WATER QUALITY MONITORING PLAN

BUFFALO NATIONAL RIVER

FEBRUARY, 1985

BUFFALO NATIONAL RIVER
IN COOPERATION WITH

NPS Water Resources Field Support Laboratory
Fort Collins, Colorado

Southwest Regional Office/Office of Natural Resources
Santa Fe, New Mexico

TABLE OF CONTENTS

INTRODUCTION

The quality of the water which flows into and along the Buffalo River is generally considered to be excellent. The river and one of its major tributaries are designated by the Arkansas Department of Pollution Control and Ecology (ADPC&E) as Outstanding Natural Resource Waters and as having extraordinary recreational and aesthetic value, the highest ranking of stream quality in this system. At the same time, a number of water pollution problems are potential threats to the Buffalo National River. The threats include the following types.

Agricultural runoff has been shown to contribute to turbidity and bacteria and nutrient levels, especially after rains have been heavy enough to cause runoff during normal and low flow periods, where animals have direct access to the stream. This threat is intensified by the traditional husbandry practices in the Ozarks of overstocking and overgrazing.

Recreational activities associated with visitor use of the Buffalo National River pose a potential threat to water quality, especially in locations and seasons of concentrated use.

Urban and residential areas which make up less than 1% of Buffalo River's watershed have potential to contribute very small quantities of pollutants, however, pollutants from such areas usually tend to be more detrimental in small quantities (i.e.,) heavy metals and chemicals). Rural residential areas may contribute pollutants to the river through poor or faulty sewage disposal methods.

Some potential for water quality degradation is associated with logging operations simply because such a large majority of the watershed is forested.

Mining is a serious potential threat to water quality in many areas due to concentrations of trace elements contained in runoff from waste dumps of abandoned mines.

At this time, almost no information on water quality is being collected for the Buffalo National River. The National Park Service relies entirely upon the State of Arkansas to monitor trends in water quality and to detect violations of water quality standards within Buffalo National River. This is based on the data gathered from the sampling station near the midpoint of the river. No routine monitoring program of any kind is carried out to assess the quality of Buffalo National River's subsurface resources.

Numerous sampling programs have been carried out in the past, to determine the quality of Buffalo National River's waters. The most significant of these have occurred after the establishment of Buffalo National River in 1972. The majority of these projects have been aimed at gathering comprehensive baseline data on a "one-shot" or limited time period basis. The most comprehensive of these being a National Park Service contract study by the Arkansas Water Research Center (AWRC) at the University of Arkansas in Fayetteville, however, these data are now eight years or more old. To continue to depend upon the State's single monitoring station to provide all of Buffalo National River's water quality data would allow only for detection of large scale changes in water quality. Serious point sources of pollution and extreme violations of State water quality standards in specific stream watersheds would probably not be detected.

It is important that the NPS initiate a water quality monitoring program as proposed in this plan, to provide for a regular comprehensive analysis of Buffalo National River's water resources and measures for mitigation of any problems discovered as a result of this monitoring. It also would provide important water quality information needed for making management decisions and protection of the water resources.

OBJECTIVES

1. To gather water quality data for the river corridor to be used for monitoring long term trends in water quality.

2. To gather data necessary to determine the degree to which certain tributaries are impacted by pollution.

3. To monitor those areas where concentrated primary contact recreational activities occur to assure that no public health problems exists.

PARAMETERS

1. Flow

Some type of flow measurement will be recorded for each sample collected. This measurement will, for river corridor samples, be recorded as discharge as reported by the USGS at the St. Joe gauging station, or as stage from a reading of a staff gauge which is to be installed near Ponca, whichever is nearest to the sample site. A stage discharge rating curve will be developed for the Ponca station either by USGS or by the NPS sometime in the future. Staff gauge height will be recorded to the nearest 0.02 feet. Staff gauges will also be established for a representative number of tributaries (see appendix A). No stage discharage rating curves will be calculated for these sites until such time as a more concentrated monitoring program may be implemented. These flow measurements are necessary in order to help understand fluctuations in other parameters and pollution levels. Discharge will be recorded to the nearest 0.1 CFS.

2. Specific Conductance

Specific conductance will be measured using YSI model 33 S-C-T meter. Readings will be recorded to the nearest umhos/cm. All measurements will be direct measurements taken in the field from the same location as where any samples are collected. The instrument should be operated according to the manufacturers instructions. The meter should be checked against a standard sample no less than 6 times per year. Specific conductivity measurements are necessary to

help explain fluctuation in other parameters and to understand relationships of certain phenomenon to pollution levels.

3. Water Temperature

Temperature will be measured in the stream using the YSI model 33 S-C-T meter and will be recorded to the nearest 0.5 degrees, C. Temperature measurements are necessary to help explain fluctuations in other parameters and pollution levels.

