwaters.

Hangman Creek

Hangman Creek is the only stream in the study area which has been the subject of a scientific inventory of its fish population. The results of this study which sampled eight locations from Spokane to Tensed, Idaho, are reported by Laumeyer and Maughan (1973).

The information below is abstracted from this reference.

Hangman Creek (Latah Creek) flows into the Spokane River near the west boundary of the City of Spokane. Although at one time this stream had produced salmonids, it had been degraded by the turn of the century.

During the warm months the stream is dry in its downstream stretches. It drains wheat and grain land and is characterized by extreme water fluctuations. During the rainy season, the stream becomes extremely turbid and contributes large amounts of silt to the Spokane and Columbia Rivers. In the summer, the portion of the stream that still contains water is composed of long still pools. The collected samples from eight locations yielded eight native and two introduced species of fish.

The fish commonly found throughout were primarily speckled dace, chiselmouth, redside shiner and squawfish. Less abundant were bridgelip suckers, longscale suckers, torrant sculpin, and brown bullheads. Rainbow trout and tench were uncommon. Rainbow trout were found only at the station near Tensed, Idaho.

The sampling also yielded freshwater clams (Anodonta californiensis) a spotted frog (Rana pretiosa) and a crayfish (Pacifastacus klamathensis). Two species of the clam Anadonta had been reported previously from this creek by Henderson in 1929.

Chamokane Creek

Chamokane Creek is the first fish-producing stream upstream from the confluence of the Spokane with Roosevelt Lake. It discharges into the Spokane Rimer above the Little Falls Dam and forms the eastern

boundary of the Spokane Indian Reservation.

This section of Chamokane Creek from its confluence with Little Falls Dam Reservoir to the Chamokane Creek Falls has a population of carp and suckers and is not utilized for recreational fisheries. Above the Chamokane Creek Falls to Ford, the stream is excellent water for brown trout, rainbow trout and some Eastern brook trout. It is managed by the Spokane Indians and entrance to the fishery is restricted.

The State of Washington Department of Game operates a trout hatchery at the town of Ford. The hatchery was built by the Bureau of Reclamation to compensate for the losses of fish resulting from the construction of Grand Coulee Dam. The hatchery, which is supplied by springs, produces rainbow and Eastern brook trout which are planted in the lakes and streams on the reservation. McCoy Lake on the Reservation in particular is the recipient of large Eastern brook trout, plants from Ford Hatchery.

The springs, which are the major water supply of the creek, are above the hatchery. Above the springs, the stream is intermittent and provides habitat for cyprinids and other nonsport species. The State Department of Game has little control over the Indian fish management policy in regard to Chamokane Creek and had therefore little information on the current fish resources of the upper watershed.

Other Tributaries of the Spokane River

Sand Creek is on the Spokane Indian Reservation. It is not a fish resource because it is an intermittent stream which is dry during the warm months. This stream is under the control of the Tribal Admini-

stration, and the management policy is unknown.

Deep Creek and Coulee Creek

Deep Creek, which enters the Spokane River above Nine Mile Dam is intermittent in its low end. In its upper reaches, there is a small trout population and some fishing occurs. The watershed has been extensively manipulated by man and is heavily ditched. It is subject to extreme fluctuations in level.

Coulee Creek joins Deep Creek about a mile above its confluence with the Spokane. Coulee Creek is a small stream that during the summer is dry at its lower end. This creek, although permanent in its upstream stretches, no longer has a trout population nor any other significant fishery. The only fish remaining are dace.

Summary

The occurence of various species is summarized in Table 1 by general location.

The correspondance between common and scientific names is shown in Table 2. Figure A illustrates the streams named throughout this section.

TABLE 1

SUMMARY OF SPECIES OCCURRENCE

No.	Location	Species
1	Spokane River mouth to Little Falls	Walleyed pike, large mouth bass.
2	Spokane River in Little Falls Reservoir	Carp, suckers, kokanee.
3	Spokane River in Long Lake Reservoir	Perch, black and yellow bullhead, large mouth bass, crappies, bluegill, pumpkinseed, green sunfish, carp, tench, chisle mouth, peamouth, chubs.
4.	Spokane River, Bowl and Pitcher to Falls	Brown trout.
5.	Spokane River, Millwood to Idaho Line	Rainbow trout.
6.	Chamokane Creek above Falls	Brown trout, rainbow trout, Eastern brook trout.
7.	Little Spokane River, mouth to branches	Carp, squawfish, bridgelip suckers.
8.	West Branch of Little Spokane above Eloika Lake	Black bass, perch, crappie, sunfish.
9.	Dragoon Creek, upper reaches	Eastern brook trout.
10.	Hangman Creek mouth to Tensed	Speckled dace, chislemouth, redside shiner, squawfish, bridgelip suckers, longscale suckers, torrant sculpin, brown bullhead.

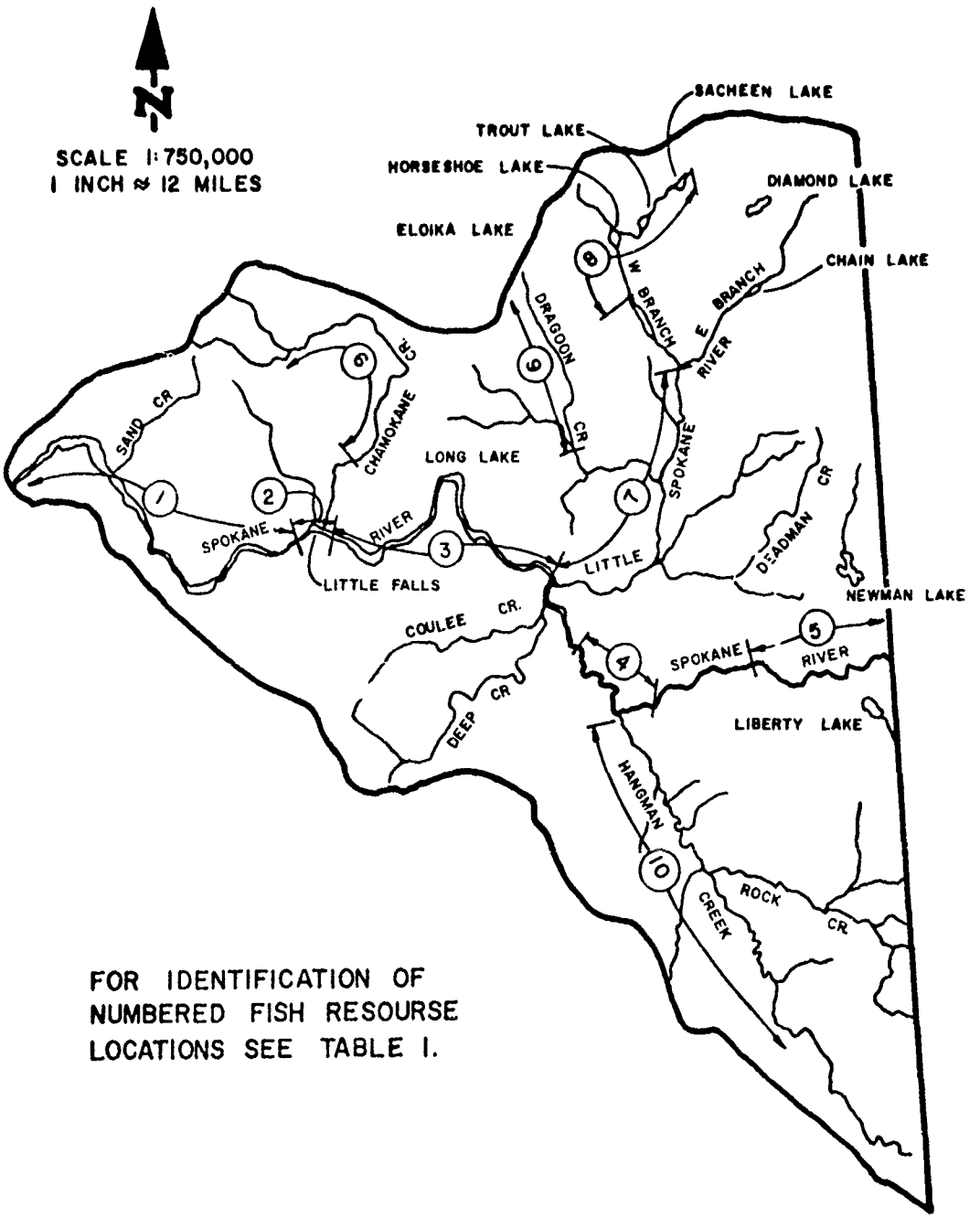
TABLE 2

SPECIES LIST

Common Name	Scientific Name
Black bass	Micropterus salmoides
Black bullhead	Ictalurus melas
Bluegill	Lepomis macrocheilus
Bridgelip sucker	Catostomus columbianus
Brown bullhead	Ictalurus nebulosus
Carp	Cyprinus carpi
Chiselmouth	Acrocheilus alutaceus
Crappies	Promoxis nigromaculatus
Eastern brook trout	Salvelinus fontinalis
Green sunfish	Lepomis cyanellus
Kokanee salmon	Onchorhynchus nerka
Large scale sucker	Catostomus macrocheilus
Peamouth chubs	Mylocheilus caurinus
Pumpkinseed	Lepomis gibbosus
Rainbow	Salmo gairdneri
Redside shiner	Richardsonius balteatus
Speckled dace	Rhinichthys osculus
Squawfish	Ptychocheilus oregonesis
Tench	Tinca tinca
Torrant sculpin	Cottus rhotheus

SPECIES LIST (continued)

Common Name	Scientific Name
Walleye pike	Stizostedion vitreum
Yellow bullhead	Ictalurus natalis
Yellow perch	Perca flavescens



FOR IDENTIFICATION OF NUMBERED FISH RESOURSE LOCATIONS SEE TABLE I.

WATER RESOURCES STUDY METROPOLITAN SPOKANE REGION Dept. of the Army, Seattle District Corps of Engineers Kennedy - Tudor Consulting Engineers	FISH RESOURCE LOCATIONS	FIGURE A

315.51-14

LIST OF REFERENCES

Laumeyer, P.H. and Maughan, O. 1973. Preliminary inventory of Fishes in Hangman Creek. Northwest Science. Vol. 47, No. 1

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SECTION 315.52

ANIMAL AND BIRD RESOURCES

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 315.52

ANIMAL AND BIRD RESOURCES

Prepared by Max Katz, Ph.D., Seattle Marine Laboratories
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2 May 1974

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

INDEX

ANIMAL AND BIRD RESOURCES

ANIMAL AND BIRD RESOURCES

Game Animals

The principal big game animal species of the Spokane River area are mule deer, whitetail deer and bear. Elk and moose have sometimes been reported in the area but they are not present in sufficient numbers to be hunted. Mule deer are limited to portions of Lincoln and Stevens Counties that are closest to Roosevelt Lake and west of the line dividing Lincoln and Spokane Counties and west of Chamokane Creek. In Spokane and Pend Oreille Counties whitetail deer are the only species taken by hunters.

In general, mule deer are characteristic of the open western ranges. They can tolerate dry conditions and will be found in the higher altitudes. In areas where there are both whitetail and mule deer populations the mule deer restrict the whitetails to the lower elevations.

The whitetail deer of the Spokane area are part of the Coeur d'Alene herd. They favor the lower elevations and adapt very well to the river valley situations. Unless inhibited by mule deer populations, they will go into the higher elevations.

An estimate of the average annual big game (deer and bear) harvest is presented in Table 1 for the various geographical areas in the Spokane River basin. These figures were furnished by Mr. Stanley Guenther, retired Washington State Game Biologist, and were derived from many years of Game Department records. They are based on average

hunter harvest during years with controlled seasons on antlerless (either sex) deer. Such seasons are normal and are established annually except during years of extremely low deer populations (following high losses in winters, etc.).

These statistics indicate that the best yield per square mile is in Stevens County in the Chamokane Creek area. Average kills per square mile are obtained in Lincoln County, Spokane County and in the upper Little Spokane River drainage in Pend Oreille County. The best bear area is in the upper Little Spokane River drainage. The least productive areas are in the Latah Creek area and the Saltese and Liberty Lake Basins of Spokane County.

Small Animals

In addition to the big game animals, muskrat, mink, beaver, racoon, otter and bobcats are present in varying numbers in the study area. Fur-bearing animals are generally abundant throughout the entire Spokane River watershed with numerical fluctuations resulting from environmental conditions. A brief resume of these animals is as follows:

Muskrats. This omnivorous animal is best suited to lakes, ponds, sloughs, and slow-moving streams. It eats flesh when available, but is dependent upon vegetation for its food. Muskrats are very numerous in Hangman (Latah) Creek and the Little Spokane River. Lakes and ponds within the entire Spokane River watershed generally support good muskrat populations. However the Spokane River itself contains few.

This is probably due to the fluctuations of water levels which are very detrimental to muskrats.

Mink. These predators are found throughout the study area in good numbers. Their nature precludes abundance. Here, too, the numbers are reduced where muskrat populations are low or lacking since mink use muskrats as a major food source. This is especially so where no other food supply is abundant. The muskrat population limits the mink population.

Beaver. This species is very common, but is most abundant in the Little Spokane River system. Here they are so numerous as to be a nuisance in many places by causing the flooding of hay and pasture lands, and by cutting ornamental plants in recreational areas. Virtually all of the Little Spokane River drainage basin has thriving colonies of beaver. Hangman (Latah) Creek supports many beaver in spite of its widely fluctuating flows and smaller food supplies. Beaver inhabit the Newman Lake watershed. At present, few are found along the main stem of the Spokane River.

Racoon. These agressive creatures are abundant throughout the entire area.

Otter. Very rare.

Bobcat. Very limited, both in numbers and distribution, being most numerous in the high country between Chamokane Creek and Loon Lake.

Aquatic Game Birds

The migratory aquatic game bird population of the Spokane area has declined in recent years due to a shift in the migratory path. The development of the extensive irrigated croplands in the Columbia Basin after World War II has provided an alternative area with greater food supply and more favorable weather conditions than the old flyway located east of Spokane. In addition, the changing agricultural practices in the Spokane area have reduced food availability. The migratory fowl have taken advantage of this more favorable alternative with the result that only about 10 percent of the former population now visits the Spokane area.

The principal resting area for water fowl is Long Lake. From Long Lake the ducks disperse to feed. There are some minor numbers of water fowl in the Chatteroy area of the Little Spokane valley. Birds here are primarily mallards and teal. The Saltese Flats east of Spokane have some mallards. The 1972 harvest of ducks and geese were 12,980 and 580 respectively for Spokane County according to the status report of the State Game Management Division.

Upland Game Birds

The predominant upland game bird of the Spokane region is the ruffed grouse which is found primarily in forests in the earlier stages of regrowth after logging or fire. The ruffed grouse is also found in the wooded creek bottoms. This species is found primarily along the northern slopes of the watershed in a band which extends al-

most to Roosevelt Lake to and into Idaho. Ruffed grouse are also found in the higher forested elevations along the Idaho border. The Newman Lake area is regarded as the best ruffed grouse area. The Spokane County harvest in 1972 was 11,190 grouse.

At one time there were substantial populations of pheasants in the agricultural areas, but these populations have been severely reduced by the new methods of intensive agriculture which have removed their habitats and almost eliminated their food supplies. Current methods of agricultural land use have greatly reduced the undeveloped marginal area which provided cover. The introduction of wheat varieties with greater resistance to stalk breakage by the wind has reduced the availability of food from fallen heads. At present, there are a few pheasant on the upper Hangman Creek area near Fairfield. Some Hungarian Partridge, which have similar food and cover requirements to the pheasant, can be found in the Hangman Creek area in the vicinity of Spokane. The populations of Hungarian Partridge are affected by the same agricultural practices that affect the pheasant. The Spokane harvests of pheasant and Hungarian Partridge were 7,810 and 2,250 respectively.

