REPORT **MR91-1**

LIFE EXPECTANCY DETERMINATION OF ZINC-COATED CORRUGATED STEEL AND REINFORCED CONCRETE PIPE USED IN MISSOURI

MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT

MHTD

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FINAL REPORT

Prepared By

MISSOURI HIGHWAY AND TRANSPORTATION DEPARTMENT

DIVISION OF MATERIALS AND RESEARCH

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EXECUTIVE SUMMARY

A study reviewing the Missouri Highway and Transportation Department's policy of culvert type selection, durability of culvert pipe, and costs of replacement or rehabilitation of corrugated metal pipe was published as an in-house report, Number MR87-1, dated May 1987. That study consisted of a literature search, survey of adjoining states, and results of previous Department investigations and field trials. In that report, zinc-coated corrugated steel pipe was found to be much less durable than reinforced concrete pipe.

The study represented by this report is a comprehensive survey of in-place culverts to more accurately determine the expected life of two culvert materials currently being used, zinc-coated corrugated steel pipe and precast reinforced concrete pipe, hereafter referred to as CSP and RCP respectively.

Many states and organizations have tried to equate the service life of culvert pipe to parameters such as pH, abrasion, soil resistivity, chemical characteristics of the effluent, and watershed characteristics. The Division of Materials and Research conducted an extensive statewide survey to determine the condition of existing CSP and RCP and to evaluate the possibility of equating service life to any single or combination of measurable parameters. The field evaluation included 2,255 CSP and 1,642 RCP stratified

by age to obtain as representative nonbiased sample as possible from all 114 counties in the state. Field and laboratory testing for specific service life parameters was conducted on a selected sample consisting of 153 CSP and 118 RCP taken from the field evaluations.

Results of this study show that neither a single or combination of measurable parameters exists that will predict a pipe's service life anywhere in the state. However, two isolated situations were identified where deterioration will occur when CSP are constantly submerged in standing water or subject to very low pH effluent from mine runoff, but these limited isolated influences are subsequently wiped out when considering the total survey.

This study indicates that CSP will generally be deteriorated to the point of needing replacement at approximately 44 years with a range from 15 to more than 60 years. The mode of failure for CSP is nearly always due to rusting out of the invert or bottom portion of the pipe. Due to insufficient number of RCP having deteriorated to the point of needing replacement, it was not possible to arrive at a realistic age for RCP replacement. The greatest problem noted with RCP is disjointing at the end pipe sections. With the durability rating system established for this survey, those pipe in need of replacement are 45.6% of the CSP and 0.3% of the RCP surveyed. Since 1987, district pipe replacement records indicate that 694 crossroad CSP have been replaced having an average age of 41.4 years.

The department's current policy permits the use of corrugated steel pipe for all entrances and for cross road drainage under all roadways except those with 400 ADT or more with an asphaltic concrete or portland cement concrete surface.

Based on this study, our recommendations are to investigate methods to reduce disjointing of RCP, investigate the use of plastic or fiberglass liners rather than replacement of deteriorated pipe, investigate the use of culvert pipe made with materials other than zinc-coated corrugated steel or reinforced concrete, that the current culvert type policy be retained and submit this report to the Design Committee for their review.

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PURPOSE OF STUDY

The replacement of crossroad culvert pipe has caused increasing expenditure by the Maintenance and Traffic Division because more pipe are now reaching a condition requiring replacement. Replacement does not necessarily mean the point when the pipe has collapsed but may mean when the deterioration is causing erosion of the roadway bed. Deterioration of culvert pipe may be defined in anyone or combination of several reasons such as, perforation of the pipe material, cracking, disjointing, etc.

The purpose of this study was to make a statewide survey of two types of existing culvert pipe, zinc-coated corrugated steel (CSP) and reinforced concrete pipe (RCP). This survey was to determine status of deterioration, to evaluate cause of deterioration, to determine life expectancy, and to evaluate the method that MHTD uses to select what type of pipe should be used in specific crossroad installations for each pipe type.

HISTORY

Several culvert surveys have been made by MHTD to determine relative failure rates or to attempt to predict life expectancy. These surveys were conducted in 1931, 1946, and 1964. Appendix A contains a copy of a summary of the 1931 and 1946 surveys and the 1964 survey report. All of these surveys concluded that CSP had a predicted life of less than 50 years and the RCP would approach 100 years.

Maintenance records continue to show that replacement of crossroad culvert pipe is an ever increasing burden on the department. Pipes which are being replaced have deteriorated beyond what these surveys have termed or rated as failure. Replacements are made when money, time and personnel are available.

Life of the crossroad pipe becomes a critical factor when present dollars are being used in a pay-as-you-go budget. Cost comparison of replacement to initial construction cost is not relevant because initial cost does not involve removal of the overburden, closing the road, maintaining traffic control, or continued maintenance required after replacement due to the "graveyard" settlement of the excavation.

This report is a follow up of the report written by the Division of Materials and Research in May 1987, Study of Use, Durability, and Cost of Corrugated Steel Pipe on the Missouri Highway and Transportation Department's Highway

System which concluded that a field study be conducted. This survey was organized to evaluate the present condition of crossroad culvert pipe, CSP and RCP, on the Missouri State Highway System and to make recommendations for future selection of materials to use.

SCOPE

This statewide survey was organized to evaluate both CSP and RCP for deterioration based on durability of the material and the structural condition. Field observations of various environmental parameters and field and laboratory tests on the pipe and soil which may influence pipe durability were included in this survey. Analysis of this database should give a comprehensive evaluation of the condition of CSP and RCP pipe in Missouri.

Sample size and distribution of pipe to be surveyed was forced by requiring 5 pipe from each county for each pipe type be within a specific age group. The age groups were:

Age	Dates Placed
10-19 Years	1970 - 1979
20-29 Years	1960 - 1969
30-39 Years	1950 - 1959
40-49 Years	1940 - 1949
50-59 Years	1930 - 1939
+60 Years	1929 or earlier

Pipe size was limited to 18 inches or greater in diameter to allow detailed inspection inside the pipe.

Survey sheets (See Appendix B) for field evaluation of corrugated metal pipe (CMP) (in this study restricted to zinc-coated) and RCP were created by reviewing most recent reports from pipe companies, states, and federal agencies. District personnel were requested to locate and survey pipe from the above categories and reduce the raw field data to a computer database file. In Appendix B is a copy of the program manual. A training school was held for the district inspectors to insure as much uniformity in the rating process as could be obtained throughout the state. The data from the surveys was then combined for analysis.

The rating system devised for evaluation of the durability and structural condition of the pipe was structured on a 0 thru 9 scale with 9 being perfect or like new condition and 0 being significant deterioration of the pipe to the point of needing immediate replacement. The exact criteria for each of the ratings is shown in the rating sheet in Appendix B. Because the two types of pipe being highly different in material and physical makeup, the criteria for the ratings will differ. This treats each pipe type fairly, however, does complicate trying to compare the two types of pipe on a hypothetical equal bases. Basically, the criteria used in this survey was that if either pipe type reached a deterioration rating of 2 thru 0 for either the durability or the structural ratings, the pipe was considered as failed and needing replacement.

District personnel surveyed a total of 2255 CSP and 1642 RCP which have been evaluated in this investigation. Figures 1 and 2 indicate the distribution and locations of the surveyed pipe and Table 1 lists the pipe shown in Figures 1 and 2 by district, county, route, log mile and date installed. All tables and figures with numerical addresses are located immediately following the Recommendations. Tables and figures with alphabetical addresses are located within the body of this report.

Life expectancy of culvert pipe has been expressed by many organizations as a relationship with various characteristics of the environment in and around the pipe. The field survey data was evaluated to determine which locations for both types of pipe should be further field tested to determine characteristics of the environment around the pipes. Figures 3 and 4 show the locations of pipe that were further tested, and Table 2 lists the tested pipe shown in Figures 3 and 4.

The number of pipe which were further field tested ranged from 12 to 20 for each pipe type in each district. The selection of specific pipe for field testing was based on the durability and structural ratings, age, and proximity to other pipe being tested. It was determined that the pipe to be field tested should represent both "good" and "bad" pipe in similar age groups. "Good" refers to pipe which is continuing to give service as designed. The pipe has maintained proper alignment and material has shown little deterioration. "Bad" refers to pipe which has shown alignment problems and/or material has shown significant deterioration. To obtain a better understanding of the relationship of "good" and "bad", refer to photographs 1 through 12.