4. Turbidity

Turbidity will be measured using a HACH model DR colorimeter. All measurements will be made on site and will be recorded to the nearest formazin turbidity unit (FTU). Specific instruction for use of the instrument in the users manual should be followed. Turbidity measurements are needed to help explain fluctuations of other parameters and to understand relationships of certain phenomenon to pollution levels.

5. Chlorine

A HACH model CN-70 kit which uses the DPD analysis method will be used to measure free chlorine. Measurements will be made in the field and recorded to the nearest .02 mg/L. Samples will be taken from the stream receiving sewage treatment plant effluent near its confluence with the river. Manufacturer's instructions will be followed in carrying out sample analysis. Chlorine measurement are necessary during low flow periods to ascertain if any potential exists for ecologically damaging levels of chlorine to occur in the river as a result of cholorination of waste water by NPS sewage treatment plants.

6. Fecal Coliforms

The membrane filter technique as described in Standard Methods will be used to perform all analysis for fecal coliforms. Samples will be collected in 100 ml Whirl-Pak bags. The following guidelines apply to sample collection for fecal coliform analysis:

A. Samples should be taken upstream from areas disturbed by wading or other activities which stir up bottom sediments.

B. Suspended or floating organic materials should not be included in the sample.

C. Samples should be taken from near the center of the stream, below the water's surface approximately halfway to the bottom (this is accomplished by not opening the Whirl-Pak bag until it is submerged to the proper depth).

D. Bags should be completely filled with no air space remaining.

E. Avoid contaminating the sample with hands or fingers. Hands should be downstream from mouth of bag when taking sample. All samples will be placed in a dark, refrigerated container within 15 minutes following collection. Samples will be transported to the lab, stored overnight in a refrigerator, and filtered and placed in the incubator the following morning. Incubation must be started on all samples within 30 hours of collection. All cultures should be counted 24 hours after incubation at 44.5 degrees plus or minus 0.2 degrees, C. Results will be recorded as the number of fecal

coliform colonies per 100 ml. An adquate number of dilutions should be filtered in order to obtain a plate count of from 20 to 40 colonies. The following dilutions should be used for the listed colony counts,

fecal coliform colonies/100 ml	sample quantity
0- 200	20 - 100 ml
200- 500	10 - 20 ml
500- 1000	2 - 10 ml
1000-10000	0.2 - 2 ml
10,000+	0.2

The sample dilution(s) and plate counts will also be recorded for each sample. Guidelines in Standard Methods and Millipore publications concerning microbiological analysis should be followed. These fecal coliform measurements are necessary in order to ascertain effects of land use activities on the watershed. The Arkansas water quality standard for bacteria has, in the past, been the only standard for which a significant number of violations or potential violations has been shown. Violations of this standard may potentially be linked to serious threats to public health. It is therefore the parameter on which primary emphasis is placed for this monitoring program.

7. Total Coliforms

Sampling and analysis techniques for total coliforms are basically the same as those described for fecal coliforms except that the incubation temperature is 35 degrees C plus or minus 0.5 degrees C and appropriate culture medium should be used as described in Standard Methods. This analysis will be used periodically to help assure accuracy of fecal coliform analysis.

8. Fecal Streptococcus

Sampling and analysis techniques for fecal streptococcus are basically the same as those described for fecal coliforms except that the incubation period is 48 hours and appropriate culture medium should be used as described in Standard Methods. Fecal streptococcus analysis will only be conducted in special cases where high fecal coliform counts are found on a sustained basis. This analysis will be used to help determine possible sources bacterial pollution.

9. Dissolved Oxygen

A HACH model OX-2P test kit will be used to measure dissolved oxygen using the Winkler methodology as described in Standard Methods. Samples should be collected in the same location as those for coliforms using methods described by the manufacturer. Results will be recorded as mg/L. This parameter will be monitored periodically because of its relevance to state water quality standards and due to its importance in maintaining an ecological balance. Percent saturation of dissolved oxygen will be determined from dissolved oxygen concentration and water temperature data.

10. Metals

Samples will be collected periodically for contract analysis for metals to include those for which a state standard exists and which are normally included in a routine USGS analysis. Samples should be collected generally as described for coliform sampling or as

directed by the contractor. Periodic measurement of this parameter is necessary to help understand relationships of any long term changes in the aquatic ecosystem to pollution levels.

11. Nutrients

Samples will be collected periodically for contract analysis for total phosphorus and total nitrogen. Samples should be collected generally as described for coliforms. Samples should be stabilized if necessary as requested by the contractor. Analysis will be done using the persulfate digestion method to digest samples and measurement by the stanuous chloride, or ascorbic acid method to measure samples as set forth in Standard Methods. Periodic measurement of this parameter is necessary in order to help understand any large scale, long term changes in aquatic flora and other associated changes in the aquatic ecosystem.