Significant numbers of quail, 5,530, and dove, 23,160, are also taken in Spokane County.

TABLE 1

ESTIMATED ANNUAL HARVEST OF MULE DEER, WHITETAIL DEER AND BEAR IN THE STUDY AREA

Area Description	Composition of Harvest	Square Miles	Kill per Sq. Mile	Total Kill
Lincoln Co.-River-mouth to Spokane Co.	70% mule deer 30% WT deer Bear	216	1.2	260 2
Stevens Co.*-Chamokane Creek Drainage	5% mule deer 95% WT deer Bear	135	2.5	240 5
Spokane Co.-South Side from County Line to Latah Cr. (Coulee Cr. and Deep Cr.)	all WT deer Bear	120	1.7	200 0
Spokane Co.-Little Spokane River	all WT deer Bear	480	1.5	720 0
Pend Oreille Co.-Upper Little Spokane River	all WT deer Bear	180	1.5 0.2	270 33
Spokane Co.-Newman Lake Basin	all WT deer Bear	60	1.5	90 5
Spokane Co.-Latah (Hangman)Creek	all WT deer Bear	490	0.6	295 3
Spokane Co.-Saltese & Liberty Lk. Basin	all WT deer Bear	40	0.4	16 0
	TOTAL DEER.....			2,091
	TOTAL BEAR.....			48

Source: Personal communication from Stanley Guenther.

*Does not include Spokane Indian Reservation for which no kill figures are available. This is, however, excellent deer country with a very high population of these animals.

TABLE 2

COMMON AND SCIENTIFIC NAMES OF BIRDS
AND ANIMALS IN THE SPOKANE BASIN

Animals

Bear, Brown	Euractos middendorffii
Beaver	Castor canadensis
Bobcat	Lynx rufus
Deer, Mule	Odocoileus hemionus
Deer, Whitetail	Odocoileus virginianus
Elk	Cerus canadensis
Mink	Mustela vison
Moose	Alces alces
Muskrat	Ondatra zibethica
Otter	Lutra canadensis
Rabbit	Lepus, Sp. Sylvilagus idahoensis
Racoon	Procyon lotor

Birds

Chuckar	Alecporis graeca
Duck, Mallard	Anas Platyrhynchus
Dove	Zenaidura macroura
Geese, Canadian	Branta Canadensis
Grouse, Ruffed	Bonasa umbellus
Partridge, Hungarian	Perdix perdix
Pheasants, Ring Necked	Phasianus Colchicus
Pigeons	Columba sasciata
Quail	Lophortyx californicus
Sage Hen	Typanuchus cupido
Snipe	Capella gallinago

SECTION 315.6

ATMOSPHERIC CONDITIONS

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 315.6

ATMOSPHERIC CONDITIONS

20 March 1974

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

INDEX

ATMOSPHERIC CONDITIONS

Introduction

Air, land, and water are the three fundamental components of our environment. Although this study is primarily concerned with water resources, it is essential to recognize the intrinsic interdependence of these fundamental components within the Spokane River Basin. Just as land and water do not exist in inexhaustible supplies, neither does the air we breathe.

Two agencies have a primary role in monitoring and managing the atmospheric resources of the Spokane River Basin. The material which follows relies heavily upon the published reports and documents from these agencies - The Spokane River Basin Depollution Policy Committee (DPC) under the auspices of EXPO '74 and the Spokane County Air Pollution Control Authority (SCAPCA). The scope of the latter agency's interest is confined to airborne pollutants within the area of Spokane County; the Policy Committee's purview extends throughout both the Washington and Idaho portions of the basin, and to all environmental conditions (including noise) having an effect upon the quality of human life.

Sources of Atmospheric Pollution

Within the study area of about 2,290 square miles, the metropolitan area centered on Spokane occupies approximately 266 square miles and forms the focus of industrial, commercial and transportation activity.

Almost half of the non-urban land within the study area is used for agriculture, wheat, peas, lentils and barley are predominant crops; the remainder is undeveloped land including a portion in forest, which supports a minor logging and wood products industry.

In the course of a review of basin-wide environmental problems, the Technical Committee of the EXPO '74 Spokane River Basin D P C compiled an estimated inventory of the annual air pollutant load in the "Spokane region", which roughly corresponds with the study area. A summary is given in Table 1, indicating an annual output totaling in excess of 200,000 tons (equivalent to 550 tons per day) of which nearly 2 percent consists of particulates; the remainder gasses. Industry, agriculture, and transportation each contribute to the pollutant load, but "mobile sources", in other words, vehicles, account for one-fifth of the particulates estimated, and over 25 percent of the gaseous pollutants. Industry is responsible for only 3 percent of the regions air pollution, but this amount includes half of the particulate emissions and virtually all the sulfur oxides. A complete estimate of agriculture's contribution has not been made; although the particulate load from grass burning has been estimated, windborne dust from cultivation and fallow land is of unknown quantity.

Dispersion of Pollutants

On an average day, the 550 tons of gaseous and particulate air pollutants emitted from all sources in the study area are dispersed throughout an area of 2,290 square miles and beyond. The quantity of pollutant to which an individual may be exposed varies according to the location within the region, and meteorological conditions.

The Spokane River basin is a natural gathering place for low-lying masses of warm air that trap pollutants in the phenomenon known as inversion. On some days, high winds and unstable atmospheric conditions may disperse even the heaviest blanket of pollution. On other days, however, weak winds and stable atmospheric conditions allow pollutants to accumulate in serious quantities. Between these extremes, weather conditions create variations in pollutant concentrations. (Spokane River Basin Policy Committee, Appendix p. 144, 1972.)

Some indication of actual pollutant concentrations experienced has been obtained in recent years from a program of air sampling and monitoring in the study area. The program has been an inter-agency effort, involving the Spokane County Air Pollution Control Authority (SCAPCA), the Washington State Department of Ecology and the Federal Environmental Protection Agency. Information regarding the findings of the program has been taken from the Annual Reports of SCAPCA for 1971 and 1972.

Permanent sampling stations are located at Spokane City Hall, Gonzaga University (Spokane), and in Turnbull Wildlife Refuge near Cheney. The latter station is chosen to indicate background levels upwind of the Spokane metropolitan area. In addition, a limited number of "grab samples" have been obtained throughout the study area for determination of carbon monoxide (CO) concentrations, by the State Highway Department, and airborne particulates have been measured in samples from a number of locations throughout the region.

Some pollutants have been studied more intensively than others. Published information on observed concentrations of sulfur oxides, nitrogen oxides (nitrogen dioxide) and oxidants is limited to the summary in the

Appendix to the Spokane Basin Policy Committee report of 1972. Hydrocarbon concentrations have not, apparently, been measured, although it is possible to draw some inferences regarding probable concentrations, based on the observations of other automotive pollutants. Table 2 summarizes the range of published information collected by the various agencies active in the field. The observed concentrations may be compared with the National Ambient Air Quality Standards, promulgated by the (Federal) Environmental Protection Agency listed in Table 3. The standards have been designated primary and secondary. Primary standards are to be achieved by 1976; secondary standards are to be attained eighteen months later.

Particulates

Observations at 4 out of 7 of the locations monitored indicate concentrations in excess of the primary ambient air quality standard of 75 ug/m^3 annual geometric mean. By this measure, particulate matter is the most serious air pollution problem at this time. High particulate concentrations may be a contributing factor to the incidence of such chronic diseases as emphysema, bronchitis, and other respiratory ailments. Aschetically, particulate concentrations are of concern because they soil the environment.

Seasonal fluctuations of particulate concentration were documented for 1970 (Spokane River Basin Policy Committee, Appendix p. 146, 1972). The pattern observed showed below average concentrations during November-January and above average concentrations in August and September. In that year, the two highest 24 hour average concentrations observed at Spokane City Hall were 472 ug/m^3 on September 22 and 282 ug/m^3 on August 28, com-

pared with the annual geometric mean of 89 ug/m^3. This observation of peak occurences in late summer contrasts with that observed for carbon monoxide. In the latter case, stable atmospheric conditions (inversion) occuring in the winter months give rise to observed maximum concentrations during the period October - January. The peaking pattern demonstrated by the particulate concentrations in 1970 probably reflects the influence of field burning. This appears to be verified by SCAPCA's observations in 1971, showing that particulate concentrations are usually lower on Sundays, but higher on Saturdays, during the critical period.

Other activities within the metropolitan area and the Spokane Central Business District (CBD) are obviously also contributors to the atmospheric particulate load. Examination of the recorded concentrations at different sites throughout the urban area show a pattern of higher concentrations northeast (or downwind under prevailing conditions) of the CBD. On the upwind fringe of the metropolitan area, at the international airport and the water tower 33rd and Lamont, particulate concentrations approaching those experienced in the Turnbull Wildlife Refuge are encountered. (SCAPCA Annual Progress Report, 1972)

Carbon Monoxide

This pollutant has also been the subject of fairly extensive monitoring efforts. Observations at Spokane City Hall are used as the basis for the comments which follows, but it should be noted that observations have also been made elsewhere, at locations where lower concentrations are generally encountered.

As mentioned above, the highest ambient concentrations of CO

occur during the winter months, reaching 15-20 ppm (8 hour average) at City Hall. This level is 2 times that of the National Ambient Standards, and is considered to have a significantly deleterious effect upon the " vital capacity" of persons exposed to it (SCAPCA Annual Progress Report, 1972). Even during the months when atmospheric conditions permit more efficient dispersion (April through August), ambient CO levels observed at City Hall lie in the range of 8-11 ppm (8 hour average) and these are on the borderline of acceptability.

The estimates in Table 1 identify mobile sources as the predominant origin of CO emissions. This is borne out by the pattern of observed diurnal fluctuations in CO concentrations, reported in SCAPCA's Annual Reports. On work days, peak concentrations are observed at 4-5 PM, and are sustained at low values during the period 8PM - 6AM. It is significant, also, that on Sundays, year-round, the maximum 8 hour concentrations of CO in 1971 never exceeded 5 ppm.

There is some indication that the occurrence of high CO concentrations may be a very localized phenomenon. The City Hall sampling point is 12 feet above street level at the corner of Trout and Wall Streets in Spokane. Observations in 1971 at Gonzaga showed maximum concentrations of 6 ppm CO, compared with 9-14 ppm observed at City Hall. This is in contrast with the observation of particulate concentrations at Gonzaga which, due to Genzaga's location downwind of the CBD, were one-and-one-half to two times those observed at City Hall during a comparable period. For a more detailed analysis of the areal dispersion of CO in the Spokane urban area, reference would have to be made to the findings of the Washington State Highway Department and the Federal EPA.

Hydrocarbons

No measurements of hydrocarbon concentrations have been made within the study area.

Nitrogen Oxides (NO_x)

The annual average concentration reported for one sampling station in 1970 indicates a concentration of nitrogen dioxide (NO_2) 15 percent below the Federal Standard. No published information is available to evaluate the existing condition at other locations, or whether changes in the ambient NO_x level have occurred since 1970.

Photochemical Oxidants

The observed concentration of "Total Oxidants" at Spokane City Hall is comparable with that of NO_2 during the 1970 period. As in the case of the nitrogen dioxide measurements, the observed levels are below those mandated by the Federal Standards. The major significance of photochemical oxidants is their role in creating photochemical smog by interacting with hydrocarbons in the atmosphere. The relatively low oxidant levels encountered indicate that this is not likely to contribute to a significant pollution problem.

Sulfur Oxides

Observations in 1970 indicated that concentrations of sulfur oxides measured at Spokane City Hall are less than the Federal secondary standards for a 24 hour averaging period and substantially (13 vs 60 ug/m^3) below the annual arithmetic mean called for in the secondary standards. Comparison with the observed areal distribution of airborne particulates suggests that City Hall may not be the location at which maximum concentrations of industry-related sulfur oxides are experienced. However, the generous margin of compliance observed, coupled with the effect of local regulation of emissions from stationary sources since 1970, indicates that sulfur oxide concentrations are within acceptable limits.

Air Quality Control Standards

In addition to ambient air quality standards, air quality control standards have been established. The control standards consist of laws, local ordinances, and regulations designed to prevent new pollution as well as to achieve the air quality standards. Within the Spokane Basin, the primary agency responsible for monitoring the enforcing the standards is the Spokane County Air Pollution Control Authority (SCAPCA).

The air pollution control program in Spokane County has been in effect since 1963. The SCAPCA Board of Directors has established policies

which have brought about reductions in both visible and particulate emissions. Completion of compliance schedules has resulted in a calculated reduction of particulate emissions of over 200 tons/month in 1972, equivalent to a reduction of particulate emissions from stationary sources of more than 66 per cent.

This improvement has come about from the implementation of regulations adopted by SCAPCA. Under Regulation I, which imposed standards for visual pollutants, a significant reduction in the number and intensity of visible plumes within Metropolitan Spokane has been achieved. Most space heating visible emissions violations have been corrected by improvement and/or adjustment of equipment. In some instances it was necessary to change fuel or install a new heating unit.

Regulation II was fully implemented during 1972. This regulation established particulate emission levels of 0.1 grain per standard cubic feet per minute for combustion and non-combustion sources. In Spokane County, compliance programs were developed with many different types of sources such as seed and feed processing, asphalt batch plants, materials handling operations and combustion sources. Under Regulation II, all incinerators are now required to have some type of emission gas scrubbing device. Compliance programs have necessitated the conversion from coal to oil or gas for several commercial or industrial heating units. From June 1969 through 1971, approximately 620 waste burners were sealed, and the resultant waste recycled or taken to sanitary landfills. (Spokane County Air Pollution Control Authority, p. 4., 1971.) A significant increase in solid wastes has been the result. Some concern has been

expressed that as a result, the Spokane Region may be facing a solid waste disposal problem. A few local industries are still in the process of bringing their operations into compliance with control standards. As they complete their compliance schedules, additional improvement can be expected.

The 1970 Amendments to the Clean Air Act required a 90 percent reduction from the then existing levels of auto hydrocarbons and carbon monoxide by 1975. The Amendments also called for a 90 percent reduction of exhaust nitrogen oxide levels by 1976. The effect of these measures in the Spokane Basin should be a significant reduction of the ambient carbon monoxide, hydrocarbon, and nitrogen oxide levels.

Although the federal, state, and local programs seem to be achieving their goal, air pollution control measures have not always been well received by the people. Local concern continues to be expressed with regard to air quality control measures that have been proposed and/or implemented. Measures proposed by the EPA to reduce the carbon monoxide levels within the central business district of Spokane have met stiff opposition.

The EPA proposals call for selective exclusion of cars from the downtown areas as well as limited parking in the central business district. Many local motorists as well as city officials have expressed their opposition to this proposal. Spokane City officials are working with the EPA to see if the city cannot implement a less disruptive program to reduce carbon monoxide levels. (Spokane Daily Chronicle, September 5, 1973.)

Measures designed to further reduce the particulate matter concentrations from non-combustion sources, including open burning and agricultural field burning, have also come under attack. The proposed amendment would prohibit open burning of field grass after the 1973 harvest as well as impose a 50 cent per acre fee for such burning this year. Opposition has expressed that this regulation would effectively eliminate the seed industry from the Basin. (Spokane Daily Chronicle, August 9, 1972.)

TABLE 1

ESTIMATED EMISSIONS IN THE SPOKANE REGION

(In tons per year)

(Base Year = 1971)

Pollutant Type	Source Type				
	Stationary Including Industry	Mobile	Solid Waste	Miscellaneous	Totals
Particulates	2,000	880	60	800*	3,740*
Carbon Monoxide (CO)	370	146,300	30	5,050	151,750
Hydrocarbons (HC)	200	24,500	110	400	25,210
Nitrogen Oxides (NO_x)	940	17,200	1	No Estimate	18,140
Sulfur Oxides	1,840	180	1	No Estimate	2,020
Aldehydes	70	50	--	--	120
Organics	---	20	--	600	620
Totals	5,420	189,130	200	6,850	201,600

* No particulates estimate available for agricultural activity

Source: Spokane River Basin Policy Committee, Appendix to Plan of Action p. 127 1972.