It is recognized that many research reports have been written by other states and the industry which indicate that certain conditions, which can be measured by making tests in the field or taking samples for laboratory evaluation, may predict life expectancy of pipe. The extensive field and laboratory testing was conducted in this survey to determine what conditions in Missouri may have caused some pipe to deteriorate more rapidly than other pipe and why some pipe only had minor deterioration after 50 or more years exposure. Tests specifically conducted were:

Field tests for CSP consisted of:

1. 4-Pin Resistance
2. Soil to Pipe Resistance
3. Single Probe Resistance
4. Soil to Pipe Voltage
5. Pipe thickness at the 12:00, 3:00, 6:00, and 9:00 positions.
6. 2 Pin Voltage
7. Soil Sample

Field Tests for RCP consisted of:

1. 4 Pin Resistance
2. Single Probe Resistance
3. 2 Pin Voltage
4. Soil Sample

Laboratory testing of the soil sample consisted of:

1. Moisture content
2. pH

3. Chloride Content

4. Sulfide Content

5. Conductance

6. Total Hardness

7. Minimum Resistance

Testing of effluent was excluded due to the characteristics of the effluent being highly variable depending on the amount of rainfall and that many pipe were observed without any water flowing through them. However, it was decided that soil taken at the inlet of the pipe could contain a residue of chemicals that normally flow through the pipe during the year, therefore, would indicate the average condition of the effluent that travels through the pipe.

This data was added to the field survey data to obtain a more complete understanding of the environment at each pipe. Details of the tests and procedures used are shown in Appendix C for the field tests and Appendix D for the laboratory testing of the soil samples.

Once all the field and laboratory tests had been completed and the survey sheets checked, statistical analysis was conducted with these variables to determine if trends existed that may explain life expectancy.

ESTABLISHMENT OF DATABASE

At the onset of this investigation, it soon became apparent that manual tabulation of field data would be impractical with a survey as extensive as this one. Therefore, a PC database file system was established using dBASE III+ software.

A dBASE III+ program was developed and used on a statewide basis to facilitate data entry. This program was sent to all Missouri Highway and Transportation Department District Materials Offices with complete instructions for use. These instructions are part of the program manual included in Appendix B.

Each District submitted their raw field data and a copy of their database file on floppy diskettes for inclusion into a statewide PC database. The statewide PC database was then expanded (not altered) to include more fields for speed and flexibility in using the SAS mainframe computer program for data analysis. The SAS (Statistical Analysis Systems) computer program contains software for data processing, summarizing and reporting statistical data evaluations that can only be run on the mainframe computer and is much faster than on the individual office PC units. A sample listing of a few surveyed pipe in the SAS database format for CSP and RCP are given in Tables 3 and 4 respectively. The abbreviated codes for column headings used in the statewide PC database and the SAS database are defined in Table 5.

The various field and laboratory tests which were conducted were also listed in the SAS program. A sample listing of the SAS databases for the CSP and RCP tests are shown in Tables 6 and 7 respectively. The abbreviated code for each database for column headings are defined in Table 8.

METHOD OF STATISTICAL ANALYSIS

The statistical methods used for analyzing the basic culvert field survey data include Simple Linear and Parabolic Regression Analyses, Stepwise Regression Analysis, and Pearson Correlation Coefficients. Simple Linear and Parabolic Regression Analyses were conducted using a BASIC program written for the IBM Personal Computer. The other two analyses were conducted using mainframe computer software programs developed by SAS Institute, Inc., Version 5.

Initially, Simple Linear and Parabolic Regression Analyses were conducted on combined district data and laboratory and field tests for both CSP and RCP, as shown in Table 9. Each dependent variable (pipe ratings) was regressed with all independent (geological, watershed, field and laboratory test analyses) variables, as shown in Tables 10 thru 12. All combinations of dependent and independent variables were then graphed using the graphing capabilities of an electronic spreadsheet computer program. Due to the tremendous volume of data to be analyzed, and the slow speed PC operation, it was decided to analyze the data using SAS programs developed for the mainframe computer.

Pearsons Correlation Coefficients were run on the combined statewide data, data stratified by Geological Areas, and by individual districts using SAS statistical programs. This analysis computed simple linear correlation coefficients for each combination of two variables included within a particular stratification of interest.

A SAS Stepwise Regression Analysis was then conducted for each stratification using the results of the Pearsons Correlation Coefficient. Only the dependent variables with a coefficient of determination (R^2) greater than 0.20 were included in this analysis to test for multiple relationships. Finally, SAS Stepwise Regression Analysis was run on Watershed Areas. Based on earlier statewide analyses, it was decided to run only "Age" as the independent variable.

RESULTS OF STATISTICAL ANALYSIS

Combined District Data for CSP and RCP-Field Placement Data

Results of the Simple Linear and Parabolic Regression Analyses of physical placement of the pipe as set-up in Table 9 are shown in Tables 13 thru 16. In these tables, each dependent variable (pipe ratings) was analyzed with all four physical placement variables (age, slope of pipe, depth of cover at inlet and outlet). Tables 13 and 14 show R^2 values for combined district results. Tables 15 and 16 show the same data broken down by district. The analysis in this report are presented in terms of R^2 values because the R^2 statistic (which is termed coefficient of determination) gives the proportion of the total variation in the dependent variable that has been explained by the independent variable. In other words, what percent of the data is truly represented by the statistical equation of the line of best fit.

Explanation of tables (13 thru 16) is simply that there is no correlation between any of the independent variables (ages, slope of pipe, depth of cover inlet, or depth of cover outlet) with the durability or structural ratings whether grouped by the whole state or subdivided by districts. This can be shown also with the use of Figures A thru D. Figure A shows the distribution of statewide data for CSP for the durability rating (material) with age. Figure B shows the same relationship for RCP. The scatter

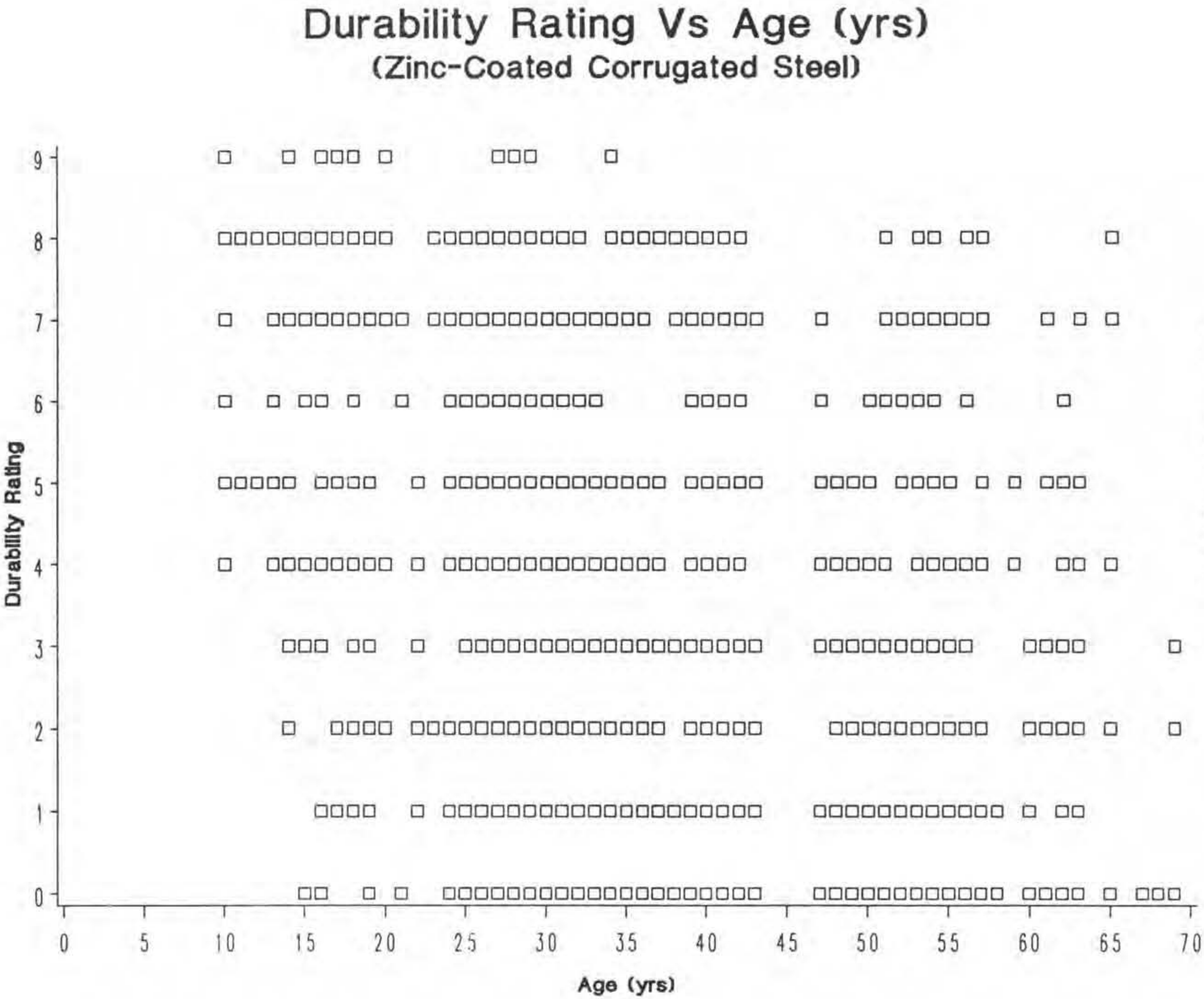

FIGURE A
Zinc-Coated Corrugated Steel Combined Statewide
Durability Rating Vs Age