SAMPLE SITES

Site selection will be grouped into three categories:

1. River Corridor (Trend Monitoring)

These sites will be located near sites used in the past for other studies for which a significant amount of data already exists. Any additional sites will be located at points along the river where significant differences in parameters might be expected between established sites (see appendix B). One sample at each site will be collected within a one week period, once per month March through

September and once every other month the remainder of the year (9 sample sets, see appendix A). Samples will be analyzed for:

Flow- (stage and/or discharge) Each sample
Specific Conductance- Each sample
Turbidity- Each sample
Temperature- Each sample
Fecal Coliform- Each sample
Total Coliform-
All samples will be analyzed for T.C. every other month that samples are collected (five sample sets per year). This will provide an element of quality assurance for the fecal coliform analysis.
Disolved Oxygen/Nutrients (TOT P/TOT N)-
All samples will be analyzed for nutrients and D.O. from one month's sample set, once each season (four sample sets per year). Since no significant problem with levels of these parameters has been detected in past sampling programs, only enough data to assess long term trends is needed. Four samples are taken to account for seasonal fluctuations.
Metals-
Two sample sets per year will be analyzed for metals in order to maintain a continuing database for this parameter.

2. Tributary Reconnaissance

Selection of these sites will be based on the relative size of the drainage area, those which have higher proportional areas or densities of land uses with potential to cause non-point source pollution, and those containing significant point sources. These sites will be sampled twice monthly March through September. The samples will be analyzed for the following parameters:

Flow (stage only)- Each sample
Specific Conductivity- Each sample
Temperature- Each sample
Turbidity- Each sample
Fecal Coliform- Each sample
Total Coliform-
All samples will be analyzed for T.C. for one sample set every two months throughout the sampling period. This will provide an element of quality assurance coliform analyses.

Dissolved Oxygen/Nutrients (TOT P/TOT N)/Fecal Streptococcus- Analysis for these parameters will only be conducted if sustained, high levels of F.C. are detected and will be conducted on a specific case by case basis as personnel time and funding permit to try to determine possible sources of pollution.

3. Primary Contact Recreation Sites

Those areas receiving concentrated canoeing or swimming will be monitored during the respective period of high use. Samples from these sites will be monitored for fecal and total coliform, specific conductivity, turbidity and temperature. If anomolously high levels of F.C. are detected in more that two consecutive samples, fecal coliform/fecal strep ratios will be analyzed. Samples will be collected once every two weeks for these sites unless a sample containing over 200 F.C. colonies/100 ml is found, in which case the site will be sampled once per week until the F.C. count drops below this level. If a reasonable potential exists for a violation of Arkansas water quality standards, an adequate number of samples will be collected to ascertain compliance or non-compliance.

DATA ANALYSIS

In order to make the data gained from this monitorings project most useful to management and to provide a database that will be useful for monitoring long term trends, a standardized format will be used to record, list and display all data. All data will be recorded on standard field forms (Appendix C). Appropriate data will be recorded at the time of collection and analysis. All data will be recorded on a summary chart showing each sample date and the

corresponding data. All data will also be graphically plotted on a yearly basis. These graphs will be prepared to show extreme values, median values and the range of the 75th percentile (bar and whisker graph). This same method will be used to prepare a graph for each river corridor site to show: 1) yearly trends (one bar representing one years data) for each parameter (except metals) at each site, 2) yearly trends for each parameter (except metals) for the river as a whole, 3) a yearly comparison of differences between sites (one bar representing one site, 4) a yearly comparison of each month's data for each parameter (one bar representing one month's data).

Similar graphs will be prepared for the tributary sites to show: 1) a yearly comparison of differenes between sites (one bar representing one site), 2) a yearly comparison of each sample date (one bar representing one sample date). All charts, graphs and data summaries will each year be prepared in professional form and maintained in one data file or document.

ACTION

Any action taken as a result of monitoring of river corridor sites will be as a result of those trends shown over the years. This is a long term, continuing program and will show only general trends. One potential action would be a stepped up or one shot intensive monitoring program to locate a pollution source. Another action would be the use of the data to determine objectives of NPS participation in review of state water quality standards or in legislation affecting land use in Buffalo River watershed.