TABLE 2

OBSERVED AIR POLLUTANT CONCENTRATIONS

Spokane River Basin (Wash.) 1970 - 1972

Pollutant	Location & Date		Type of Observation (and averaging time)	Concentration ug/m^3	Concentration ppm
Particulates	Spokane City Hall	9-70	Maximum 24 hr. average	479	-
	Spokane City Hall	1970		89	-
	"	1972		82	-
	Crown Zellerback	1972		121	-
	Gonzaga University	1972		111	-
	Rogers High School	1972	Annual Geometric Mean	76	-
	33 & Lamont	1972		46	-
	International Airport	1972		32	-
	Turnbull Ref.	1972		21	-
Carbon Monoxide (CO)	Spokane City Hall	1970	Maximum 1 hr. average	(40,000)	35
	Spokane City Hall	1-70	Maximum 8 hr. average	(23,000)	20
		11-71		(20,000)	18
		10-72		(18,000)	16
	Gonzaga University	1970	Maximum 1 hr. average	(7,000)	6
		1970	Maximum 8 hr. average	(7,000)	6
Hydrocarbons (HC)	No records		-	(See Text)	
Nitrogen Dioxide	Spokane NASA	1970	Annual Arithmetic Mean	85	(0.04)
Photochemical Oxidants	Spokane City Hall	1970	Maximum 1 hr. average	(80)	0.04
Sulfur Oxides	Spokane City Hall	1970	Maximum 24 hr. average	(210)	0.08
			Annual Arithmetic Mean	(13)	0.005

Sources: Compiled from SCAPCA 1971 and 1972 Annual Progress Reports and Spokane River Basin DPC Plan of Action Appendix

TABLE 3

NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

Pollutants	Type of Standard	Averaging Time	Frequency Standard	Concentration ug/m^3	Concentration ppm
Particulate matter	Primary	24 hr	Annual maximum	260	--
		24 hr	Annual geometric mean	75	--
	Secondary	24 hr	Annual maximum	150	--
		24 hr	Annual geometric mean	60[c]	--
Carbon monoxide	Primary and Secondary	1 hr	Annual maximum[a]	40,000	35
		8 hr	Annual maximum	10,000	9
Hydrocarbons (nonmethane)	Primary and Secondary	3 hr (6 to 9 a.m.)	Annual maximum	160[b]	0.24[b]
Nitrogen dioxide	Primary and Secondary	1 yr	Arithmetic mean	100	0.05
Photochemical oxidants	Primary and Secondary	1 hr	Annual maximum	160	0.08
Sulfur dioxide	Primary	24 hr	Annual maximum	365	0.14
		1 yr	Arithmetic mean	80	0.03
	Secondary	3 hr	Annual maximum	1,300	0.5
		24 hr	Annual maximum	260[d]	0.1[d]
		1 yr	Arithmetic mean	60	0.02

[a]Not to be exceeded more than once per year
[b]As a guide in devising implementation plans for achieving oxidant standards
[c]As a guide to be used in assessing implementation plans for achieving the annual maximum 24 hour standard
[d]As a guide to be used in assessing implementation plans for achieving the annual arithmetic mean standard

Source: U.S. Environmental Protection Agency. A Mathematical Model for Relating Air Quality Measurements To Air Quality Standards, November 1971.

LIST OF REFERENCES

Spokane County Air Pollution Control Authority. 1972. Annual Progress Report.

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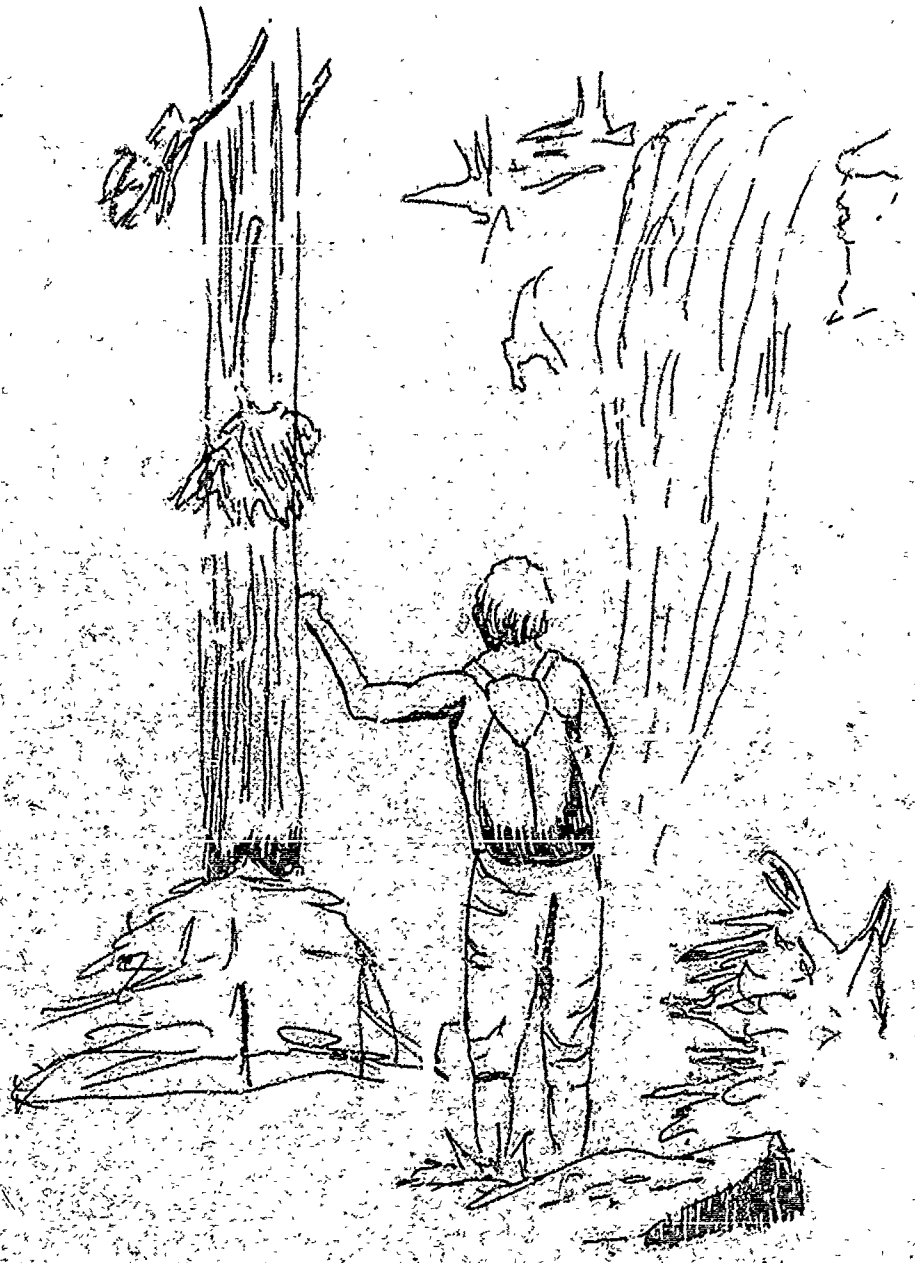

SECTION 316

EXISTING RECREATION FACILITIES AND OPEN SPACE POLICY

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 316

EXISTING RECREATION FACILITIES AND OPEN SPACE POLICY

25 April 1974

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

INDEX

All plates are large drawings bound at the end of this section.

EXISTING RECREATION FACILITIES AND OPEN SPACE POLICY

Introduction

The first objectives of this section are to create an inventory of all recreational facilities and features of the study area and to categorize these sites as to their primary orientation, that is, toward land or water related activities. The term "recreational" is used in a broad sense and includes not only the usual activities, such as hiking, picnicking, boating, swimming, etc., but also more passive uses and site values, such as scenic vistas and drives, boulevards, and landscape preserves. Also included in the broad definition of recreational use are the categories grouped under "conservation areas" such as forests, wildlife habitat, historical and cultural sites and areas of outstanding natural beauty.

The second objective of this section is to compile and summarize the open space policies of all public agencies having responsibility for land use within the study area.

These compilations of existing facilities and existing open space policies are required background for evaluation of alternative water and wastewater management plans both as to their impact on existing recreation facilities and goals and with regard to their potential enhancement.

Overview of Existing Facilities and Sites

The Washington Statewide Comprehensive Outdoor Recreation and

Open Space Plan (State of Washington, 1973) characterizes the recreation and open space facilities of Spokane County as follows: "Generally, the natural setting and open space is not of sufficient quality or quantity to attract outdoor recreationists from outside the district." Following this rather unflattering generalization, the report continues by pointing out the considerable unrealized potential of the area. This same report points out that a significant proportion of the recreational demands of the residents of the urban area, centered in the City of Spokane, are satisfied by facilities in adjoining areas, particularly northern Idaho and Pend Oreille and Stevens Counties in Washington.

Origin-destination studies of existing recreational travel have been made by the Interagency Committee for Outdoor Recreation. The results are shown in detail in Washington Statewide Comprehensive Outdoor Recreation and Open Space Plan, Volume I, 1973 (State of Washington). For the Spokane district, these data are summarized as follows: Of 23,971 Spokane residents registering as overnight guests in State parks, only 744 were at State parks in Spokane County, 7,145 were in adjoining districts; primarily those including Pend Oreille, Stevens and Lincoln Counties. The remainder were in more distant parts of the State. These studies also showed that District 12, Spokane, received only 1.5 percent of the State's overnight recreation visitors of which two thirds were from out of state.

A more eulogistic evaluation of Spokane's place in the area of recreation appears in the publication, Tourist Resources and Investment Potential by the State of Washington Department of Commerce and

Economic Development (1970). The following is quoted from that source:

> "Mount Spokane, numerous excellent fishing lakes, and the civic and cultural events of Metropolitan Spokane highlight the Spokane Region's tourist resources. Mount Spokane is among the state's most popular ski areas and boasts the longest illuminated night-skiing run in the United States. The ski area, located within the 20,771 acre Mt. Spokane State Park, offers skiers two chair lifts taking them up a 1,500 foot vertical rise slope.
>
> The Spokane Region has more than forty lakes, many exceeding 300 acres in size. Nearly all of the lakes have been developed for recreational use, and are well stocked with trout and a variety of spiny ray fish. Fishing, water skiing, pleasure boating, camping, swimming, and picnicking are among the most popular recreational activities offered at the various lakes.
>
> Spokane, Washington's second largest city, offers a variety of urban oriented recreational activities and cultural attractions for tourists. The city features seven excellent golf courses and a modern civic auditorium and sports arena which hosts a variety of spectator attractions. The Spokane public park system includes more than 60 parks, and the beautiful formal Duncan Gardens."

Considering the promotional purpose of the latter publication, a more correct evaluation of existing recreation facilities in Spokane is probably represented by the Comprehensive Outdoor Recreation and Open Space Plan and the origin-destination statistics. Although statistics, such as State park overnight guest registration data, indicate that a relatively small proportion of local and transient recreation demand is satisfied within the study area, there is a significant inventory of well used recreational facilities within that area.

All levels of government, from federal to local, as well as

private operations are represented among those providing recreational facilities and sites. Some of the most significant features provided by each of these agencies are summarized below. Refer to Plates 316-1 and 316-2 for locations of facilities. Refer to Table 1 for a summarization of areas in Spokane County devoted to recreational activities by agency and by type of facility.

Federal. There are only two federal recreation facilities in the study area, Coulee Dam National Recreation Area and Fort Spokane. A small portion of the Turnbull National Wildlife Refuge, south of Cheney, extends into the study area but most lies outside. The Turnbull National Wildlife refuge is owned in behalf of the Federal Government, by the Bureau of Sports Fisheries and Wildlife of the Department of the Interior and covers over 17,000 acres.

It is significant to note that there are no National Park or National Forest lands in the study area. The only large federally owned preserve in the study area is the Spokane Indian Reservation which occupies most of Stevens County within the study area.

The larger of the two federal facilities, the Coulee Dam National Recreation Area, consists mainly of Franklin D. Roosevelt Lake, the extensive impoundment of the Grand Coulee Dam, part of which is in the study area. Because of the large potential for water-based recreation, the lower reach of the Spokane River which has become an arm of the lake is the only site that attracts a significant number of people from outside the study area. Near its shores is the other federal recreation site, Fort Spokane, offering camp sites and access to the lake and serv-

ing a regional population.

State. At the state level there are two agencies providing recreational facilities. The Washington State Parks and Recreation Commission is responsible for three major and four small state parks. Riverside State Park, on the banks of the Spokane River, consists of over 77 acres including facilities for picnicking, camping, fishing and hiking within a few miles of downtown Spokane. Mount Spokane State Park, also in Spokane County, is an extensive park of over 20,000 acres dominated by the 5878 foot mountain, which offers a well developed ski area plus ample wilderness recreation. Pend Oreille State Park, in that county, offers picnicking, hiking and camping in a site of over 300 acres. The State's Department of Natural Resources maintains three small primitive camp and picnic sites in northern Spokane County at Dragoon Creek, Long Lake and Homstead. In addition, the Department of Natural Resources owns over 6,000 acres of land, mostly leased for grazing, on which hunting, fishing and hiking are permitted. These lands are scattered, some being in the vicinity of the Mount Spokane State Park.

County. Spokane is the only county which sponsors recreational facilities within the study area. The responsible agency is the Spokane County Parks and Recreation Department, most of whose 38 parks are in the suburban areas immediately north and east of the City of Spokane. Almost all are community or neighborhood parks, serving the local population. Two are golf courses, at Hangman Valley and Liberty Lake. Liberty Lake is also the site of the County's largest park, at 2930 acres, with facilities for swimming, boating, hiking and camping.

Cities. The City of Spokane is the most important municipal agency in the study area providing recreational facilities. The Spokane Park Board is the responsible department with jurisdiction over most of the City recreational facilities. There are over 50 in all, covering over 3,000 acres. Most of them typically include a playground, picnic area and some ballfields serving the local neighborhood and often associated with a school. Other types of frequently encountered City parks are wide landscaped boulevards with grassy areas for play, and scenic drives or linear parks associated with roadways or the Spokane River, such as High Drive, Cliff Park and Upriver Drive. Monito Park is one of the most important City pa s, covering 90 acres and including the Duncan Gardens and facilities for picnicking, softball and tennis. Other major recreational attractions which are used by the people throughout the urbanized area include Albi Stadium, for football and rodeos, the 62 acre Finch Arboretum, the 129 acre Indian Canyon Park associated with the golf course, the Interstate Fairgrounds and Baseball Park, the 50 acre Lincoln Park, the nearly 40 acre Minnehaha Park, and the 40 acre Shadle Playfield and Pool, all three with ballfields and tennis, and the Spokane Coliseum. The City also maintains three golf courses, Downriver, Esmeralda and Indian Canyon with a combined 540 acres.

The only other community with significant recreational sites is the town of Tekoa in Whitman County, which administers five facilities including two City parks, two school playgrounds and a 34 acre golf course.

Private. Several private recreational facilities are found in the study area, primarily in and around the City of Spokane and in southern Pend Oreille County. Many of these, in both areas, are small private resorts where guests can swim, launch a boat or picnic at small lakes. The others are mostly private golf courses in the Spokane urban area, such as Manito Country Club, Sundance and Wandermere Lake.

Detailed Inventory

A detailed inventory of recreational facilities in the study area is shown in Table 2. Locations are shown on Plates 316-1 and 316-2.

Table 2 lists more than 130 facilities together with the most significant types of activities available at each. Table 2 includes 3 federal, 10 state, 62 municipal, 38 county and 23 private facilities.