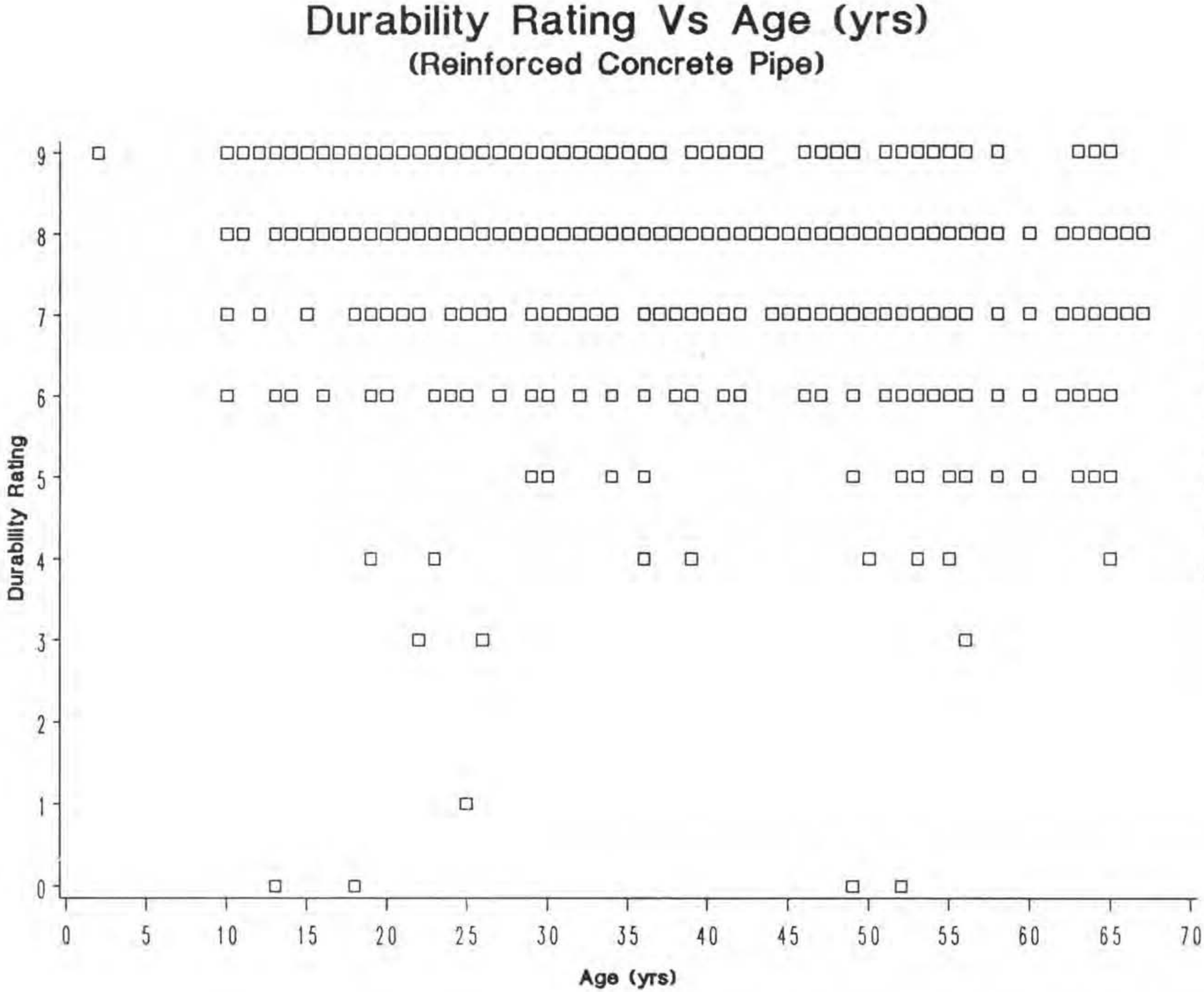

FIGURE B
Reinforced Concrete Pipe Combined Statewide
Durability Rating Vs Age

Durability Rating Vs Age (yrs) Vs Frequency

(Zinc-Coated Corrugated Steel)

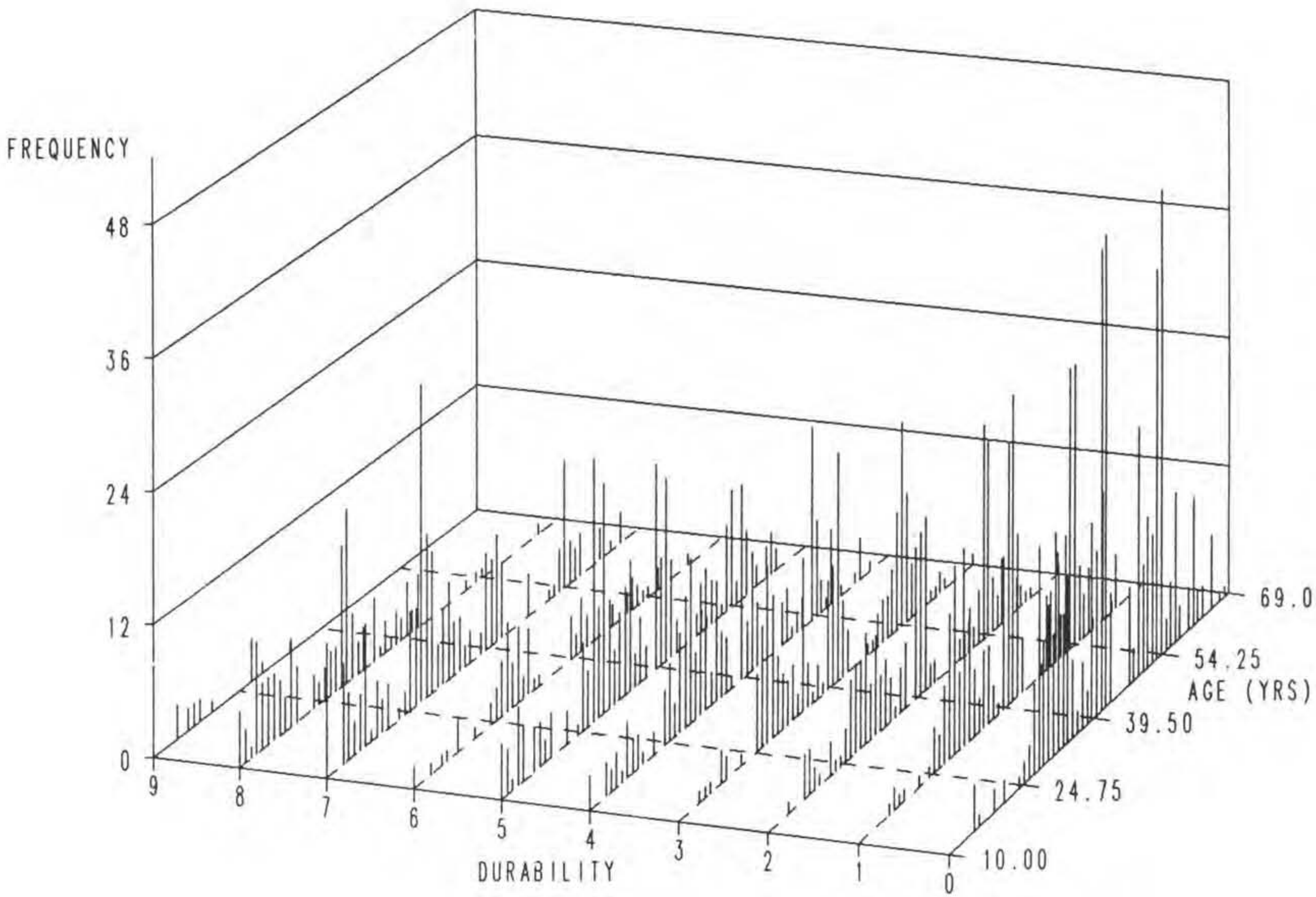

FIGURE C
Zinc-Coated Corrugated Steel Combined Statewide
Durability Rating Vs Age (yrs) Vs Frequency

Durability Rating Vs Age (yrs) Vs Frequency
(Reinforced Concrete Pipe)