Tributary monitoring is designed to determine the origin from which any existing pollutants enter the river. In addition the program will determine which tributaries display man-induced impacts and which do not. Actions taken as a result of this monitoring will be:

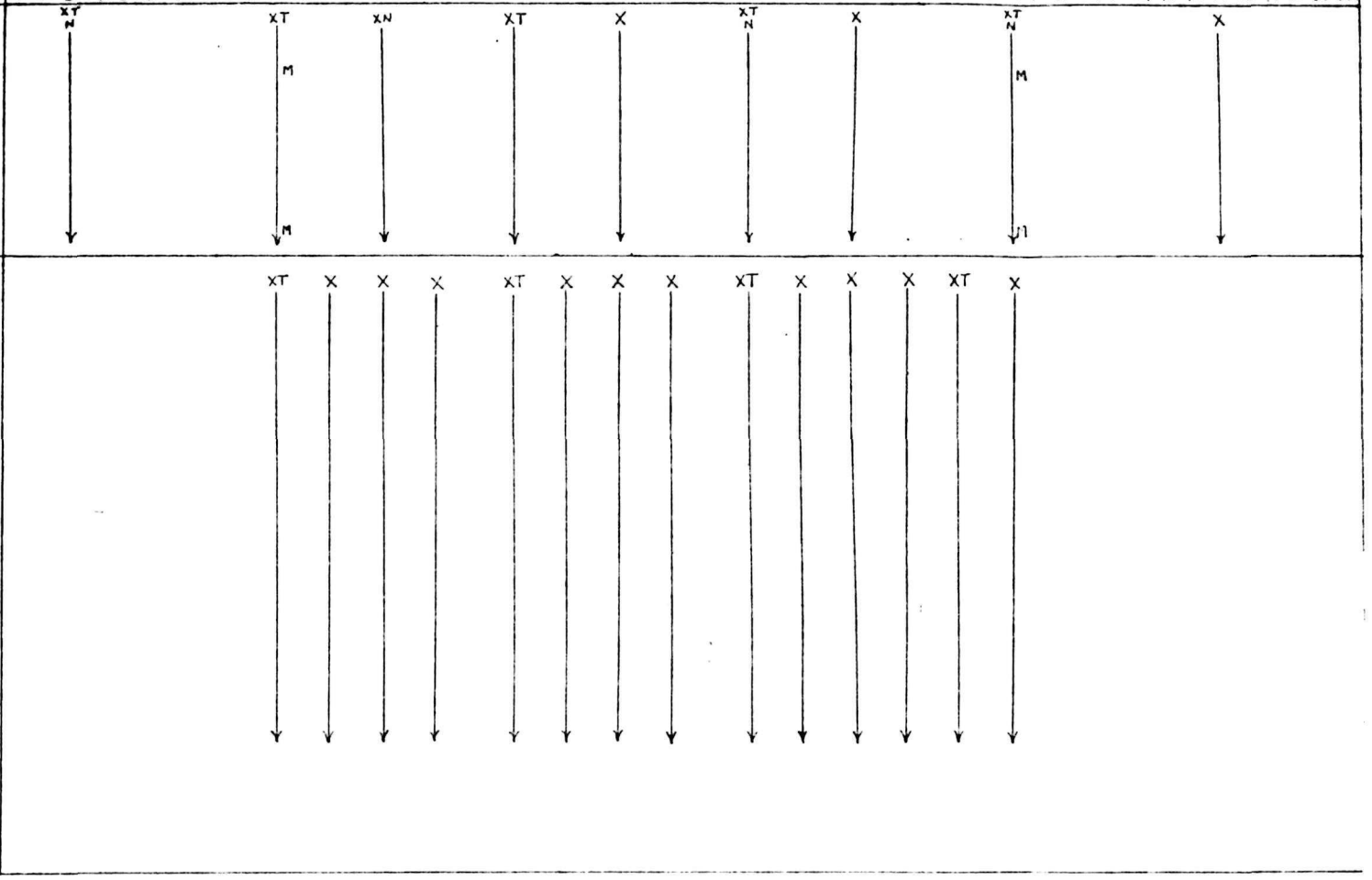
1) classification of individual watershed's according to their respective water quality, 2) continued or more intensive monitoring of any tributary found to be contributing significant pollution loads to the river. Upon the completion of this analysis, there should be little need to continue to monitor those tributaries found to have relatively high water quality on other than an infrequent basis to maintain long term trend data or for a specific problem.

The monitoring of water quality at areas receiving concentrated public use is designed primarily to protect public health. Action taken as a result of this monitoring should therefore be in the interest of protecting public health. Monitoring should be geared to those times when water quality would be most likely to cause health problems. Any samples found to exceed 200 fecal coliform colonies per 100 ml of water that are not suspect or cannot be explained by some other phenomenon should result in the posting of that particular area warning visitors of the potential health hazard.

The site should then be sampled daily until the fecal coliform level drops below this level and warnings are removed. Any significant repetition of such problems should bring about a monitoring or research project to determine the source of the problem and identify a solution.