Not included in Table 2 are many of the numerous historical and cultural sites compiled by the Spokane Metropolitan Area Transportation Study in their Historical and Cultural Site Inventory (SMATS, 1970). Reference should be made directly to this document for the 258 listings.

The Interagency Committee for Outdoor Recreation has compiled a public recreation lands inventory for the entire State. The summary of this inventory for District 12, Spokane County, is shown in Table 1.

Another approach to inventory and overall classification of

recreational facilities is found in Appendix XIII, Recreation of the Columbia-North Pacific Region Comprehensive Framework Study (Pacific Northwest River Basin Commission, 1971). This document shows that the study area has only 6 class II and 5 Class VI facilities. The definition of classes is paraphrased as follows:

Class II: General Outdoor Recreation Areas typified by areas with facilities for camping, boat launching, winter sports, lake frontage, etc.

Class VI: Historical and Cultural Sites of national, state or local interest.

This same publication maps adjoining Pend Oreille County in Washington and Boundary, Bonner, Kootenai and Benewah Counties in Idaho which all have a relative abundance of these same and other classes of sites including Class III--Natural Environment; potential national rivers; and designated scenic routes.

Water Oriented Activities. The inventoried recreational activities in the study area as shown in Table 2 are categorized into water oriented and land oriented. The primary water-oriented activities listed are swimming, wading, boating and fishing. Opportunities for swimming are about equally divided between public pools and the small national lakes. The pools are primarily associated with Spokane City parks. Some of the lakes, such as Silver Lake, Clear Lake, Liberty Lake and Newman Lake are in Spokane County and the rest are in Pend Oreille County, including Diamond Lake and Sacheen Lake. Wading pools often supplement public swimming pools and are concentrated in the Spokane City parks.

Almost all of the area's boating activity takes place in the

small private resorts on the lakes mentioned above, plus the man-made lakes, Long Lake and Franklin D. Roosevelt Lake. They provide launching facilities and some boat rentals. Those specific facilities which list fishing as one of their activities are limited to Dragoon Creek, Long Lake, Horseshoe Lake, and Wandermere Lake. Naturally, there is more fishing activity in the study area than this would seem to indicate, and it is discussed in more detail in the section on fishery resources of the Spokane region.

It is of significance to note that there is little publicly owned water frontage in the study area. This is true of rivers, streams, natural lakes and man-made impoundments. In the case of the natural lakes, not only is there little public ownership, there is relatively little frontage not already privately developed. An examination of the aerial photos of the natural lakes indicate the following approximate degrees of existing shoreline development.

Lake	Approximate Percent of Developed Shoreline
Sacheen	67
Diamond	77
Trout	5
Horseshoe	21
Fan	9
Eloika	12
Chain	5
Newman	56
Liberty	77

The man-made lake frontage is, by contrast, largely undeveloped. There is some development on Long Lake. The north shore of Franklin D. Roosevelt Lake is entirely within the Spokane Indian Reservation. The south shore, in Lincoln County, is all zoned Recreation-

Open Space.

Substantially all of the smaller rivers and streams, including Hangman Creek and the Little Spokane River, are in private ownership. The only exceptions are Chamokane Creek and other small streams in the Spokane Indian Reservation and the small streams in Mount Spokane State Park.

Above Long Lake, the Spokane River has publicly owned frontage only within Riverside State Park and the Downriver Municipal Golf Course.

Land Oriented Activities. Land oriented activities are likewise inventoried and categorized in Table 2. Land-based recreational facilities are more varied than water-based. One of the most common is picnicking. Not only do most of the urban parks include picnic tables and barbecue pits, but so do the lake resorts outside the city and even the primitive camp sites. Playgrounds are another ubiquitous urban facility serving the local neighborhoods. Somewhat less prevalent are baseball and softball fields. Tennis courts are also common in the urban parks. There are nine full golf courses in the study area, most of them in and around the City of Spokane.

Several major scenic drives are located in the urban area which should be considered a recreational resource, especially in view of their potential for bicycle use. A few of these drives plus some other parks have such impressive vistas that they are considered recreational resources in themselves. Some should also be regarded as water oriented since river vistas are the prime attraction.

The three state parks and a few of the rural parks have hiking trails. Camping is primarily found in southern Pend Oreille County, often at Boy Scout Camps, although Spokane County has several camping sites in the Department of Natural Resources facilities and in rural county parks.

Other activities usually found in urban parks are also found in the study area including horseback riding, ice skating, horseshoes, shuffleboard, handball, etc. Special mention should be made of the winter sports activities centered in Mount Spokane State Park.

Hunting is a land-based recreational activity that is not confined to particular sites. There are both animal and bird hunting activities which are described in detail in the section on animal and bird resources of the study area.

Open Space Policy

There are a number of government agencies involved in the development of open space and recreation policy from the federal to the municipal level. The impact at the federal level is minimal in the study area due to the absence of national park and national forest lands. The federal impact in the study area derives from three sources: the federal interest in the Spokane Indian Reservation, the federal interest in the shores of Franklin D. Roosevelt Lake, and the federal control of the Land and Water Conservation Fund through the Bureau of Outdoor Recreation.

Federal policy relative to Franklin D. Roosevelt Lake is to

reserve the shoreline for recreational or other conservation purposes. As stated previously, the north bank is doubly protected because it also lies within the Spokane Indian Reservation. The south bank is protected by Lincoln County zoning.

The Bureau of Outdoor Recreation is responsible for recommending and allocating monies from the Land and Water Conservation Fund to the states for projects recommended to it by appropriate state agencies.

State Involvement. The State government is involved in open space and recreation policy making through a number of its departments. This multiplicity of departmental involvement led to the formation of the Interagency Committee for Outdoor Recreation.

> In 1964, voters of the State of Washington...overwhelmingly passed Initiative 215, a measure that created the Interagency Committee for Outdoor Recreation (IAC) and the Outdoor Recreation Account. With this commitment of manpower and funds, the State of Washington made the protection of scenic and recreational wealth and the provision of recreation facilities firm, on-going state goals.
>
> This agency was directed to assist state and local agencies in the acquisition and development of outdoor recreation resources. The original act was amended by legislative action in 1967 to add a planning responsibility to the IAC.
>
> The Committee now consists of twelve members, including five citizen members who are appointed by the Governor for three-year terms, and the directors of those seven state agencies most directly concerned with outdoor recreation. These agencies are the departments of Commerce and Economic Development, Ecology, Fisheries, Game, Highways, Natural Resources and the Parks and Recreation Commission. The Governor-appointed chairman of this entire group is one of the citizen members. This Committee holds public meetings at various locations across the state at least four times a year.
>
> Outdoor recreation projects proposed by state and local govern-

ment bodies are presented to the Committee with complete plans and justification of the need for the project. IAC Committee approval of projects is given based upon the Washington Statewide Comprehensive Outdoor Recreation and Open Space Plan.

The planning guideline used by the IAC is the Statewide Comprehensive Outdoor Recreation and Open Space Plan, a document that qualifies this state to receive acquisition and development grants from the federal Land and Water Conservation Fund.

This plan (SCORP) must be continually refined and maintained in order for the State of Washington to receive these LWCF monies from the Bureau of Outdoor Recreation.

(Quoted from Annual Report, Natural Resources and Recreation Agencies, State of Washington.)

The policy for District 12, Spokane County, as contained in the Washington Statewide Comprehensive Recreation and Open Space Plan, Fourth Edition, May 1973, is as follows:

Resources. The Spokane district is the state's second most populous district. Recreation resources, primarily a city and county park system and two major state parks, are related to the needs of an urban population. Generally, the natural setting and open space is not of sufficient quality or quantity to attract outdoor recreationists from outside the district. However, several features within the district have potential to meet additional resident needs--including numerous lakes, Mt. Spokane (which serves the nearby urban population both as a major regional park and winter sports area) and the Spokane River. The river cascades through an urban setting in a series of waterfalls which afford an unusual opportunity to develop a unique urban park. Plans are now underway to improve aesthetic qualities of the riverfront corridor, improve its water quality, and acquire additional riverfront sites. When completed, these actions could complement Riverside State Park and the 1974 Expo site to provide one of the state's most outstanding urban recreation and open space complexes.

Needs. Much of the demand generated by Spokane district residents is satisfied outside the district, particularly in nearby North Idaho and in the Northeast Planning District (Stevens, Pend Oreille and Ferry Counties). Some impact on regional and overnight facilities results from travelers passing

through the area on I-90 and from visitors from British Columbia. However, overall need is related to serving the demand of a relatively large and increasing resident population. Acquisition and development of freshwater shorelands within the district offer some opportunity, however, potential shorelands are inadequate to meet existing needs. The continued pressures of urbanization can be expected to make the acquisition of additional shorelands even more critical. Development needs for small urban, large urban, and regional areas have been identified in addition to acquisition needs for small urban areas.

Actions. Local actions should be directed to the acquisition of shorelands, and the development of local recreation areas and freshwater shorelands. Additional local funds should be channeled into the acquisition and development of urban trails and regional recreation areas. State actions should consider for the acquisition and development of critical resource areas and freshwater shorelands. Major federal actions for open space and outdoor recreation are not anticipated in this district.

A further element of State open space policy is currently being defined by the Spokane County Shoreline Citizens Advisory Committee and the Washington State Department of Ecology, in order to fulfill the requirements of the Shoreline Management Act of 1971. The existing review draft of the first section contains Goals and Policies which would apply broadly to all "shorelines of the State" within the county. Later sections will describe more detailed policies for specific use-activities for various management areas. The following goals from the draft are not yet adopted but indicate the probable direction of State open space policy as applied to significant shorelines.

1. Limit economic development in shoreline areas to those activities which depend on access to water and locations which are environmentally suitable for development and are consistent with other goals of this program.

2. Provide as much public access, both physical and visual, to the shorelines of Spokane County as is feasible and

consistent with environmental goals, as long as such access is not harmful to either the natural environment or private property rights.

3. Provide a safe and convenient, circulation system which will minimize disruption to the shoreline environment.

4. Increase, to the extent feasible, diverse recreational opportunities on the shorelines of Spokane County.

5. Shoreline land uses should be dependent on water front locations, compatible with adjacent land uses, be serviced with adequate circulation and utility systems, and not present potential hazards to the environment or the public welfare.

6. Preserve for the future those natural resources, including the unique, fragile and scenic qualities of the shoreline which cannot be replaced, and provide for the conservation and restoration of renewable resources.

7. Identify, protect, preserve, acquire and restore shoreline buildings or sites which have cultural, historic, educational or scientific values.

County Open Space Policy. The open space policies of Spokane County are documented in Major Parks and Special Facilities (Spokane County Planning Commission, 1965). This report consists of material adopted as amendments to the Recreation Element of the Comprehensive Plan for Spokane County. Standards have been adopted for various types of open-space facilities. Major urban parks are described as "broad expanses of natural scenery...capable of accommodating large numbers of people...easily accessible from major thoroughfares and transit routes...of 100 acres or more where possible." Each major section of the urbanizing area is to contain one major urban park of 2.5 acres per 1000 population outside the City of Spokane. Regional parks, which include waterfront and riverfront parks, are of larger size--over 200 acres. The primary purpose is to provide public access to scenic natural

environments outside the urban area with some varied intensive recreational facilities. The standard applied here is 15 acres per 1000 people. Total county population is used for county facilities and inaccessible or conservation areas are not to be included. Another open-space category, lakefront beaches, is to be developed as the opportunities present themselves. The standard is for 25 feet of shoreline per 1000 people. For each foot of shoreline there should be 100 square feet of swimmable water, 200 square feet of beach and 250 square feet of buffer and picnic area and 265 square feet of parking. For swimming pools, both indoor and outdoor, the standard is 500 square feet of water surface area per 1000 people in the urbanizing area (minus the City of Spokane). The standard for golf courses is one 18-hole course per 50,000 population in the County exclusive of the City. The 1970 Census population of 116,971 outside of the City is therefore fairly well served by the two existing courses. Ideal size is 150 to 200 acres and the minimum is 120 acres. Recommendations are made for other types of parks such as public access and historical parks, which do not have generalized standards.

The County relied on four principles in developing its priorities for park development:

a. Recreation facilities most desired and in shortest supply should receive higher priorities.

b. Projects for which there is a shortage of good available, vacant, well located sites should receive higher priorities.

c. All sections of the County should be served with needed recreation facilities, but ares where the

greatest need exists should have priority.

d. Recreation needs served in part by private facilities may require less total public resources, but the danger of conversion of these facilities to nonrecreation purposes should be recognized.

While only a small part of the Spokane River Basin study area is in Whitman County, The Comprehensive Outdoor Recreation Plan for Whitman County, Washington 1970 indicates policies which would influence that portion. A concluding recommendation is "that the county accelerate acquisition and development programs for outdoor recreation in order to realize an increased economic input for the county." State Route 27 through Tekoa has been designated a scenic and historic route and the town itself is to be developed to bring out its historical western character. The Comprehensive Plan indicates two new recreation areas in the study area, a six-acre park and a 30-acre golf course, both in Tekoa.

The Preliminary Land Use Plan for Pend Oreille County of December 1969 makes three recommendations which indicate the direction of future policy.

"1. Encourage the development of new recreation complexes which will expand fall, winter and spring employment.

2. Encourage public agencies to expand facilities in Pend Oreille County.

3. Restrict development in flood plains."

In the southern portion of Pend Oreille County which is in the study area the Land Use Plan indicates recreation-housing around Trout Lake, Horseshoe Lake, Fan Lake, Sacheen Lake and Diamond Lake. State Route 311 and U.S. Route 2 are designated scenic highway with sign con-

trol.

Open space policy in Lincoln County as applicable to the study area can be summed up in the one-mile wide zoning for open-space recreation along the Spokane River which defines its northern boundary.

Most of that portion of Stevens County within the study area is composed of the Spokane Indian Reservation which has its own open-space limitations.

City Open Space Policy. The City of Spokane's open space policy is well documented in the Park and Open Space Plan approved by the Park Board on October 28, 1965 and by the City Plan Commission on October 20, 1965. The plan was made part of the Comprehensive Plan on November 15, 1965 by the City Council. The open space lands affected include major parks, reservations, conservation lands (including river-front) and greenbelts.

A major park is defined as a large open area featuring natural scenery, elements of city-wide interest, and opportunities for active and passive recreation. The standard for major parks is one acre per 400 population. Minimum size is 75 acres, preferably 100 or more. Each major section of the City should have one major park. The 90-acre Manito Park is the only major city park, so that the standards would suggest a 336-acre deficit based on the 1970 population of 170,516.

A reservation is described in the Open Space Plan as "a large tract of land, usually with scenic and special features, reserved primarily in its natural state for public recreational uses." The standard for reservation land is not less than one acre per 100 popu-

lation. The preferred size is 1000 acres or more. Such areas, which can be smaller and still useful, should be within at least a 20-minute drive from each city neighborhood. Although Spokane has no reservations, this function is partly served by Riverside State Park northwest of the City.

Conservation area is defined as land either publicly owned or protected through zoning and easement rights. Their purpose is "to preserve geological, botanic, historic or scenic values, to conserve natural resources, or to avoid development of lands subject to flooding, landslides or nuisances destructive of property and life." Spokane has four such areas now, Palisades Park, Indian Canyon Park, Hangman Creek Park, and Upriver Drive Park. Conservation by zoning and easements without public ownership has been proposed around the Browne Mountain Reservation, the Latah Creek area, and the Spokane River. City policy concerning the Spokane River and falls is of prime importance to the study:

> The Spokane River and falls is one of the City's greatest natural assets. The river should be declared a conservation area and should be cleansed, conserved, beautified, developed, and made safe. Some of the river frontage should be in public ownership and available for enjoyment by the entire community and regional population. The balance of the riverfront should remain in private ownership, zoned compatible with the river potential.

Conservation by purchase has been proposed for two areas, an 18-acre tract just north of Indian Canyon Golf Course, and a 184-acre tract just north of Palisades conservation area.