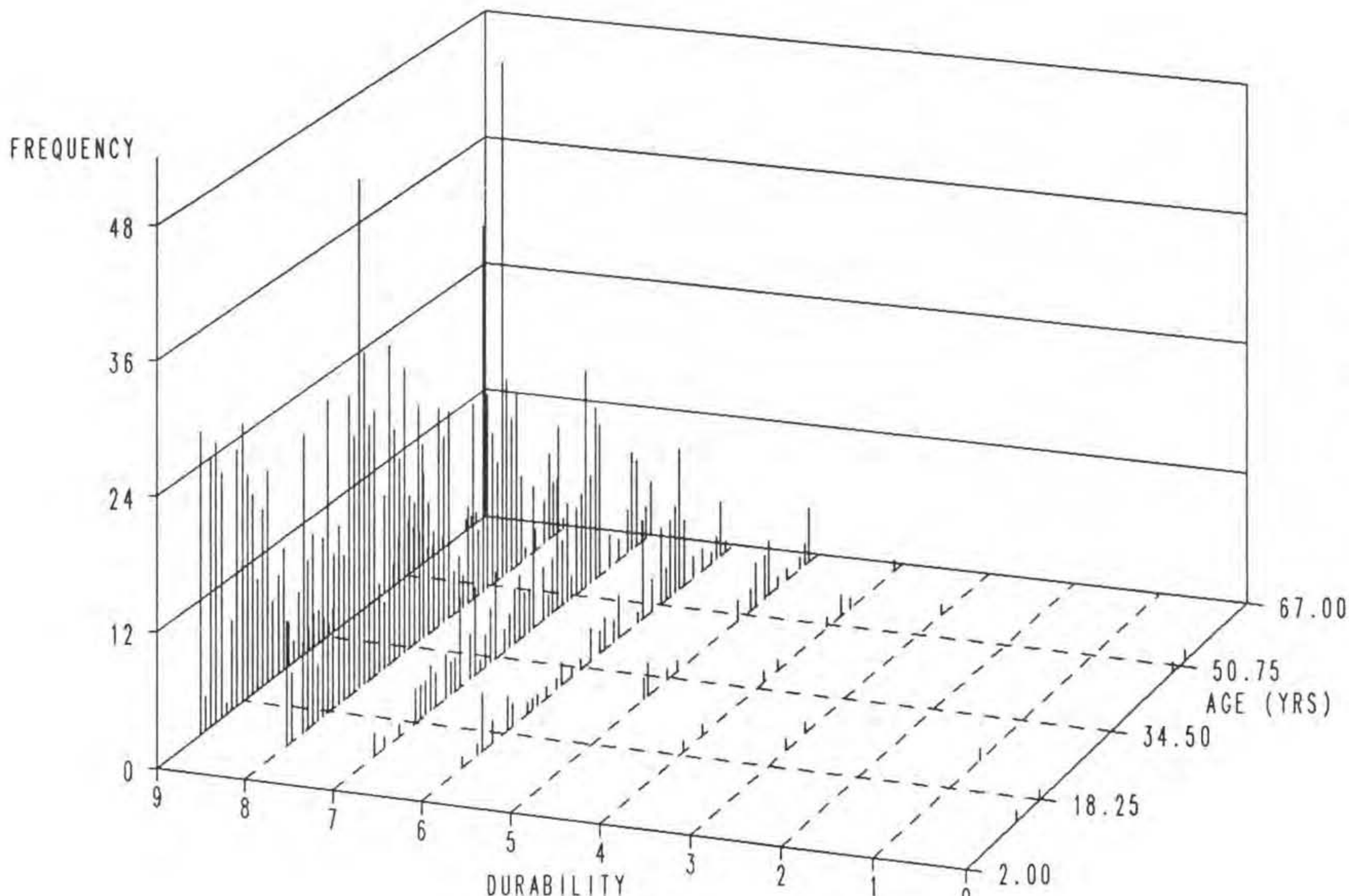

FIGURE D
Reinforced Concrete Pipe Combined Statewide
Durability Rating Vs Age Vs Frequency

of the data in Figures A and B make it obvious that a simple line drawn through the data will not represent many of the points. When adding the sample frequency (number of pipe at each point) shown in Figures A and B, the distribution of the data then becomes that shown in Figures C and D.

The scatter of this data does not allow a simple calculation of mean (average) age at a given durability rating to have much meaning. However, since data analyses in most culvert reports seem to be shown in terms of mean age, this data has also been averaged and is shown in Table A. The mean age data indicate the CSP (Part A-1) will deteriorate at a lesser rate than the RCP (Part B-1) because mean age of CSP at zero durability is 44 years whereas RCP is 33. This obviously does not represent the true relationship because, as noted in Figures C and D, the actual number of pipe in the rating of zero is highly skewed. Note the number of pipe evaluated as zero is 478 CSP to 4 RCP. Note also there are 1028 or 45.6% of the CSP in the rating of 2 thru 0 whereas only 5 or 0.3% of the RCP are in these ratings. This causes the skew in the data and the relative nonsense relationship of the "mean age" data.

The mean durability rating for each pipe type within each age group are also shown in Table A, Part A-2 and B-2. This may tend to better indicate the mean deterioration rate of a given type of pipe, however, can not be used to predict ultimate life expectancy because of the skew in the data causing a curve of almost zero slope between 40 and +60

TABLE A

MEAN AGE OF CSP AND RCP BY DURABILITY AND STRUCTURAL RATING

PART A-1 - CSP BY RATING

Number Pipe	Durability Rating	Mean Age	Number Pipe	Structural Rating	Mean Age
478	0	44	3	0	43
323	1	42	17	1	49
227	2	41	20	2	46
227	3	39	58	3	45
234	4	36	69	4	43
271	5	34	90	5	41
75	6	33	147	6	38
246	7	31	295	7	40
152	8	27	917	8	38
22	9	19	639	9	33
2255			2255		

PART A-2 - CSP BY 10 YEAR INCREMENTS

Number Pipe	Age Group (Years)	Mean Durability Rating	Mean Structural Rating
217	10-19	5.9	8.0
487	20-29	4.3	7.9
519	30-39	3.2	7.8
454	40-49	2.3	7.3
486	50-59	2.2	7.1
92	+60	2.1	6.6
2255			

TABLE A (Continued)

MEAN AGE OF CSP AND RCP BY DURABILITY AND STRUCTURAL RATING

PART A-3 - CSP BY DURABILITY RATING AND AGE GROUP

RATING	AGE GROUP 10-19 #	10-19 %	20-29 #	20-29 %	30-39 #	30-39 %	40-49 #	40-49 %	50-59 #	50-59 %	+60 #	+60 %
0	7	3.2	47	9.7	105	20.2	145	31.9	141	29.0	33	35.8
1	5	2.3	46	9.4	70	13.5	87	19.3	97	20.0	18	19.6
2	11	5.1	42	8.6	54	10.4	47	10.4	62	12.7	11	12.0
Subtotal 2 thru 0		10.6		27.7		44.1		61.6		61.7		67.4
3	8	3.7	55	11.3	49	9.4	48	10.6	61	12.5	6	6.5
4	23	10.6	54	11.1	75	14.5	32	7.0	44	9.1	6	6.5
5	36	16.6	72	14.8	76	14.6	44	9.7	34	7.0	9	9.8
6	8	3.7	29	6.0	14	2.7	12	2.6	11	2.3	1	1.1
7	52	24.0	85	17.4	46	8.9	27	5.9	29	6.0	7	7.6
8	53	24.3	50	10.3	29	5.6	12	2.6	7	1.4	1	1.1
9	14	6.5	7	1.4	1	0.2	0	0	0	0	0	0
	217		487		519		454		486		92	

PART A-4 - CSP BY STRUCTURAL RATING AND AGE GROUP

RATING	AGE GROUP 10-19 #	10-19 %	20-29 #	20-29 %	30-39 #	30-39 %	40-49 #	40-49 %	50-59 #	50-59 %	+60 #	+60 %
0	0	0	1	0.2	0	0	0	0	2	0.5	0	0
1	0	0	1	0.2	1	0.2	5	1.1	8	1.6	2	2.2
2	0	0	3	0.6	1	0.2	7	1.5	7	1.5	2	2.2
Subtotal 2 thru 0		0		1.0		0.4		2.6		3.6		4.4
3	2	0.9	6	1.2	9	1.7	14	3.1	20	4.1	7	7.6
4	1	0.5	8	1.6	17	3.3	16	3.5	21	4.3	6	6.5
5	8	3.7	13	2.7	19	3.7	20	4.4	24	4.9	6	6.5
6	15	6.9	30	6.2	27	5.2	36	7.9	30	6.2	9	9.8
7	20	9.2	52	10.7	56	10.8	73	16.1	78	16.0	16	17.4
8	73	33.6	193	39.6	206	39.7	190	41.9	218	44.9	37	40.2
9	98	45.2	180	37.0	183	35.2	93	20.5	78	16.0	7	7.6
	217		487		519		454		486		92	

TABLE A (CONTINUED)

MEAN AGE OF CSP AND RCP BY DURABILITY AND STRUCTURAL RATING

PART B-1 - RCP BY RATING

Number Pipe	Durability Rating	Mean Age	Number Pipe	Structural Rating	Mean Age
4	0	33	4	0	32
1	1	25	32	1	51
0	2	--	72	2	46
3	3	35	46	3	42
9	4	44	117	4	38
34	5	52	141	5	38
107	6	45	182	6	36
258	7	45	225	7	38
813	8	35	496	8	33
413	9	26	327	9	29
1642			1642		

PART B-2 - RCP BY 10 YEAR INCREMENTS

Number Pipe	Age Group (Years)	Mean Durability Rating	Mean Structural Rating
1	0-9	9.0	9.0
318	10-19	8.4	7.2
363	20-29	8.1	7.6
271	30-39	7.8	6.7
264	40-49	7.8	6.5
336	50-59	7.4	6.0
89	+60	7.1	5.0
1642			

TABLE A (CONTINUED)