Appendix A

	SITE NO.	SITE LOCATION	Stage Gauge Used
RIVER CORRIDOR	R1	Boxley	P
	R2	Ponca	P
	R3	Pruitt	P
	R4	Hasty	P
	R5	Woolum	S
	R6	Gilbert	S
	R7	Hwy 14	S
	R8	Rush	S
	R9	River Mouth *	S
TRIBUTARIES	T1	Beech Creek	X
	T2	Ponca Creek	X
	T3	Cecil Creek	X
	T4	Mill Creek	X
	T5	Little Buffalo R.	X
	T6	Big Creek	T9
	T7	Davis Creek	X
	T8	Cave Creek	T9
	T9	Richland Creek	X
	T10	Calf Creek	T9
	T11	Mill Creek	X
	T12	Bear Creek	X
	T13	Brush Creek	T12
	T14	Tomahawk Creek	X
	T15	Water Creek	T14
	T16	Rush Creek	T17
	T17	Clabber Creek	X
	T18	Big Creek *	X



	SITE NO.	SITE LOCATION	STAGE GAUGE USED
PUBLIC USE SITES	P3	Steel Crk Lnch	P
	P4	Kyles Launch	P
	P6	Pruitt Launch	P
	P1	Ponca LW Bridge	P
	P2	Steel Crk Sw Ar	P
	P5	Pruitt Swim Area	P
	P7	Hwy 65 Bridge	S
	P8	Gilbert Beach	S
	P9	Buffalo Pt	S
	P10	Buff Pt/E Loop	S
	P11	Rush Landing	S
	P12		
	P13		
	P14		
	P15		
	P16		
	P17		
	P18		
	P19		
	P20		
	P21		
	P22		
	P23		
	P24		
	P25		
SEWAGE TREAT. PLANTS	C1		S
	C2		S

JANUARY FEBRUARY MARCH APRIL MAY JUNE JULY AUGUST SEPTEMBER OCTOBER NOVEMBER DECEMBER

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52

P3, P4, P6: X X X X X XT

P1, P2, P5, P7–P25: X X X XT X X XT

C1, C2: C C C C C

* collection as schedule permits

X-fecal coliform, flow, turbidity, specific conductance, temperature

T-total coliform

N-total phosphorus, total nitrogen, D.O.