The last open space category described is the greenbelt, a long strip of "landscaped or natural open space held by zoning or by

public ownership to provide a buffer between residential and non-residential areas, or to delineate and give form to neighborhoods and communities." Spokane has no greenbelts at present but has proposed a few. As an example, the GNRR industrial spur and its adjacent industries need to be separated from nearby residential areas by a greenbelt.

TABLE 1

AREAS DEVOTED TO RECREATION
IN SPOKANE COUNTY*

By Agency

Agency	Area, Acres
Cities	3,333
County	3,388
State Park and Recreation Commission	23,438
State Department of Game	95
State Department of Natural Resources	6,780
State Institute of Higher Education	21
Bureau of Sport Fisheries and Wildlife	17,177**

By Type of Facility

Type	Area, Acres
Small Urban	619
Large Urban	1,801
Regional	5,830
Winter Sport	331
Golf Course	541
Forest	17,630
Wildlife Habitat	23,921
Freshwater	391
Scenic Road and Highway	256
Urban Trails	18
Historical/Cultural	131
Outstanding Natural	2,753

*Source: State of Washington. 1973. Washington statewide comprehensive outdoor recreation and open space plan, Volume II.

**This area is the Turnbull National Wildlife Refuge, which is within Spokane County but mostly outside of the study area.

TABLE 2

INVENTORY OF EXISTING RECREATION FACILITIES AND ACTIVITIES

Park Name	Area Acres	Type*	Activities: Water: Swimming	Wading	Boating	Fishing	Land: Picnicking	Playground	Baseball	Softball	Tennis	Golf	Scenic Drive	Vista	Hiking	Camping	Remarks
Albi Stadium		R															Football, rodeo, etc.
American Campgrounds		RP														X	
Audubon Park and Playground	98.95	CN			X		X	X	X	X	X						541 Campsites
Balfour Park	2.80	CN					X	X	X								
Barber's Resort		RP			X		X										
Big Arrow Motel		RP															Maximum population = 12
Brentwood Park	5.00	CN															Undeveloped
Bushby's Resort		RP															Maximum population = 150
Byrne Park	3.00	CN					X	X	X								
Camp Cowles-BSA		R														X	Maximum population = 350
Camp Reed-YMCA		R														X	Maximum population = 200
Cannon Playground and Pool, A.M.	3.52	CN	X	X				X		X							
Cannon Hill Park	13.11	CN						X									Skating
Cedar Creek Resort		RP															Maximum population = 200
Central Valley Lions Club Recreation Area		M					X										
Cheney East Park	0.60																Special facilities
Clark Playground	8.77	CN					X	X	X	X							

TABLE 2 (continued)

Park Name	Area Acres	Type*	Activities: Water: Swimming	Water: Wading	Water: Boating	Water: Fishing	Land: Picnicking	Land: Playground	Land: Baseball	Land: Softball	Land: Tennis	Land: Golf	Land: Scenic Drive	Land: Vista	Land: Hiking	Land: Camping	Remarks
Cliff Park	4.48	M												X			
Coeur d'Alene Park	9.78	CN		X			X	X			X						Horseshoes
Comstock Park and Pool	21.33	CN	X				X	X	X	X	X						
Corbin Park	11.50	CN					X	X		X	X						Horseshoes
Coulee Dam Natural Recreation Area		R	X		X	X	X									X	Hunting
Courtland Playground	3.26	CN						X		X	X						
Cowley Park	2.08	M						X									
Cunninghams Resort		RP			X												
Dishman Hills	117.0	CN													X	X	Riding
Downriver Golf Course	168.85	R										X					
Downriver Park	95.30	M											X				
Dragoon Creek		R				X	X									X	
Drumheller Springs		M															
Edgecliff Park	4.70	CN	X		X	X	X	X	X		X						
Elk Park		CN															
Elliott Drive	57.01	M											X				
Esmeralda Golf Course	165.00	R										X					
Fairchild Air Force Base Resort		RP	X		X		X										
Farwell Park	9.00	CN															

TABLE 2 (continued)

Park Name	Area Acres	Type*	Activities: Water: Swimming	Water: Wading	Water: Boating	Water: Fishing	Land: Picnicking	Land: Playground	Land: Baseball	Land: Softball	Land: Tennis	Land: Golf	Land: Scenic Drive	Land: Vista	Land: Hiking	Land: Camping	Remarks
Finch Arboretum	62.65	R															
Fish Lake Resort and Park	55.27	RP	X				X										
Fort Spokane		R					X									X	
Franklin Park and Playground	41.83	M					X	X		X							
Garry Park, Chief	9.61	CN					X	X	X	X							
Glass Playground	2.97	CN		X				X		X	X						
Glover Field	2.29	M					X			X							
Gramp's Landing		RP			X												
Grant Playground	3.00	CN						X		X	X						
Hamblin Park	16.00	CN					X	X		X							
Hangman Creek Golf Course	200.00	R										X					
Harbor Resort		RP															Maximum population = 100
Harmon Field	10.25	CN					X	X	X	X	X						
Hays Park	7.83	CN					X										
High Bridge Park	63.42	CN					X										
High Drive Parkway	177.51	M											X				
Hill Park, James J.	1.58	CN					X	X									
Hillyard Pool	1.09	CN	X														
Holmberg Park	6.00	CN							X								
Horseshoe Lake Resort and Game Access Area		RP				X											Hunting

TABLE 2 (continued)

Park Name	Area Acres	Type*	Activities: Water: Swimming	Wading	Boating	Fishing	Land: Picnicking	Playground	Baseball	Softball	Tennis	Golf	Scenic Drive	Vista	Hiking	Camping	Remarks
Indian Canyon Golf Course	206.26	R										X					
Indian Canyon Park	129.00	R											X		X		
Indian Rock Paintings State Park		R															
Indian Trail Park	3.50	M					X	X									
Interstate Fairgrounds and Baseball Park		R					X		X								Auto racing
Joe Bear's Boy Scout Camp-BSA		M														X	
Knox Park	1.25	CN						X									
Latah Creek Park	19.65	M															Waterfront reservation
Liberty Lake County Park	2930.00	R	X		X										X	X	Riding, coasting
Liberty Lake Public Golf Course	140.00	R										X					
Liberty Park and Pool	20.44	CN	X	X			X										
Lincoln Park and Playground	50.65	M		X				X		X	X			X			Skating
Linwood Park	6.03	CN					X		X		X						
Long Lake		R			X	X	X							X		X	
Manito Boulevard	8.20	CN															Wide median

TABLE 2 (continued)

Park Name	Area Acres	Type*	Activities: Water: Swimming	Wading	Boating	Fishing	Land: Picnicking	Playground	Baseball	Softball	Tennis	Golf	Scenic Drive	Vista	Hiking	Camping	Remarks
Manito Country Club Golf Course		RP	X									X					
Manito Park	90.00	R		X			X	X		X	X						
Minnehaha Park	38.92	CN					X			X	X						
Mirabeau Park	5.00	M					X									X	Riverfront
Mission Park	12.00	CN					X	X	X	X	X						
Morgan Acres Park	1.80	CN					X	X	X								
Morrow Park	40.00	R					X									X	
Mount Spokane State Park		S					X								X	X	Skiing
Mount Vista Park	6.40	CN						X	X								
Myers Resort		RP	X		X		X										
Ness Park	3.50	CN							X								Basketball
Nevada Field	9.97	CN						X		X							
North Silver Resort		RP			X												
Northwest Boulevard	14.92	CN											X	X			
Orchard Avenue Community Park	3.70	CN							X	X							
Palisades Park	464.15	R											X				Reservation area
Park Boulevard	3.70	CN															Irrigated lawn
Park Road Pool	2.00	CN	X														

TABLE 2 (continued)

Park Name	Area Acres	Type*	Activities: Water: Swimming	Wading	Boating	Fishing	Land: Picnicking	Playground	Baseball	Softball	Tennis	Golf	Scenic Drive	Vista	Hiking	Camping	Remarks
Peone Creek	11.00	CN															
Peaceful Valley	10.93	M															
Pend Oreille State Park		R					X								X	X	
Picnic Pines Resort		RP	X		X		X										
Pine River Park	14.50	M					X										
Pioneer Park	15.00	M											X	X			
Pineacres Par 3 Golf Course												X					
Plantes Ferry Park	20.60	R					X	X									
Progress Park	4.70	CN															Undeveloped
Rim Rock Drive and Aubrey L. White Parkway		M					X						X	X			
River Terrace		N															
Riverside State Park	77.53	R				X	X								X	X	
Rohner's Resort		RP															Maximum population = 50
Ruth Playground	1.68	CN						X									
Saint Michael's Mission State Park		R															Historical
Sandy Beach Resort		RP	X		X		X	X	X								
Shadle Playfield and Pool	40.00	CN	X	X			X		X	X	X						Football, track, shuffle-board, handball

TABLE 2 (continued)

Park Name	Area Acres	Type*	Activities: Water: Swimming	Wading	Boating	Fishing	Activities: Land: Picnicking	Playground	Baseball	Softball	Tennis	Golf	Scenic Drive	Vista	Hiking	Camping	Remarks
Sig's Resort		RP	X		X		X										
Silver Lake Public Access	2.00	R															
Sontag		C															
Spokane Coliseum		R															
Spokane House State Park		R															Historical
Spokane Plains Battlefield State Park		R															Historical
Stadacona Park	1.30	CN															Undeveloped
Sterling Heights	8.27	CN															Riding
Sullivan Bridge Park	5.20	R					X	X									
Sunburst Park		RP										X					
Sun Dance Golf Course		RP										X					
Sunset Par 3 Golf Course		M					X		X								
Tekoe City Park 1	2.00	M							X								
Tekoe City Park 2	1.00	R										X					Riding
Tekoe Golf Course	34.00	M							X								
Tekoe Grade School	3.00	M							X								
Tekoe High School	6.00	M	X														
Tekoe Swimming Pool	1.00	CN	X				X		X								
Terrace View Park	11.00																

TABLE 2 (continued)

Park Name	Area Acres	Type*	Activities: Water: Swimming	Water: Wading	Water: Boating	Water: Fishing	Land: Picnicking	Land: Playground	Land: Baseball	Land: Softball	Land: Tennis	Land: Golf	Land: Scenic Drive	Land: Vista	Land: Hiking	Land: Camping	Remarks
Thornton Murphy Playground	8.00	CN		X			X	X	X								
Underhill Playground	19.20	CN		X			X	X	X	X	X						
Upriver Drive	189.52	M											X				
Upriver Drive Park	147.04	M			X								X			X	River beach
Valley Mission Park	7.00	CN					X	X	X								
Valleyford Park	22.00	CN					X	X								X	
Wandermere Lake		RP	X			X	X					X					
Webster Park	1.76	CN						X		X							
Weeks Resort, Ted		RP	X		X		X										
Whittier School Playground	3.50	CN						X		X	X						
Willow Cove Resort		RP															
Witter Triangle and Pool	1.33	M	X														
Woodard Park, Seth	4.80	CN							X								

*Code for types of facilities is as follows: CN = Community, Neighborhood; RP = Regional, Private; R = Regional, Public; M = Metropolitan.

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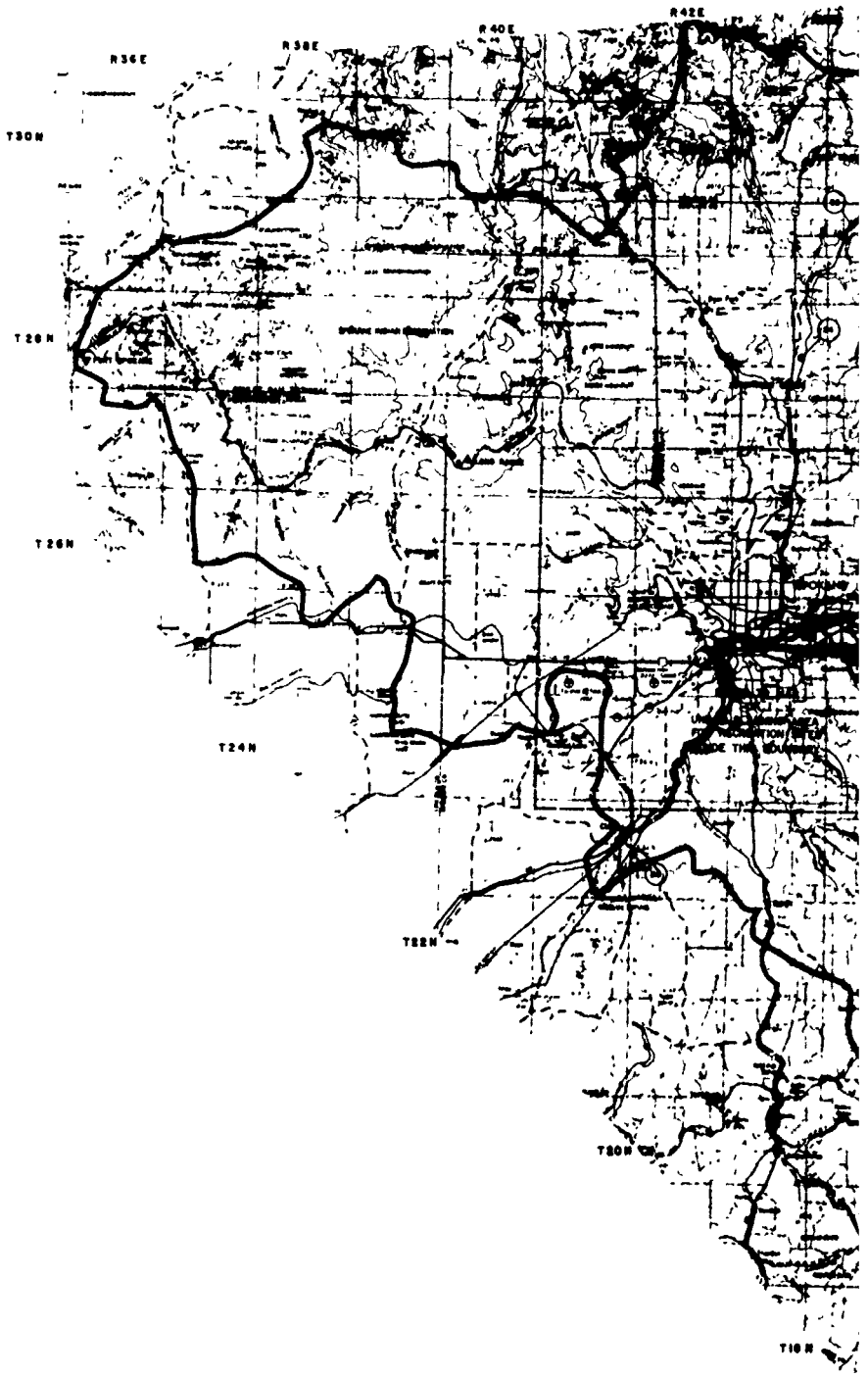