MEAN AGE OF CSP AND RCP BY DURABILITY AND STRUCTURAL RATING

PART B-3 - RCP BY DURABILITY RATING AND AGE GROUP

RATING	AGE GROUP 10-19 #	10-19 %	20-29 #	20-29 %	30-39 #	30-39 %	40-49 #	40-49 %	50-59 #	50-59 %	+60 #	+60 %
0	2	0.7	0	0	0	0	1	0.4	1	0.3	0	0
1	0	0	1	0.3	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal 2 thru 0		0.7		0.3		0		0.4		0.3		0
3	0	0	2	0.6	0	0	0	0	1	0.3	0	0
4	1	0.3	1	0.3	2	0.8	0	0	4	1.2	1	1.1
5	0	0	2	0.6	5	1.9	2	0.8	16	4.8	9	10.1
6	12	3.8	7	1.9	12	4.4	19	7.2	46	13.7	11	12.4
7	10	3.1	32	8.8	41	15.1	60	22.7	82	24.4	33	37.1
8	115	36.0	216	59.5	167	61.6	135	51.1	148	44.0	32	36.0
9	179	56.1	102	28.0	44	16.2	47	17.8	38	11.3	3	3.8
	319		363		271		264		336		89	

PART B-4 - RCP BY STRUCTURAL RATING AND AGE GROUP

RATING	AGE GROUP 10-19 #	10-19 %	20-29 #	20-29 %	30-39 #	30-39 %	40-49 #	40-49 %	50-59 #	50-59 %	+60 #	+60 %
0	2	0.6	0	0	1	0.4	0	0	1	0.3	0	0
1	1	0.3	0	0	4	1.5	4	1.5	16	4.8	7	7.9
2	2	0.6	4	1.1	14	5.2	17	6.4	21	6.3	14	15.7
Subtotal 2 thru 0		1.5		1.1		7.1		7.9		11.4		23.6
3	5	1.6	3	0.8	11	4.1	6	2.3	17	5.1	4	4.5
4	19	6.0	20	5.5	20	7.4	20	7.6	26	7.7	12	13.5
5	29	9.2	13	3.6	20	7.4	27	10.2	47	14.0	5	5.6
6	37	11.6	28	7.7	39	14.4	33	12.5	29	8.6	16	18.0
7	37	11.6	38	10.5	32	11.8	43	16.3	56	16.7	19	21.3
8	110	34.6	149	41.0	60	22.1	82	31.1	86	25.5	9	10.1
9	77	23.9	108	29.8	70	25.7	32	12.1	37	11.0	3	3.4
	319		363		271		264		336		89	

years for both pipe type. The skew in the durability data has been shown graphically in Figures C and D and numerically in Table A, Parts A-3 and B-3. Parts A-4 and B-4 of Table A are similar data for the Structural ratings. This tabulated data also gives further evidence of the scatter in the data.

Basically, what this data does show is that CSP does have a shorter mean life expectancy than does RCP because of durability of material and the mean life of CSP is approximately 44 years. The life expectancy of RCP can not be realistically determined until sufficient pipe have reached the lower ratings to unskew the data, however, it will be significantly higher than CSP.

Using the previously stated criteria that pipe having a rating of 2 thru 0 with either durability or structural ratings is considered as failed and needing replacement, Table A, Parts A-3, A-4, and B-3, B-4 have been subtotaled for the 2 thru 0 ratings. The subtotal values represent the percentage of pipe in each age group which should be replaced or repaired. CSP shows a replacement rate of better than 60 percent above 40 years of age and the RCP only shows 23.6 percent in the plus 60 years of age group.

The most predominant cause for a pipe type to be rated poorly in the durability and structural categories has been determined by statistical evaluation of the relationship of each sub-category rating to the overall rating of the pipe. Sub-categories rated, depending on type of pipe, were softening, weathering above flow line, erosive losses, spalling, joint and seam condition, alignment, and cracking.

Table 17 gives the correlation coefficient (R) for the statistical relationship of each sub-category rating to the overall durability and structural rating for CSP and RCP. For CSP, durability had no specific sub-category because corrosion is the only loss in CSP which may cause failure. Alignment was the most significant factor in the CSP structural ratings. With RCP the most significant factor is erosive loss for durability and joint condition for structural. Therefore, shift and movement of earth fills appears to cause stress on both of these culvert pipe systems.

Analysis of Pipe Rating by Relationship with Geological Area

The State of Missouri has a large diversity of geological topography and mineral deposits. The chemistry of the water in each stream contains residues from the soils and minerals which it runs through. Because of this diversity in chemicals, the reaction of the effluent with the pipe culvert causes variability in rate of deterioration. In an attempt to evaluate the interaction of the geological effect, the database was subdivided and analyzed for only pipe contained in the following areas: Forest, Surficial (surface) Materials; Shale, Clay, and Silica Sand Mixture; Minerals; Ground Water Flow; and Water Quality. Each of these areas was further subdivided into other more specific categories as shown in Table 10.

The results of geological area effects are shown in Tables 18 and 19 for CSP and RCP respectively. No correlations were significant in this analysis. Even though some pipe may fail in specific streams with given characteristics, there is no significant trend that all pipe in that area of influence will fail similarly. Trends to explain pipe deterioration could not be developed from the tests made. Thus development of a given test or tests to predict life expectancy could not be developed from this survey.

Analysis of Pipe Rating by Relationship with Watershed Characteristics

Effluent from watersheds also contain chemicals which are unique to the major industry in that watershed. The watersheds identified in this survey were: cropland, livestock, forest, mining, vegetation/pasture, residential, and other. The survey data were subdivided into the category respective to their location and the pipe ratings analyzed for significant relationships. Tables 20 and 21 show that only the mining watershed had a significant effect on RCP in the softening, weathering, and spalling mode of the durability rating and with cracking in the structural mode. However, the reliability of these relationships are questionable because only three pipe observations are represented by this data. Also, the reliability of these relationships are further questioned because CSP generally deteriorates at a very rapid rate when exposed to mine effluents. Apparently, with the number of pipe in this survey, the significance is hidden because not all mine effluents have low pH by the time it gets to the pipe.

Analysis of Pipe Ratings by Relationship With Field and Laboratory Tests

The field and laboratory tests conducted at selected sites were to determine if there was a common parameter or set of parameters which might predict pipe life. Appendices C and D give the descriptions of the field and laboratory tests in this survey. Tests were made at 153 CSP sites and 118 RCP sites throughout the state as shown in Figures 3 and 4. The specific tests made in this survey were selected because various reports from other states and the pipe industry had suggested possible relationships might exist. Field soil tests for voltage, resistance, and moisture are measures of the ease with which corrosion currents can flow in the backfill material. The laboratory tests for pH, chloride content, and conductivity are measures of the effluents ability to cause material loss from the inside of the pipe. Breakdown of the survey data by pipe rating with each of the tests made is shown in Table 12.

None of the tests which were made in the field or the laboratory were satisfactory for prediction of a pipes longevity as shown in Tables 22 and 23.

DISCUSSION

This is the fourth survey which has been made in Missouri to document the performance of corrugated metal pipe, specifically zinc-coated corrugated steel pipe (CSP) for this survey, and reinforced concrete (RCP) used for crossroad drainage systems. Rating systems have been revised in each successive survey depending on what had been realized from the previous survey and what could be learned from the reports from other states and industry. This survey has been the most extensive survey in terms of trying to explain key factors which cause CSP and RCP pipe failure. This has been the first survey which incorporated field and laboratory tests to evaluate the environment around and in the pipe.

This survey covered the entire state of Missouri. The sample surveyed represents approximately 8,000 miles of primary and interstate roads and 24,000 miles of secondary roads. Pipe from various age groups in each county were included, if available. Some areas of the state may not have pipe placed in specific age groups because of the manner in which the road systems were developed or because of shortage of material such as the 1940's with World War II.

The Department's current policy for selection of type of culvert pipe to be used has been in effect for many years and is contained in Chapter IX, Section 9-10 of the Policy

Procedure and Design Manual. Briefly, the policy allows corrugated metal pipe for all entrances but restricts the use of corrugated metal pipe for crossroad installation to roadways with less than 400 ADT regardless of surface and roadways with more than 400 ADT that do not have a concrete or asphaltic concrete surface.

Repairs to the heavier traveled roadways are always more extensive and costly than are secondary lighter traveled roadways. This is why it is more desirable to use the type of pipe that will be most likely to give a comparable service life to that of the roadbed. Roadbeds are not designed to last any particular life except they are generally expected to last as long as the roadway is in service. As determined and explained in Report MR 87-1, Study of Use, Durability, and Cost of Corrugated Steel Pipe on the Missouri Highway and Transportation Department's Highway System, "...approximately 25 percent of the Department's roadbeds are already 50 years or older and 74 percent are over 25 years of age". Roadbeds which were once part of the state highway system and are now abandoned or transferred to city or county systems were not included in this estimate. This means that with our present design method, RCP is more desirable for use as crossroad pipe under heavily traveled roadways like the interstate and primary highways.