M-metals

C-free chlorine

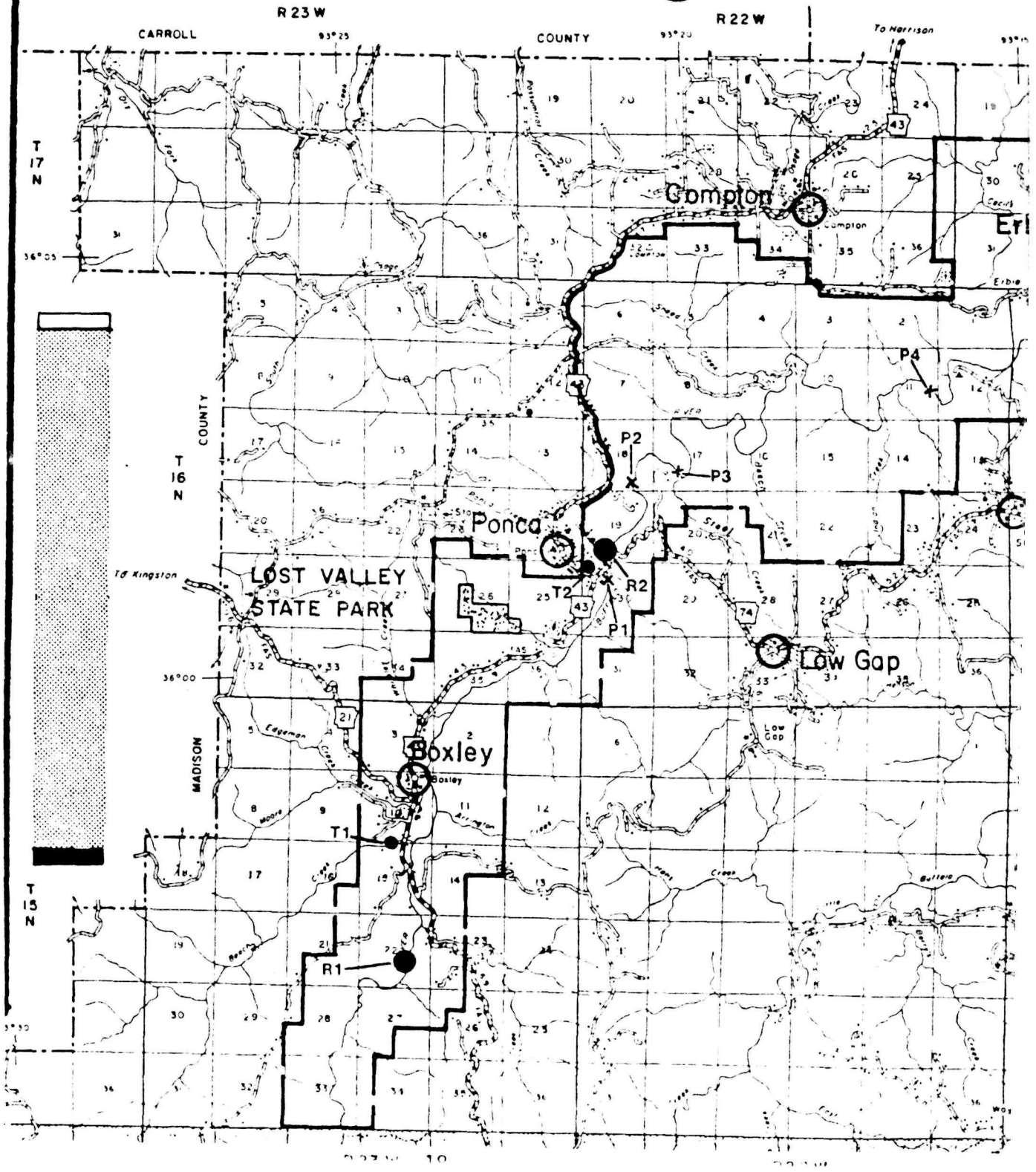
APPENDIX B

Proposed

TOWNS, VILLAGES, CO

○ 0-50 People

◎ 50-100



BUFFALO NATIO

MUNITIES - POPULATION

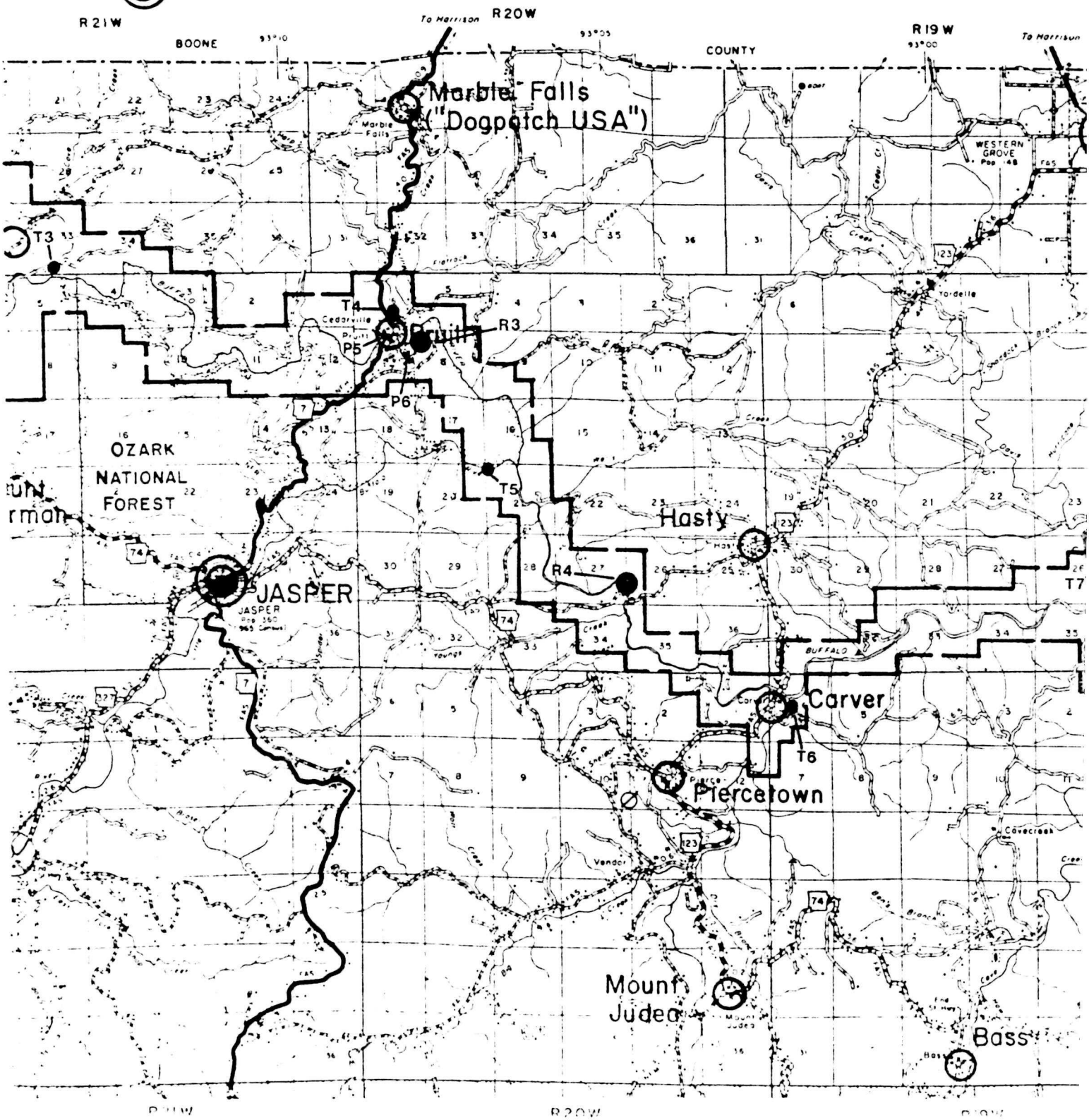
100 - 500 People

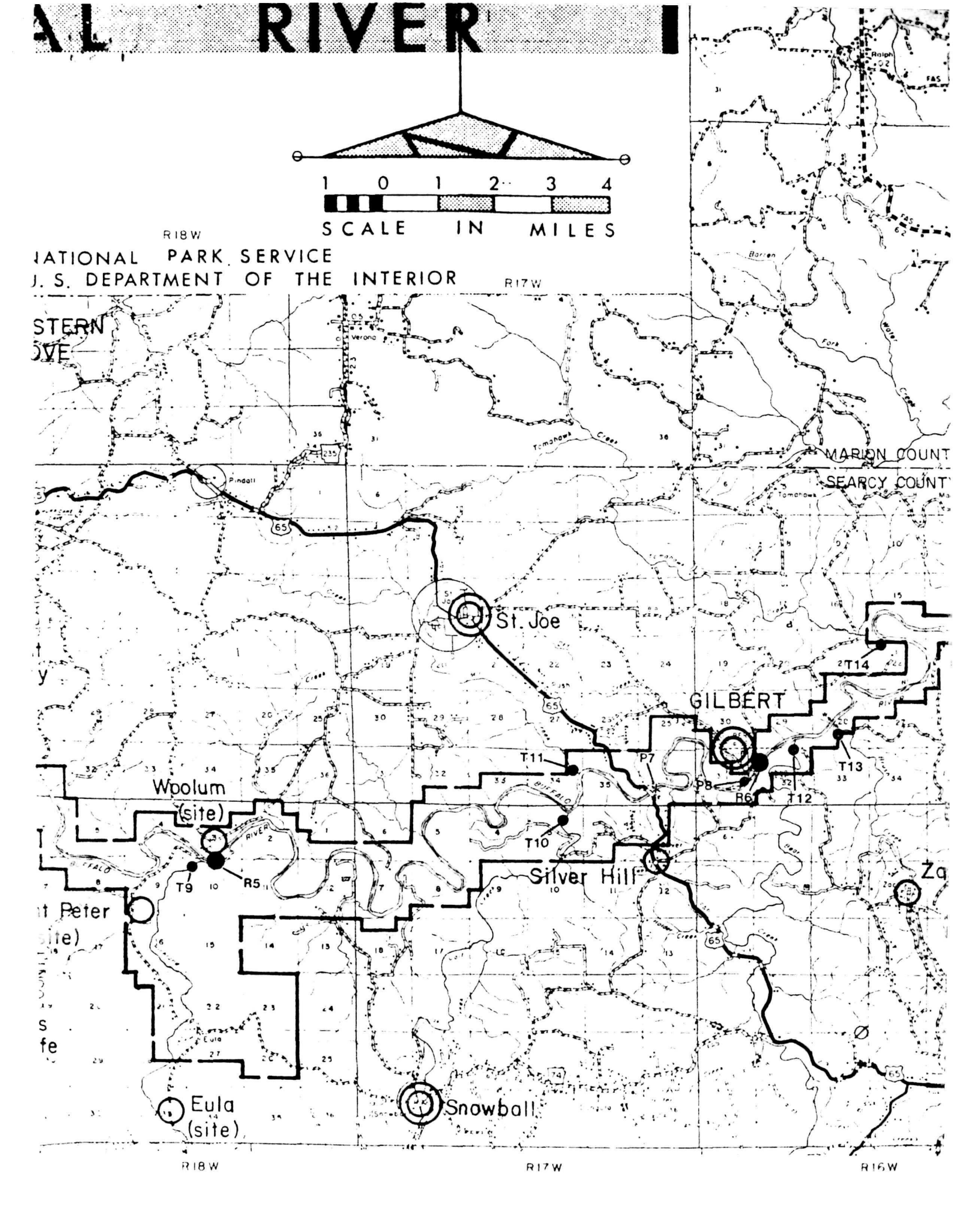
500 - 1500

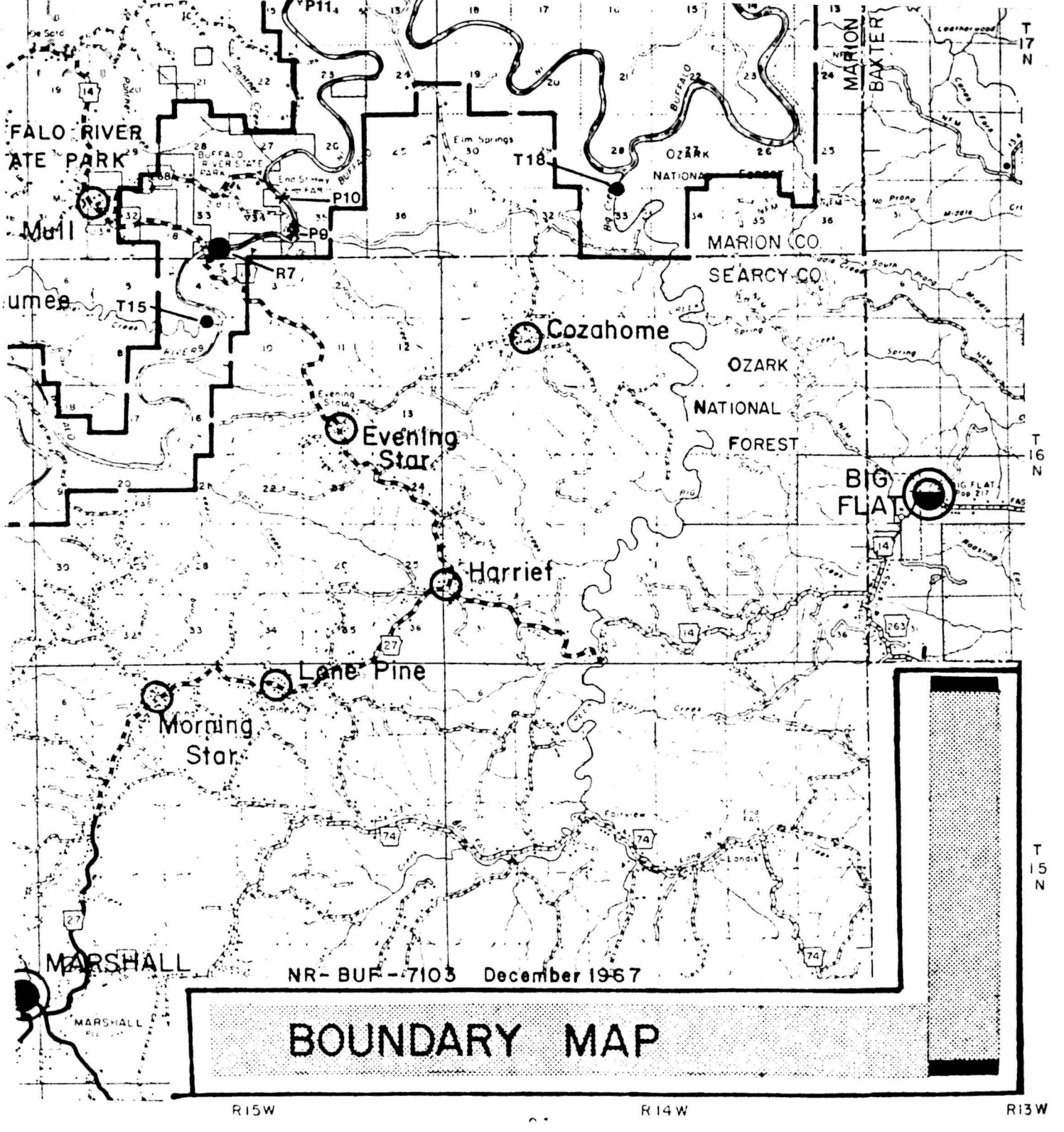
● River Corridor

• Tributary

x Public Use




AL RIVER
1 0 1 2 3 4
SCALE IN MILES
R18W
NATIONAL PARK SERVICE
U. S. DEPARTMENT OF THE INTERIOR
R17W
STERN
OVE
MARION COUNT
SEARCY COUNT
Pindall
St. Joe
GILBERT
T14
T11
P7
T13
P8
R6
T12
Woolum
(site)
T10
Silver Hill
T9
R5
Peter
ite)
Eula
(site)
Snowball
R18W
R17W
R16W


FALO RIVER
ATE PARK
Mull
umee
T15
P11
P10
P9
R7
T18
Elm Springs
Ozark
National Forest
MARION
BAXTER
MARION CO.
SEARCY CO.
Cozahome
OZARK
NATIONAL
FOREST
Evening
Star
Harriet
BIG
FLAT
Lone Pine
Morning
Star
MARSHALL
T17
N
T16
N
T15
N
R15W
R14W
R13W
NR-BUF-7103 December 1967
BOUNDARY MAP