GRAPHIC SCALES

REVISIONS			
SYMBOL	DESCRIPTION	DATE	BY

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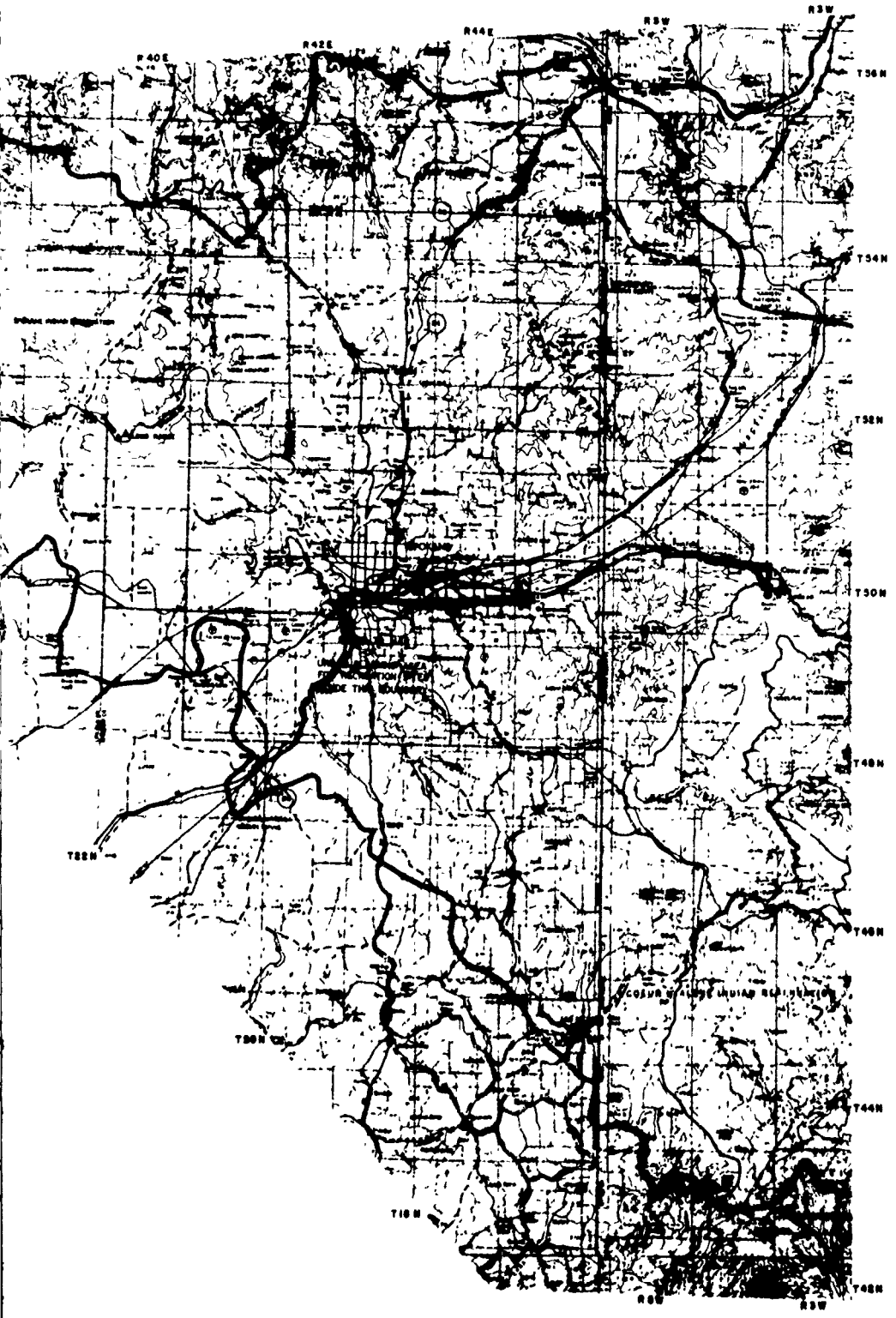
SANDPOINT 1956, RITZVILLE 1963, SPOKANE 1966, GRAN



IDENTIFICATION OF SITES

Spokane County

74. River Terrace
80. Elk
96. Chaney

Town of Tekoa

140. Grade School
141 High School
142 City Park 1
143 City Park 2
144 Swimming Pool
145 Golf Course

RECREATIONAL FACILITIES

- (1) SPOKANE COUNTY FACILITIES [4]
- TOWN OF TEKOE FACILITIES
- STATE FACILITIES
- PRIVATE FACILITIES
- NATIONAL FACILITIES
- [1] CITY FACILITIES

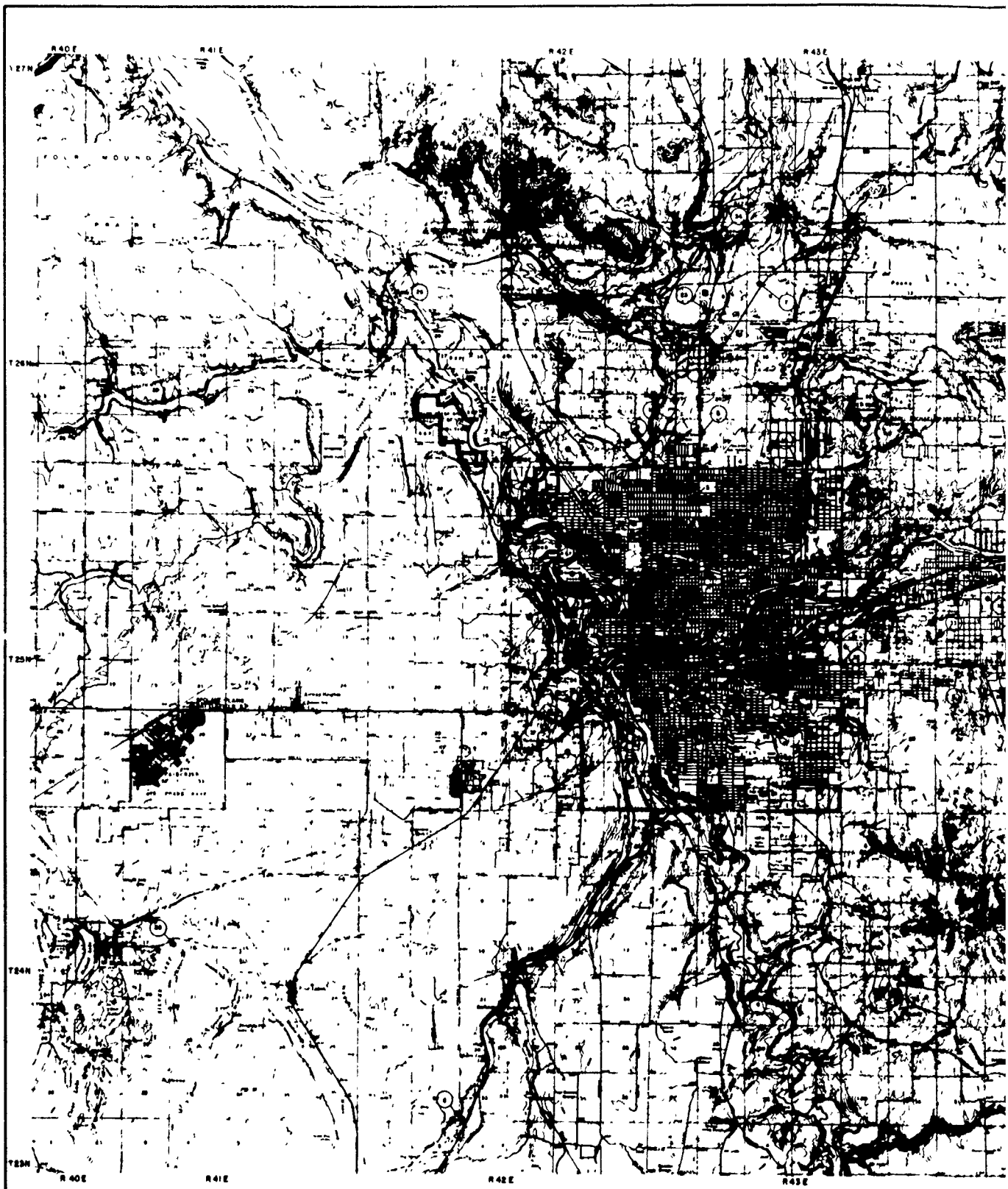
[4] NUMBER CORRESPONDS TO SPOKANE COUNTY NUMBERING SYSTEM

MAP SOURCE: PREPARED FROM USGS, UNITED STATES TOPOGRAPHIC SERIES, SANDPOINT 1956, RITZVILLE 1960, SPOKANE 1960, [illegible] 1964

[illegible] CONSULTING ENGINEERS SEATTLE, WASHINGTON	U S ARMY ENGINEER DISTRICT, SEATTLE CORPS OF ENGINEERS SEATTLE, WASHINGTON

WATER RESOURCES STUDY
METROPOLITAN SPOKANE REGION
RECREATION SITES
OUTSIDE OF URBAN PLANNING AREA

[illegible] DACW67-73-C-0006	[illegible]	PLATE 316-1



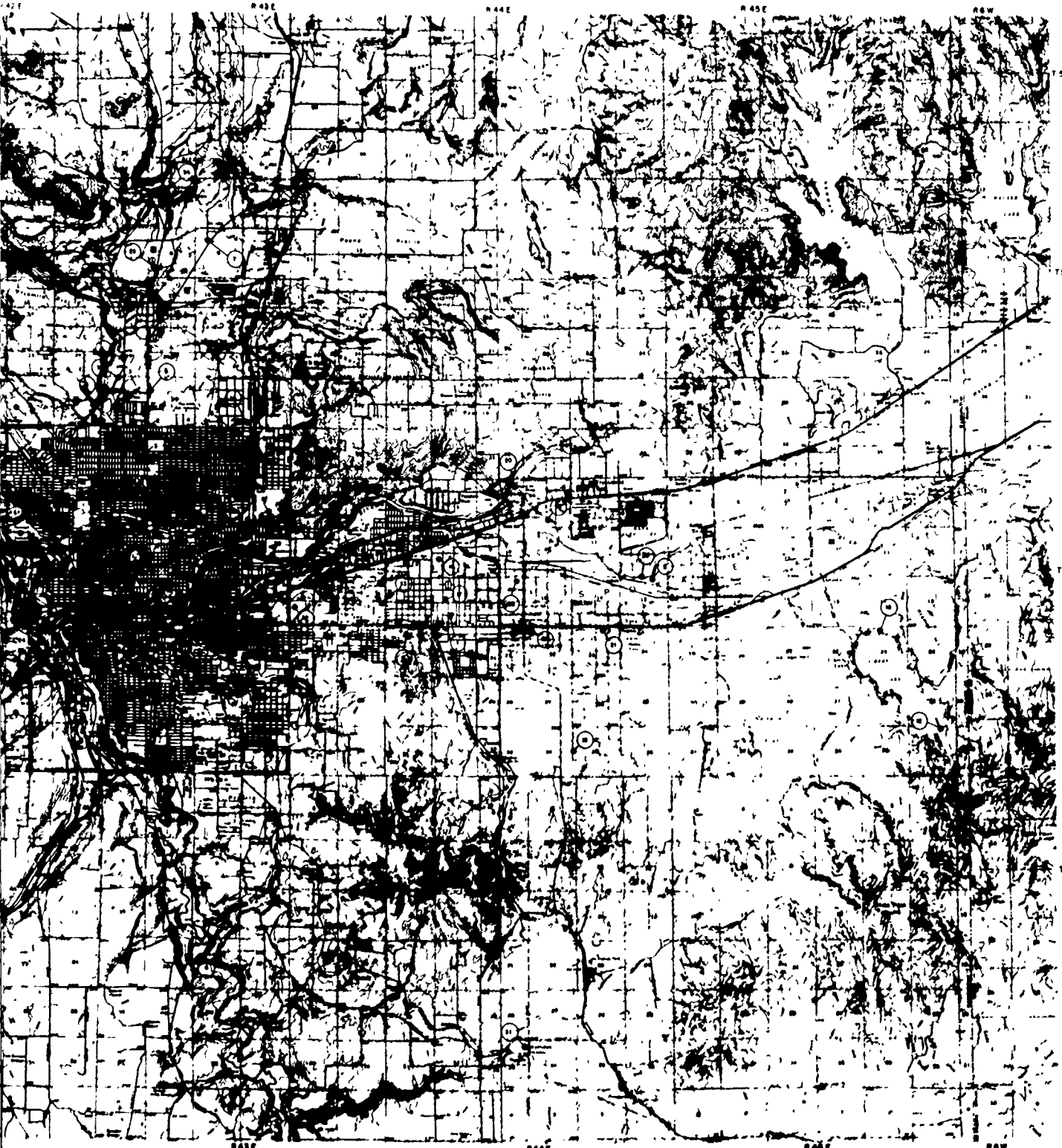
MAP SOURCE: USGS 15 MINUTE QUADRANGLE SERIES, CLAYTON WASH 1960, DEER PARK WASH 1949, MEDICAL LAKE WASH 1964, SPOKANE WASH 1960, GREENACRES WASH-IDAHO 1949

GRAPHIC SCALES

REVISIONS			
SYMBOL	DESCRIPTION	DATE	BY

IDENTIFICATION OF COUNTY SITES

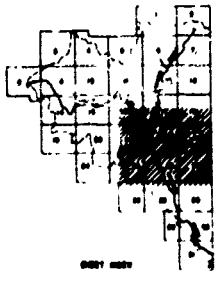
1	Belfair	14	Morgan Acres	27	..th Woodard
2	C Y Lions Club Area	15	Morrow	28	..ullivan
3	Sunburst Park	16	Mt Vista	29	..orrace View
4	Dishman Hills	17	Napa School Site	30	Valley Mission
5	Edgecliff	18	Liberty Lake Golf Course	31	Valleyford
6	Hangman Valley Golf Course	19	Pamos Creek	32	(see Plate 316-1)
7	Farwell	20	Planters Ferry	33	Park Pool
8	Fish Lake	21	Progress	34	Pine River
9	Helmberg	22	Fairgrounds	35	Orchard Avenue
10	Town	23	Brentwood	36	(see Plate 316-1)
11	Linwood	24	(see Plate 316 1)	37	Elk Rock Drive
12	Liberty Lake	25	Saratoga	38	Sterling Heights
13	Mirabeau	26	Silver Lake Public Access		



SOURCE USGS 15 MINUTE QUADRANGLE SERIES, CLAYTON WASH 1960, DEER PARK WASH 1949, MT SPOKANE WASH - IDAHO 1950, MEDICAL LAKE WASH 1964, SPOKANE WASH 1960, GREENACRES WASH - IDAHO 1949

IDENTIFICATION OF COUNTY SITES

1	Balfour	14	Morgan Acres	27	Beth Woodard
2	C V Lions Club Area	15	Morven	28	Sullivan
3	Seaburst Park	16	Mt Vista	29	Terrace View
4	Dishman Hills	17	Rose School Site	30	Valley Mission
5	Edgecliff	18	Liberty Lake Golf Course	31	Valleyford
6	Evergreen Valley Golf Course	19	Fancon Creek	32	(see Plate 316-1)
7	Farwell	20	Pioneers Ferry	33	Park Pool
8	Fish Lake	21	Progress	34	Pine River
9	Goldberg	22	Polygrowdo	35	Orchard Avenue
10,	Fern	23	Brentwood	36	(see Plate 316-3)
11	Linwood	24	(see Plate 316-1)	37	Oak Park Drive
12	Liberty Lake	25	Bowdag	38	Sterling Heights
13	Mirabeau	26	Silver Lake Public Access		