Records from Maintenance and Traffic Division indicated that approximately 178,656 feet of CSP (including crossroad and entrances) has been replaced in the last 5 years (1985 thru 1989). Of 1018 records of CSP crossroad pipe replaced by the Maintenance and Traffic Division since 1987, only 694 of these reports could document the age of pipe being replaced. Table B shows a breakdown of the replaced pipe of known ages by periods of 1987 thru 1989, 1990, and combined 1987 thru 1990. The reason for the division into groups is a revision in the reporting requests in January 1990. The mean age of replacement of the combined group is 41.4 years whereas the median age is 50.8 years.

The main objection to the need for replacing any culvert pipe is the time and cost. Closure of the roadway to replace a crossroad pipe takes time, equipment, materials, partial or complete closure of the road, and extensive disruption of traffic and inconvenience to the driving public. Photos No. 13 through 20 show a deep fill replacement and Photos 21 through 30 show a shallow fill replacement which were completed in August and September 1990. The deep fill site required 69 man hours, 5 dump trucks, one crane with drag bucket, one road maintainer, and 13 hours of complete roadway closure to the driving public. The shallow fill replacement required 48 man hours, 5 dump trucks, one backhoe, and 7 hours of partial roadway closure.

TABLE B

AGE AND FREQUENCY OF CSP REPLACED BY MAINTENANCE AND TRAFFIC 1987 THRU 1989 AND 1990

1987 thru 1989		
Pipe Age	Number Pipe	Frequency Distribution
14	1	0.2
22	3	0.7
23	1	0.9
24	6	1.9
25	5	2.8
26	4	3.5
27	4	4.2
28	2	4.5
29	5	5.4
30	10	7.2
31	9	8.7
32	14	11.2
33	6	12.2
34	6	13.3
35	9	14.9
36	76	28.1
37	1	28.3
38	10	30.1
39	5	30.9
40	5	31.8
41	2	32.2
46	10	33.9
47	7	35.1
48	10	36.9
49	8	38.3
50	20	41.8
51	45	49.7
52	9	51.2
53	21	54.9
54	27	59.6
55	37	66.1
56	29	71.2
57	114	91.1
58	40	98.1
59	4	98.8
61	3	99.3
65	4	100.0

Mean Age = 40.7 Years
Median Age = 51.5 Years

1990		
Pipe Age	Number Pipe	Frequency Distribution
20	1	0.8
27	21	18.0
29	1	18.9
30	1	19.7
31	1	20.5
33	4	23.8
34	5	27.9
35	1	28.7
36	5	32.8
37	1	33.6
38	1	34.4
39	4	37.7
41	5	41.8
42	10	50.0
43	4	53.3
44	2	54.9
48	1	55.7
51	4	59.0
52	2	60.7
53	1	61.5
54	12	71.3
55	6	76.2
56	3	78.8
57	3	81.1
58	1	82.0
59	10	90.2
60	1	91.0
65	2	92.6
68	9	100.0

Mean Age = 44.6 Years
Median Age = 42.0 Years

Combined 1987 thru 1990		
Pipe Age	Number Pipe	Frequency Distribution
14	1	0.1
20	1	0.3
22	3	0.7
23	1	0.9
24	6	1.7
25	5	2.4
26	4	3.0
27	25	6.6
28	2	6.9
29	6	7.8
30	11	9.4
31	10	10.8
32	14	12.8
33	10	14.3
34	11	15.8
35	10	17.3
36	81	28.9
37	2	29.2
38	11	30.8
39	9	32.1
40	5	32.8
41	7	33.9
42	10	35.3
43	4	35.9
44	2	36.2
46	10	37.6
47	7	38.6
48	11	40.2
49	8	41.3
50	20	44.2
51	49	51.3
52	11	52.9
53	22	56.0
54	39	61.7
55	43	67.9
56	32	72.5
57	117	89.3
58	41	95.2
59	14	97.3
60	1	97.4
61	3	97.8
65	6	98.7
68	9	100.0

Mean Age = 41.4 Years
Median Age = 50.8 Year

Partial traffic was maintained by requiring the operation to stop and move out of the way every 10 minutes or as needed to allow traffic to pass.

What are the costs of replacing pipe? Maintenance and Traffic records (See Appendix E) show that in the last 5 years (1985 thru 1989) MHTD has spent over 5 million dollars in the replacement of CSP. Cost of RCP replacement for the same 5 year period was $239,000. The mean (average) cost of material and installation over this 5 year period per lineal foot of pipe was $27.54 and $41.08 for CSP and RCP respectively. Significantly higher costs should be realized for replacement of pipe in the future if trends identified by this survey are true.

CONCLUSIONS

This survey has shown that the scatter in the data and the fact that failure of the pipe does not relate to any single parameter or set of parameters, it is impossible to generically predict a pipe's longevity for any given location. The only reliable prediction is from the service record of a pipe of similar material previously placed in the given location.

This survey indicates that the mean age which the CSP will be deteriorated to the point of needing replacement is approximately 44 years. This is generally consistent with industry's prediction of 50 years. If projections are possible from the data taken in this survey and the rating of 2 thru 0 is used, then approximately 46% of the CSP in the state should be ready for replacement at this time.

This survey also indicates that some RCP has deteriorated and needs replacing. Maintenance and Traffic Division records also indicated that some RCP has also been replaced. As shown in Appendix E, 5,152 lineal feet of RCP has been replaced in the last 5 years (1985 thru 1989). The cause of replacement has been generally from alignment problems or severe acid attack on the concrete by the effluent from mining operations. A few CSP have been replaced by using RCP in the northern part of District 7 because of low pH effluents. Concrete is also attacked by the low pH effluents, however, at a somewhat slower rate and a longer life is obtained. Neither of the types of pipe in this survey will survive long in a low pH or acidic environment. Other products such as plastic pipe and pipe liners are being considered for these specific environments.

Even though this survey could not find specific parameters with which to predict life expectancy of either type of culvert pipe, the results continue to indicate, as all previous surveys did, that the majority of the CSP will probably have to be replaced at approximately 45 to 50 years of age and the age of replacement of the majority of the RCP will be significantly greater. Replacement costs are a significant part of the yearly budget and, as indicated, are expected to grow proportionately with the increasing number of CSP becoming 45 to 50 years old.

RECOMMENDATIONS

The following recommendations are offered based on observations and results of the data analyses from this survey:

1. The department should investigate methods to better insure joint stability of RCP, especially with the end sections of pipe.

2. The department should investigate the use of pipe liners, plastic or fiberglass, rather than replacement of deteriorated pipe to eliminate closure of roadways and possible cost benefits.

3. The department should investigate the use of culvert pipe made with materials other than zinc-coated corrugated steel or reinforced concrete.

4. The department should continue with the present culvert type design policy as set forth in the Design Policy and Procedure Manual, and