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WATER RESOURCES STUDY
METROPOLITAN SPOKANE REGIO

RECREATION SITES
IN THE URBAN PLANNING AR

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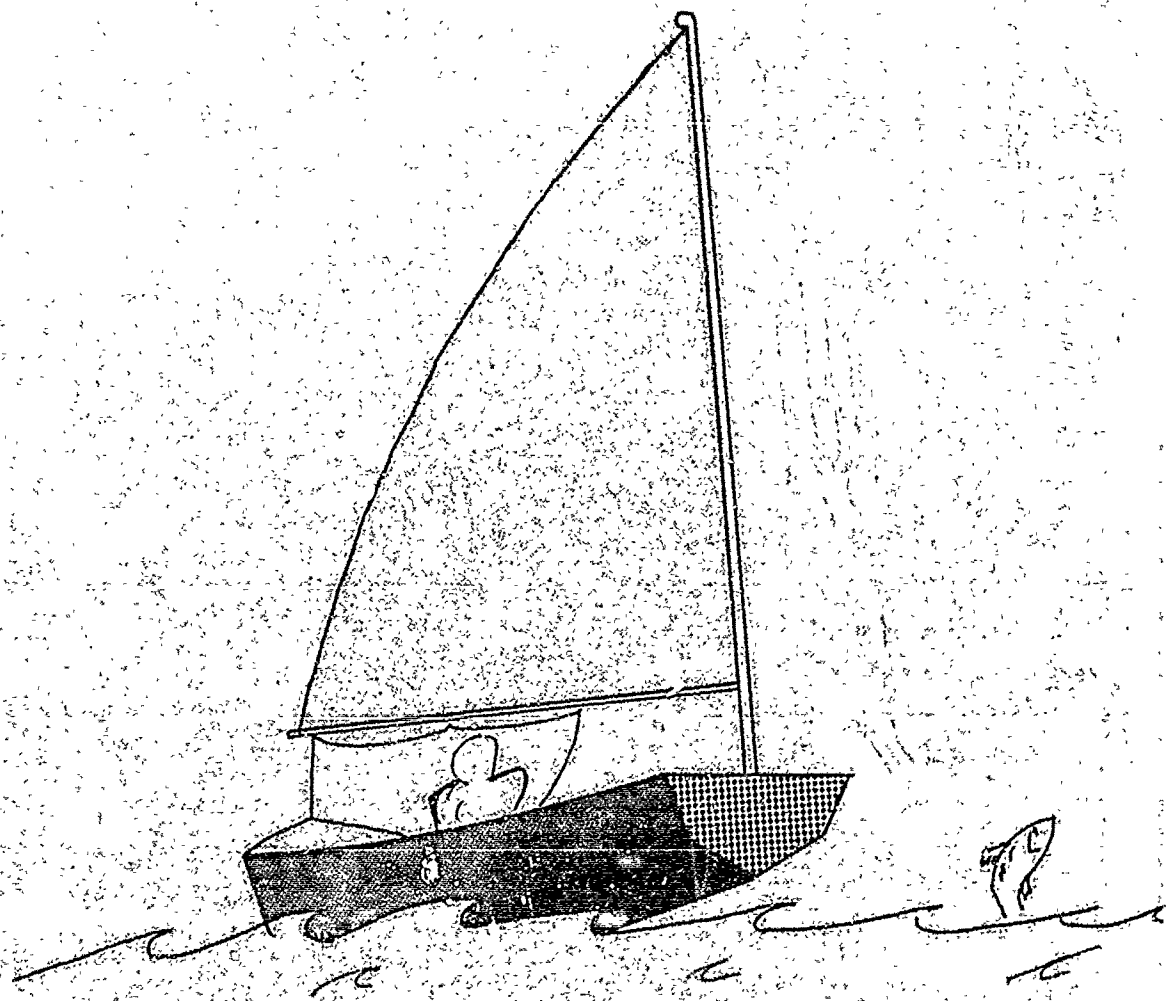

SECTION 408

PROJECTED RECREATION AND OPEN SPACE NEEDS

WATER RESOURCES STUDY

METROPOLITAN SPOKANE REGION

SECTION 408

PROJECTED RECREATION AND OPEN SPACE NEEDS

15 May 1975

Department of the Army, Seattle District
Corps of Engineers
Kennedy-Tudor Consulting Engineers

INDEX

TABLE AND FIGURE INDEX

SECTION 408

Introduction

The objective of this section is to evaluate the projected recreational needs of the study area for the purpose of determining their potential interaction with wastewater management and flood control planning. Projected recreational needs are to be related to population forecasts developed in other sections from considerations including land use projections. The projected recreational needs are to be evaluated in terms of the two basic categories of water oriented and land oriented activities.

Existing Recreation Plans

General. Three local governments within the study area have existing recreation plans that project needs and set goals. These three are the City of Spokane, Spokane County, and Whitman County. In addition, Pend Oreille County has a land use plan which designates recreation land use sites but does not project needs. These plans collectively do not comprise a ready reference to the projected recreation needs of the study area. The City of Spokane and County plans are complementary and cover the urban planning area. Only a small part of Pend Oreille County is in the study area and the focus of recreation planning is outside the study area and oriented toward serving non-local needs. A similar situation exists with regard to Whitman County which has only a small part in the study area, but unlike Pend Oreille County

is focused on the local population needs outside the study area. Each of these plans is abstracted below for its impact on the study area and the urban planning area in particular.

These plans are most important for their concern with local opportunities and constraints. They provide an inventory of areas and sites of concern for their preservation and enhancement regardless of a calculated "need" based on generalized standards.

Much of the effort in existing plans is devoted to identifying the needs for small neighborhood and community parks and special purpose facilities such as swimming pools. In general the mutual impact between recreation facilities of these types and wastewater management plans or flood control options is insignificant. For this reason, the analysis of local agency plans is limited to the following major categories:

Large Urban Parks
Regional Parks
Resource Areas
Aesthetic Areas

Refer to Table 2 for description of subcategories under Resource and Aesthetic classifications. Since Golf Courses represent relatively large areas, are a potential use for infrequently flooded areas and provide a potential use for reclaimed water, this particular Special Purpose area is also considered.

City of Spokane. The most recent City plan is set forth in the Park and Open Space Plan of 1965 by the Spokane City Plan Commission. This document looks ahead to 1980. In 1965 the population

forecasts being used were much higher than current forecasts so that the figure being used in 1965 for 1980 at 216,000 is comparable to the current figure for 2020. Refer to Table 1 for a summary of population forecasts developed for this study. The unmet needs from this report are summarized below:

1. A need for approximately 450 additional acres in major parks. The preferred locations are:

   a. Northwest, in the vicinity of Francis and Assembly, no water frontage.

   b. Northeast adjacent to Minnehaha Park, no water frontage.

   c. Central and Southwest. River frontage between the mouth of Hangman Creek and Peaceful Valley.

   d. East Central and Southeast. Adjacent to Lincoln Park, no water frontage.

   e. Browne Mountain, outside the southeast city limits, no water frontage.

2. A need for approximately 3000 acres of reservation lands, preserved as open space in natural condition within near driving distance of the City. The City itself has no such lands, the present need being partially filled by Riverside State Park. Proposed locations are:

   a. Northeast. Adjoining Minnehaha Park, and extending to river frontage.

   b. Southeast. Browne Mountain area, no water frontage.

   c. West. Acquisition of surplus Fort Wright land adjoining Riverside State Park.

3. Conservation area needs are not stated in terms of area but by location. (The City already holds four areas in this category, Palisades Park, Indian Canyon Park, Hangman Creek Park and Upriver Drive Park. The Hangman Creek Park includes some land subject to flooding and Upriver Drive Park includes Spokane River frontage.) The

additional areas selected include the following:

a. Brown Mountain vicinity

b. Additional area in Hangman Creek lowlands

c. Falls vicinity of the Spokane River

d. Additional area adjoining Indian Canyon

e. Additional area adjoining Palisades Park

These areas of concern to the City to fulfill present and projected needs for all recreation, conservation and open space needs are summarized in Table 3 and Figure A.

For a forecast year 2020 population of 212,000 and using the City adopted standards the forecast needs for the three major categories are as follows:

Category	Criteria	Required Area, Acres	Proposed Area, Acres*
Major Parks	1 acre/400 persons	530	536
Reservations	1 acre/100	2,120	3,402
Conservation	As Required to preserve resources		2,164

*Refer to Table 3.

Spokane County. The most recent Spokane County plan is contained in their "Six Year Action Program" dated May 1, 1973. This program looks to the year 1979 and projects a Spokane County population forecast for the suburban area, exclusive of the City of Spokane of 128,197 at 1980. This is in substantial agreement with the forecast made for this study which has 110,000 for the same area and date.

Refer to Table 1. The report covers forecast needs from the neighborhood park and playground level to major urban parks and regional parks. For the purpose of evaluating alternative plans, the significant interactions are with major urban and regional parks and river and waterfront areas. The County goals for these types is abstracted from the total program and summarized in Table 4 and Figure B.

The County selected several different populations to apply to adopted criteria in setting goals for the various categories of recreation facilities. For major urban parks a saturation population of the suburban area of 347,700 is selected together with a standard of 2.5 acres per 1000* to arrive at a requirement of 869 acres. The forecast suburban population for year 2020 developed in this study is 193,104, in Table 1. Thus the County goal is set at almost double the 2020 population for this category. The total proposed and existing sites for major urban parks (MUP) is 731 acres (see Table 4), a figure lower than the goal based on saturation but adequate to 2020.

For the regional park category, which includes waterfront and riverfront parks, the population selected by the County is 362,577 for the total County, including the City, to year 1985. This estimate is in substantial agreement with corresponding values in Table 1. For an adopted standard of 15 acres per 1000 people this results in a requirement for 5439 acres. The proposed and existing sites (from Table 4) total 7438 acres. Neither the County nor the City appear to include a

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*Note that this is the same as City standard of 1 per 400.

credit to the existence of Riverside State Park at 6200 acres against regional park requirements. Note that the County includes the City population in the calculation so that there is some duplication between what the County designates as Regional and the City designates as Reservations to which the City applies a lower standard of 10 acres per 1000.

For golf courses, the County selects a population of 146,000 for all areas outside the City at year 1975. This is slightly higher than the corresponding figure obtained by interpolation from Table 1. With the adopted standard of one 18 hole course per 50,000 persons, the requirement is three courses or approximately 450-600 acres. Four courses totaling 780 acres are proposed.

Note in Table 4 and in Figure B that a large proportion of the proposed water oriented parks are in the southwest corner of the County outside the study area.

Long Lake and its environs are not included in any of the County recreation plans although this is by far the largest body of water in the study area, with over 5000 acres of surface as compared with the next largest, Newman Lake at 1190 acres.

Whitman County. The recreation plans of Whitman County are contained in the report "The Comprehensive Outdoor Recreation Plan for Whitman County, Washington, 1970". Only a small portion of Whitman County containing the community of Tekoa is in the study area. The population centers are in the southeast area and the predominant recreational focus is on the Snake River which forms the southern

border. The planning report looks ahead to the year 2020. Only two new recreation facilities are proposed within the study area, both in Tekoa, one an additional small park and the other a very small golf facility.

The population of Tekoa is forecast to remain substantially unchanged throughout the planning period.

Pend Oreille County. The recreation plans for Pend Oreille County are contained in the Preliminary Land Use Plan of 1969. This report predicts that recreation will probably be the largest sector of the economy in the future. The report contains no forecast of needs in terms of area or population served. The report output is in terms of generalized land use mapping. Most of the County except for a strip along the Pend Oreille River and the southern part, which is in the study area, is in National Forest. These large preserves of forest land, although outside the study area, must be considered as part of the recreation resources of the Spokane area. Almost the entire length of the Pend Oreille River not designated flood plain is designated recreation-housing.

The important recreation potential sites in Pend Oreille County within the study area is centered on the following lakes:

Fan Lake
Horseshoe Lake
Trout Lake
Sacheen Lake
Diamond Lake

Except for the area at the west end of Diamond Lake, the rest

of the shoreline is zoned for recreation housing. For Sacheen Lake the entire shoreline is designated recreation housing. The report states: "Most subdivision activity has taken place adjacent to a lake or a stream. This trend will probably continue until all available water-frontage has been subdivided." It would appear that the plan has made the trend a goal as well.

The population of Pend Oreille County is very small and forecast to remain so. The recreation needs pressure in the future is therefore from outside the County and the region.

Pend Oreille State Park, approximately 400 acres, is in the study area.

Stevens County. There is no available recreation plan for Stevens County. The majority of Stevens County within the study area is in the Spokane Indian Reservation which includes the north bank of the Spokane River from the vicinity of Long Lake Dam to the mouth. Most of the north shore of Long Lake is outside of the Reservation and in private ownership. Population of Stevens County within the study area is small, expected to remain relatively constant and mostly within the Reservation. See Table 1.

Lincoln County. Lincoln County has a zoning ordinance which includes a category "open space-recreation". The area adjoining the Coulee Dam National Recreational Area is zoned in this category thus making the entire south bank of the Spokane River, which in this reach is part of the Franklin D. Roosevelt Lake impoundment, a recreational area. The agricultural area which fills the remainder of Lincoln

County within the study area has an extremely small population of approximately 400 which is forecast to become even smaller.

State and Federal. There are no known site specific state or federal recreation or open space plans within the study area. It is known that the State wishes to consolidate its Mt. Spokane Park holdings by possible exchanges of non-contiguous parcels for adjoining ones but not for enlargement.

State policy from the Washington Statewide Comprehensive Recreation and Open Space Plan, Fourth Edition, May 1973 is quoted in Section 316. This statement implies an intent to not expand existing State facilities in District 12, Spokane County.

Basis for Projection

The traditional basis for projection of recreational needs is the product of projected population and per capita standards for various categories. Standards have been developed by national and state agencies and associations which have been adopted and modified by local agencies. Typical of standards developed by national agencies and associations are "Outdoor Recreation and Space Standards" by the Department of the Interior and "National Park Recreation and Open Space Standards" by The National Recreation and Park Association. State standards for Washington are developed in "Technical Report II" by Washington State Planning and Community Affairs Agency. Local adaptations of standards are exemplified by "Major Parks and Special Facilities" by the Spokane County Planning Commission.

These standards have all been developed since 1960 and presumably recognize the national trend pointed out by the Bureau of Outdoor Recreation that foresees a four-fold increase in public participation in outdoor recreation activities in the period 1960 to year 2000. This concern suggests that the likelihood of a projection falling short of the real need may be high and that no matter how much is provided for future recreation it may not be enough.

Other studies suggest that the accepted methods for evaluating recreation demands may be in error because they are too site and facility specific without recognizing the social implications of leisure activities. These factors are discussed by Field (1973). One of the conclusions drawn is that flexibility of leisure settings to adapt to a variety of activities is more important than overdevelopment with facilities specific to certain selected activities. In this context, and for long range concerns, it is judged more significant to project needs for settings for leisure activity than to enumerate specific activities.

Generalized criteria for recreation and open space cannot recognize the opportunities and constraints of a specific locality. Recognition of these opportunities and constraints forms an important part of plans prepared by local agencies. Deviations from generalized standards both as to categories and quantities depend on the site specific conditions.

Another factor which affects the projection of recreation needs is the selection of the population to be served; is it to be only the population of the study area, is it to include some nearby

region or is it to consider national tourist impact. As pointed out in Section 316, the study area is evaluated as having relatively low attractiveness to tourists for non-urban recreation, not because the study area itself is unattractive, but because of the proximity of competing outstanding natural areas in Pend Oreille County and Northern Idaho. Therefore, the projections herein substantially discount demand generated by populations outside the study area.

Integrated Goals for the Study Area

The fragmented view of projected recreation and open space plans from city and county sources requires integration and comparison with standards on an overall basis.

The City of Spokane and its suburbs in Spokane County will have a population of approximately 405,000 at year 2020. Criteria for major urban parks range from 2.5 acres per 1000 per State of Washington recommendations to 5.0 acres per 1,000 persons according to the National Recreation and Park Association (NRPA). The forecast requirement could then be from 1013 to 2025 acres. The total of existing and proposed major urban park sites listed by City and County together is 1267 acres, which corresponds with state criteria.

The entire study area is forecast to have a population of approximately 450,000 at year 2020. Criteria for regional park needs range from 10 acres per 1000 by the State of Washington and City of Spokane through 15 acres per 1000 adopted by Spokane County to 20 acres per 1000 recommended by NRPA. The City includes as a separate category

"Conservation", an amount equal to another 10 acres per 1000. Taking the mid-range criterion of 15 acres per 1000, the forecast need is 6,750 acres. The total proposed resources are as follows:

Proposed and existing City Reservations	3,402
Proposed and existing City Conservation	2,164
Proposed and existing County Regional	7,438
	13,004 Acres

The City and County goals together appear to be well over the range of usual standards. In addition to these close-in regional open spaces, there are existing State parks and National open spaces in the vicinity as follows:

Riverside State Park	6,200*
Mt. Spokane State Park	20,771
Pend Oreille State Park	400
Department of Natural Resources	6,000
Turnbull National Wildlife Refuge	17,000
	50,371 Acres

The strip of Coulee Dam National Park along the lower Spokane River is over 20 miles long and provides a significant existing resource not included above.