5. This report should be forwarded to the Design Committee for their review.

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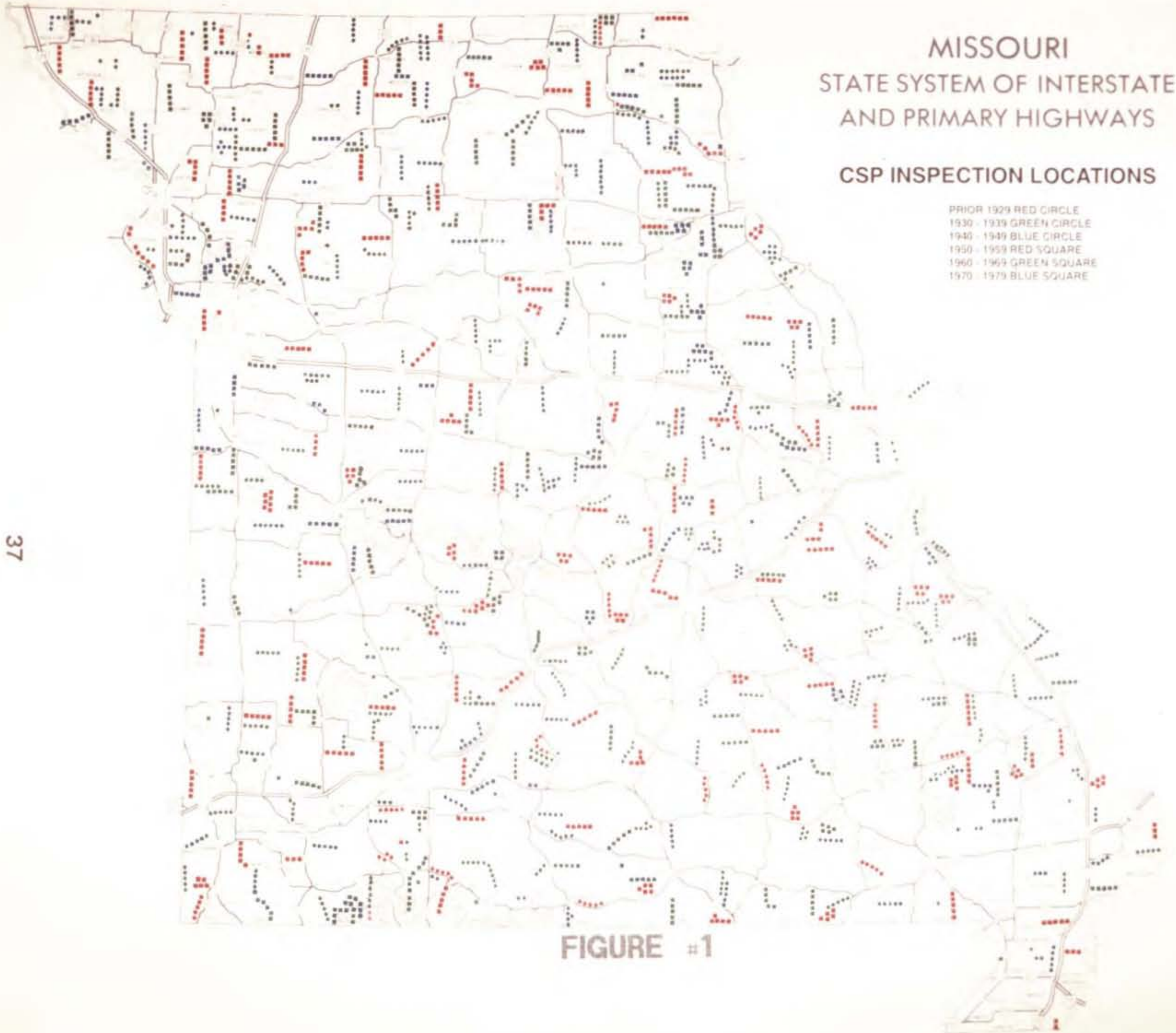
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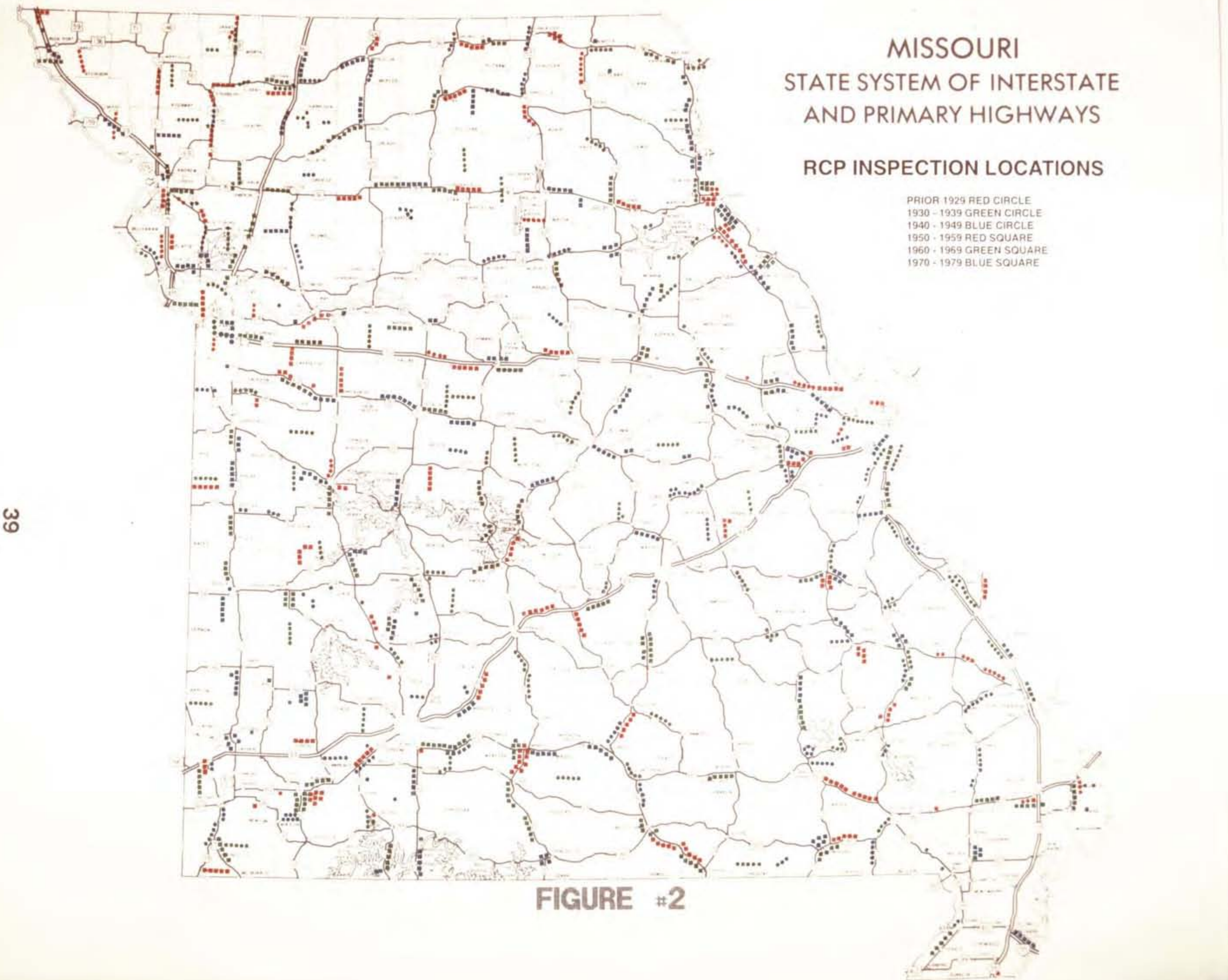
AND PRIMARY HIGHWAYS
CSP INSPECTION LOCATIONS
PRIOR 1929 RED CIRCLE
1930 - 1939 GREEN CIRCLE
1940 - 1949 BLUE CIRCLE
1950 - 1959 RED SQUARE
1960 - 1969 GREEN SQUARE
1970 - 1979 BLUE SQUARE

FIGURE #1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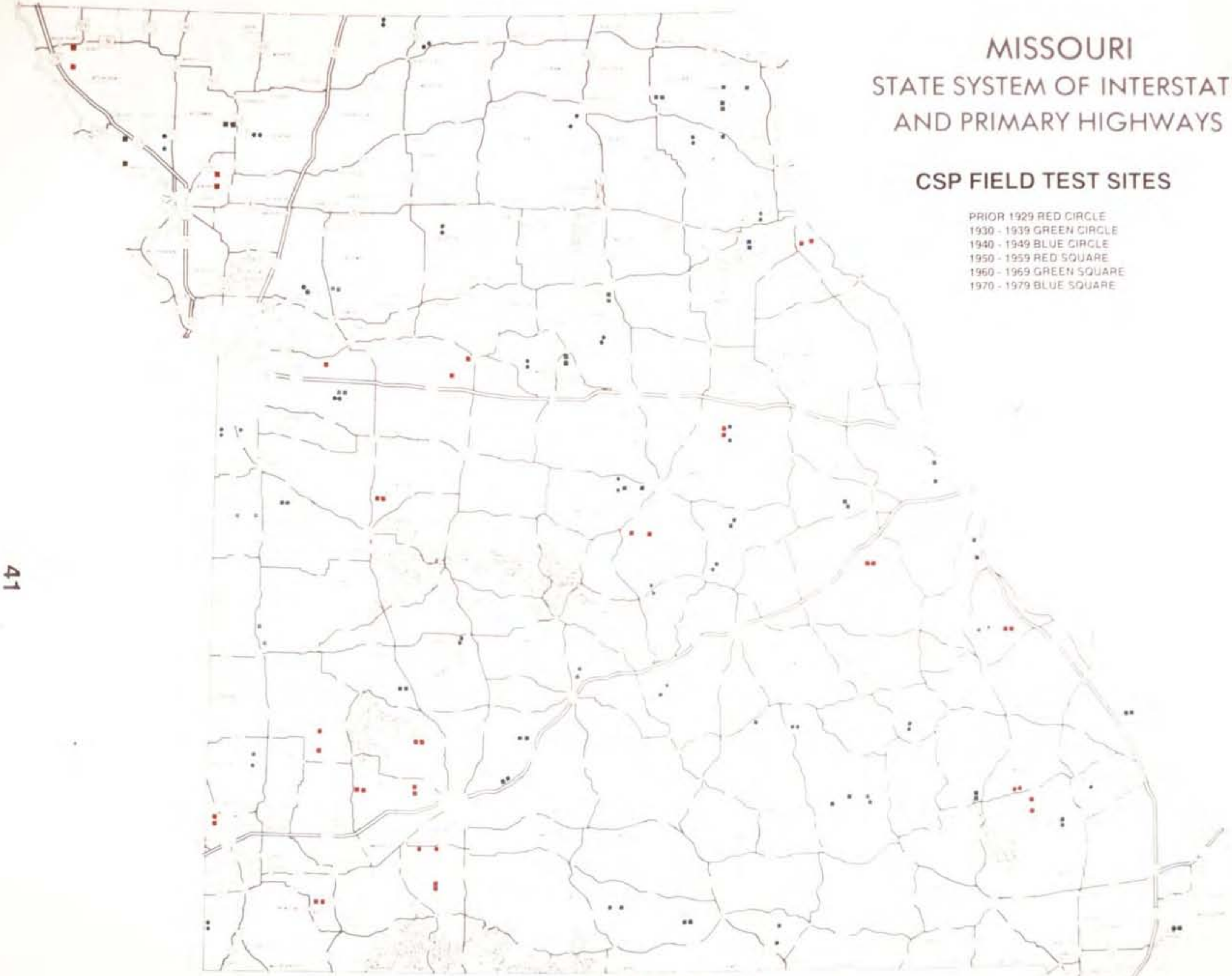
1940 - 1949 BLUE CIRCLE
1950 - 1959 RED SQUARE
1960 - 1969 GREEN SQUARE
1970 - 1979 BLUE SQUARE
JANUARY 1, 1989