Significance to Plan Formulation and Evaluation

From the foregoing comparison of projected need for major recreation and open space sites with all existing sites and planned

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*Includes 360 acres the State would like to exchange for more suitable contiguous land. The State has plans for acquisition of an additional 2060 acres, 1700 acres net after exchanges making future total area 7540 acres.

programs of the City of Spokane and Spokane County, it is evident that, with respect to gross areas, more than adequate sites have been identified. If, as a minimum, these identified sites are given recognition in plan formulation and evaluation a significant step will have been made toward protection and enhancement of recreational opportunities for the study area.

Although the gross area requirements appear to be met by the identified sites, the kind and quality of sites may not be optimal to meet the desires of the community in some categories. The most significant category in short supply is lake frontage of the kind and quality typified by Liberty and Newman Lakes. The limited natural supply is aggrevated by the fact that most of the existing supply has been taken by uncontrolled private development.

The existing and proposed recreation and open space sites indicate that the following should be target areas for protection and enhancement of wastewater management and flood control plans:

1. Spokane River from Trent to Fort Wright. This stretch of river is at the heart of City plans to make the river the key aesthetic element in the vicinity of the City. The upper part forms frontage for the proposed Baldy Mountain recreation complex.

2. Spokane River from Fort Wright to the Little Spokane Confluence. This portion of the river is the reason for existence of Riverside State Park.

3. Long Lake. Although this large body of water does not figure in any recreation plan it has high potential for boating, water skiing and fishing. Boating and water skiing in particular put heavy pressure on smaller lakes that could be relieved. A combination of improved water quality and game management would provide an important spiny-ray fishery.

4. Lower Little Spokane River. The County has two proposed riverfront parks in this area. Although both water quality and flow stability are relatively good, there is the need for protection. Overbank flows are common indicating possibility of combining open space and recreation with flood zoning. Summer flow augmentation is a need as indicated by recent suspension of surface water rights applications.

5. Lower Hangman Creek. This stream has very low flow stability, going from dry in summer to very high turbid flows in winter and spring. Water related use is not the focus for recreation at this location for these reasons.

6. All natural lakes. Both Spokane County and Pend Oreille County have identified practically every lake of any size for recreation use. Protection of water quality is the prime concern.

7. Golf courses and green belts provide opportunities for use of reclaimed water throughout the area.

No recreation plan contains provision for creation of artificial lakes for recreation or creation of wet areas to attract wildfowl. These are both possible uses for reclaimed water use or diverted surplus flood flows.

TABLE 1

POPULATION PROJECTION
SUMMARY RELATED TO RECREATION
PLANNING UNITS

Planning Units	1970	1980	2000	2020
County Control Totals				
Spokane	287,500	324,600	390,000	450,000
Lincoln	9,600	8,900	7,900	7,700
Pend Oreille	6,000	5,300	4,600	5,000
Stevens	17,400	17,300	17,900	18,600
Whitman	37,900	41,900	43,700	45,500
Spokane Co. Breakdown				
City of Spokane	170,516	182,145	196,050	211,896
Suburban not including City	87,584	109,995	154,950	193,104
Rural (total)	29,400	32,460	39,000	45,000
Rural (inside study area)	26,834	29,627	35,596	41,072
Portions of Other Counties inside Study Area				
Lincoln	413	383	340	331
Pend Oreille	884	781	678	737
Stevens	2,646	2,661	2,722	2,829
Whitman	855	945	986	1,026

TABLE 2

RECREATION SITE CATEGORIES

A. General Recreation Areas

1. Small Urban
2. Large Urban
3. Regional

B. Special Purpose Recreation Areas

1. Winter Sports
2. Golf Courses
3. Spectator Sports
4. Field Sports
5. Boating
6. Swimming

C. Conservation Oriented Areas

1. Resource Areas

a. Outstanding Natural Areas

1) Fresh Water Shorelands and Access
2) Forest Areas
3) Mountain Areas
4) Range Areas
5) Agricultural Areas
6) Wetlands

b. Interpretive Areas
c. Key Ecological Areas

2. Aesthetic Areas

a. Scenic Roads
b. Urban Greenbelts and Parkways
c. Urban Malls/Squares

TABLE 3

MAJOR OPEN SPACE GOALS
OF THE CITY OF SPOKANE

Category	Location		Proposed Area Acres*	
Major Park	Peaceful Valley		86	
	Stadium Park		84	
	Manito		90	
	Minnehaha		97	
	Lincoln		77	
	Browne Mountain		102	
		Subtotal		536
Reservation	Baldy Mountain		800	
	Browne Mountain		2,060	
	Fort Wright		542	
		Subtotal		3,402
Conservation	Palisades		648	
	Indian Canyon		147	
	Latah Creek		491	
	Riverfront		878	
		Subtotal		2,164
Greenbelts				122
TOTAL OPEN SPACE				6,224
	Subtotal inside City			1,426
	Subtotal outside City			4,798

*Includes existing and proposed future additions.

TABLE 4

SPOKANE COUNTY LONG TERM GOALS FOR
MAJOR PARKS AND OPEN SPACES

Map No.	Name	Type and Area, Acres** MUP	RIP	WP	RP	HP	GC
PROPOSED SITES							
N-38	Lower Little Spokane		300				
S-12	Moran	150					
E-57	Dishman Hills	203					
N-5	Holmberg	100					
N-42	Upper Little Spokane		375				
W-17	Fish Lake			53			
N-34	Elk Park				10		
E-67	Sullivan Bridge		20				
E-61	Morrow				80		
W-18	Silver Lake			200			
W-22	West Medical Lake			150			
W-24	Willow Granite Lake			100			
W-10*	Amber Lake			100			
W-23*	Williams Lake			200			
W-13*	Chapman Lake			200			
N-29	Bailey Lake			200			
E-63	Pasadena	150					
W-20*	Little Hole in the Ground				250		
E-62	Newman Lake			200			
W-11*	Badger Lake			150			
S-10	Lower Hangman				200		
N-36	Occident School					50	
W-12*	Bonnie Lake				600		
W-15*	Clear Lake			200			
W-16*	Downs Lake			250			
W-19	Horseshoe Lake			250			
N-33	Deer Park						300
N-43	Wandermere						340
Subtotals, Proposed		603	695	2253	1140	50	440
EXISTING SITES							
N-28	Bear Lake			250			
N-5	Holmberg	6					
E-65	Plantes Ferry		20				
W-17	Fish Lake			57			

TABLE 4 - Continued

Map No.	Name	Type and Area, Acres** MUP	RIP	WP	RP	HP	GC
N-34	Elk Park				10		
E-67	Sullivan Br.		10				
E-61	Morrow				40		
E-56	CV Lions Club		2				
E-69	Valleyford				22		
E-60	Mirabeau	5					
N-40	Pine River		9				
E-57	Dishman Hills	117					
E-66	Liberty Lake			2930			
E-58	Liberty Lake						140
S-14	Hangman Creek						200
Subtotals, Existing		128	41	3237	72	-	340
TOTAL, Existing and Proposed		731	736	5490	1212	50	780

*Not in the study area.
**MUP = Major Urban Park
RIP = Riverfront Park
WP = Waterfront Park
RP = Regional Park
HP = Historical Parks
GC = Golf Course

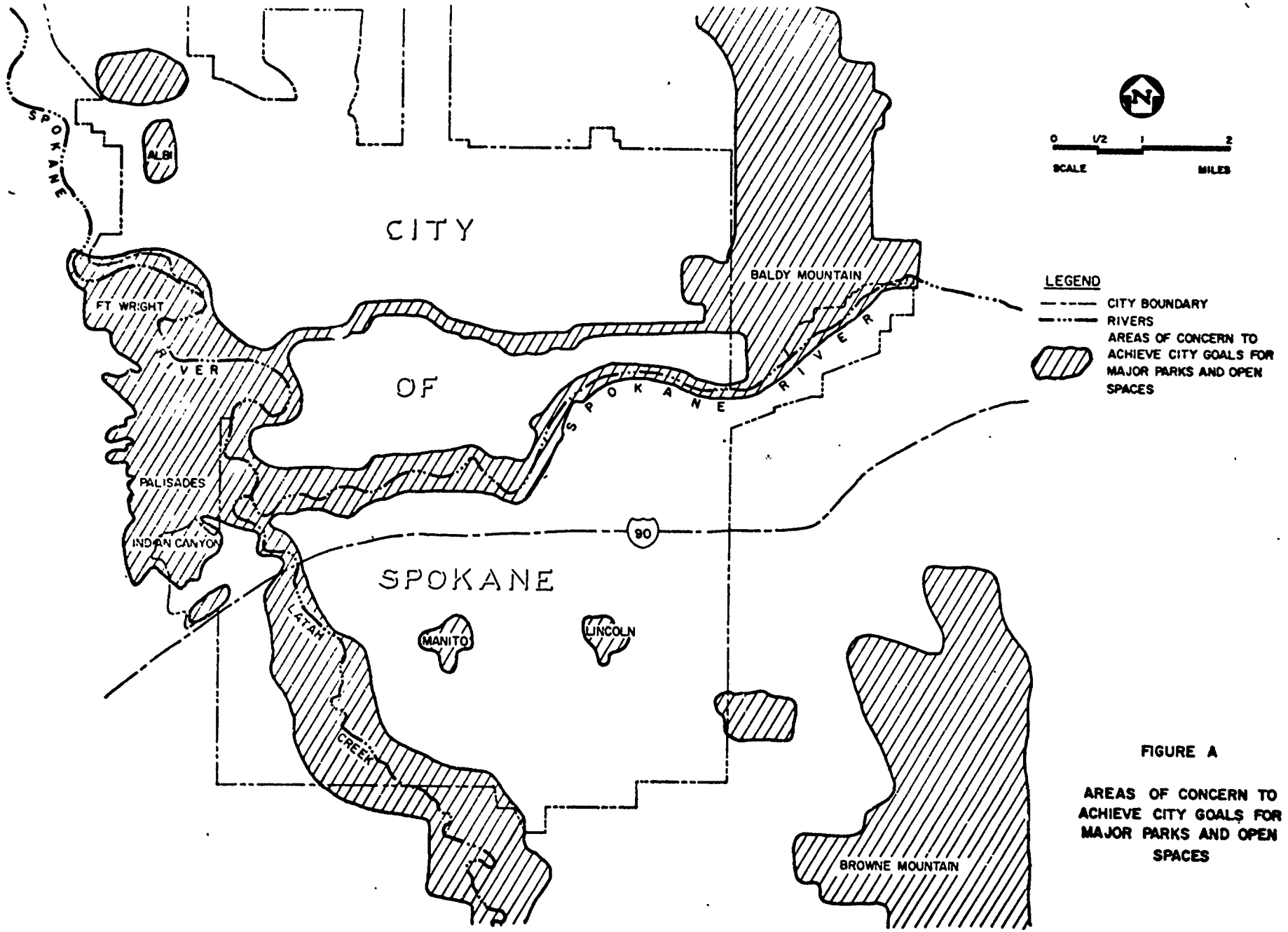
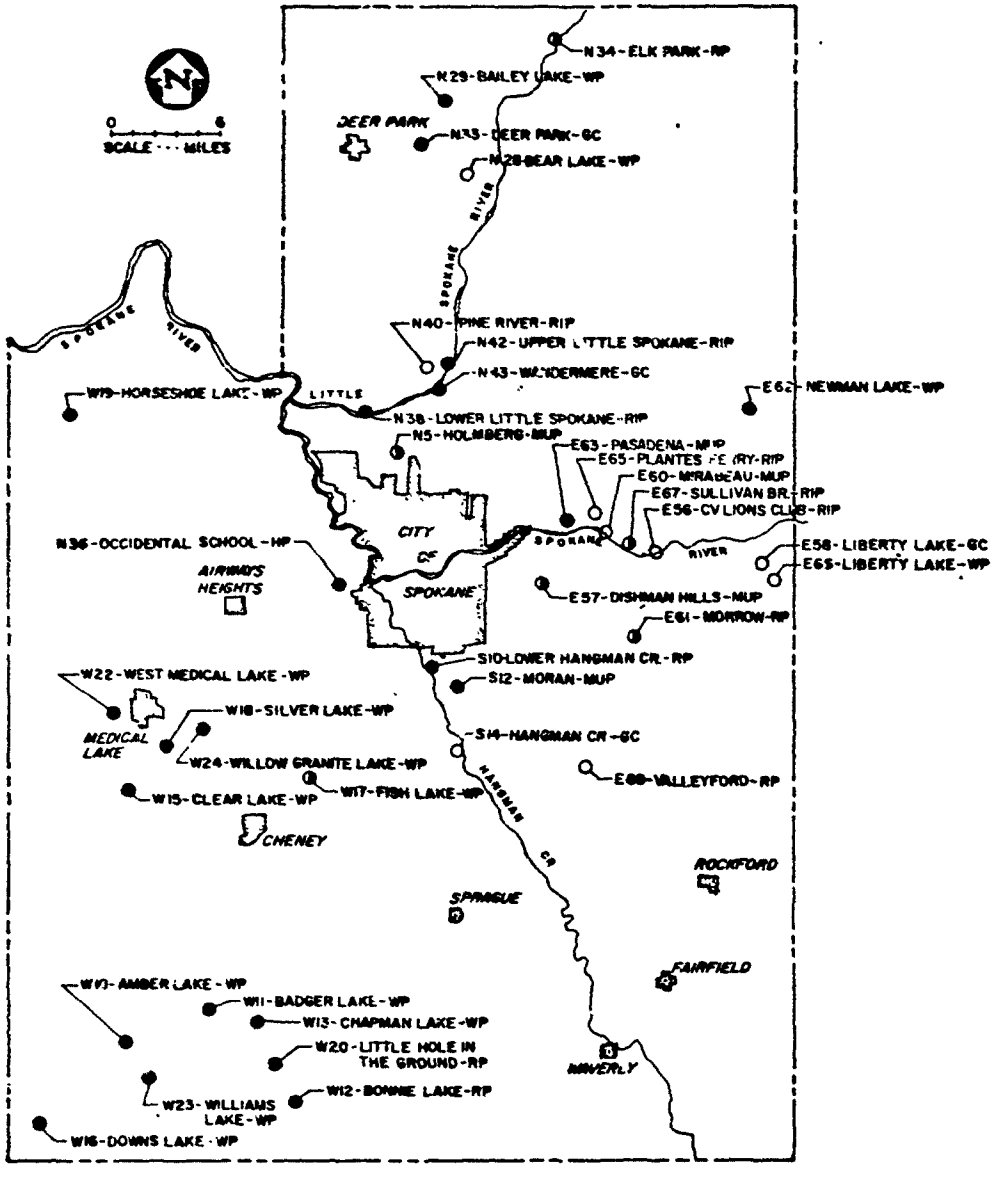


FIGURE A

AREAS OF CONCERN TO ACHIEVE CITY GOALS FOR MAJOR PARKS AND OPEN SPACES



LEGEND

○	EXISTING RECRATION SITE
●	PROPOSED RECRATION SITE
◑	EXISTING SITE WITH PROPOSED ADDITION
W13	SITE MAPPING NUMBER (SEE TABLE 4)
MUP	MAJOR URBAN PARK
RIP	RIVERFRONT PARK
WP	WATERFRONT PARK
RP	REGIONAL PARK
HP	HISTORICAL PARK
GC	GOLF COURSE

FIGURE 8

EXISTING AND PROPOSED
SPOKANE COUNTY
MAJOR RECREATION SITES

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