FIGURE #2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CSP FIELD TEST SITES
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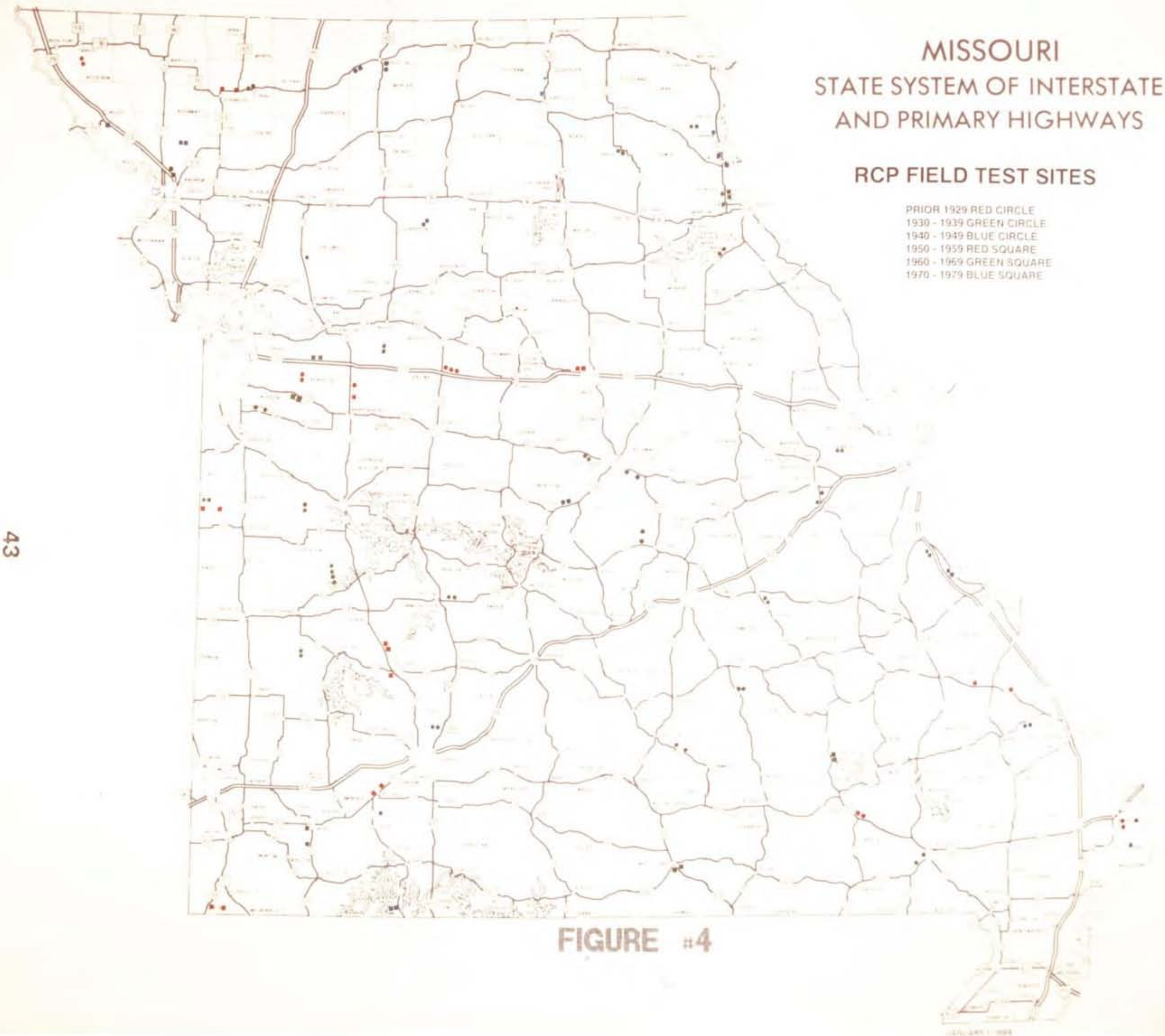
1940 - 1949 BLUE CIRCLE
1950 - 1959 RED SQUARE
1960 - 1969 GREEN SQUARE
1970 - 1979 BLUE SQUARE

FIGURE #3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RCP FIELD TEST SITES
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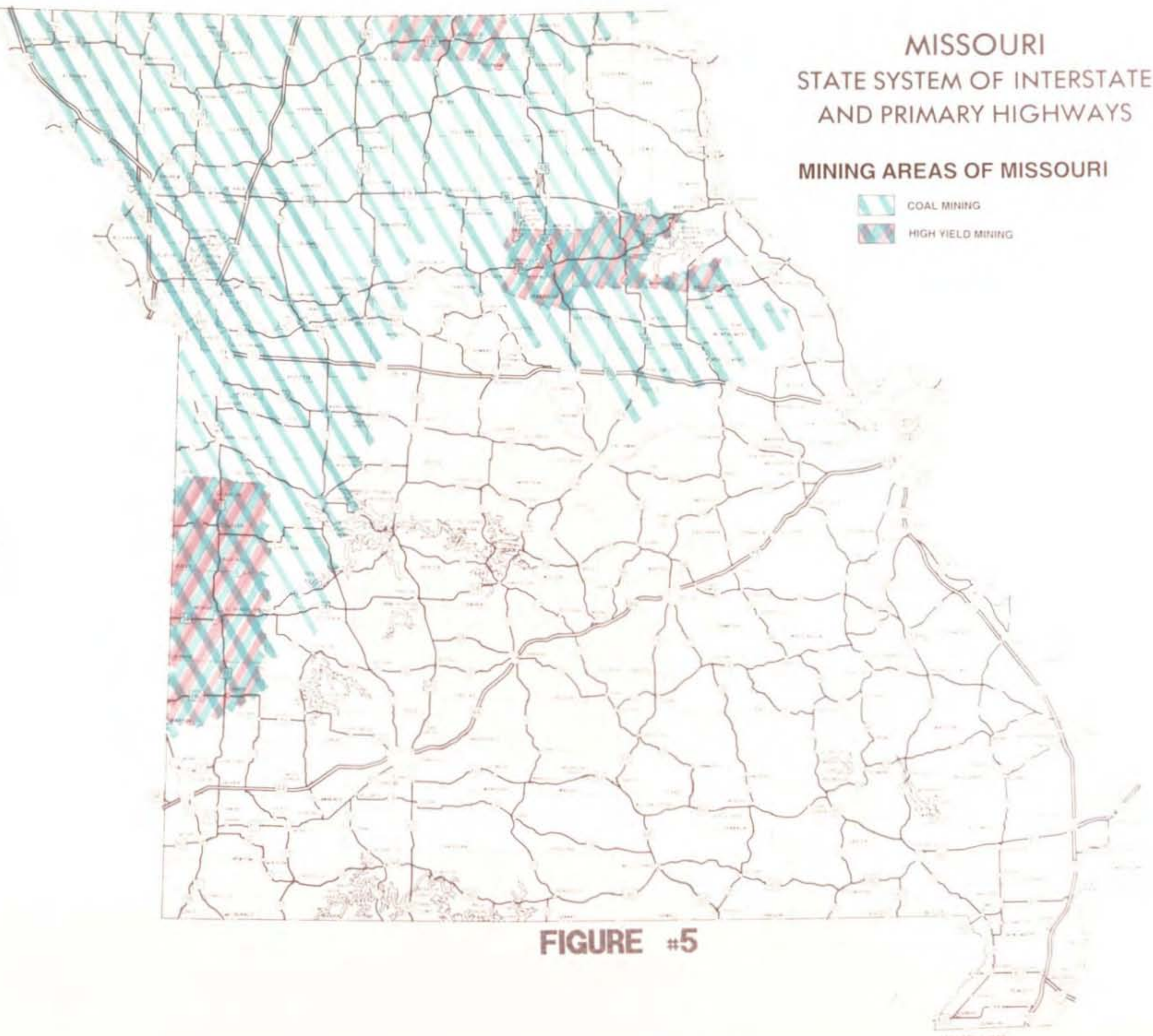
1940 - 1949 BLUE CIRCLE
1950 - 1959 RED SQUARE
1960 - 1969 GREEN SQUARE
1970 - 1979 BLUE SQUARE

FIGURE #4



MISSOURI
STATE SYSTEM OF INTERSTATE
AND PRIMARY HIGHWAYS
MINING AREAS OF MISSOURI
COAL MINING
HIGH YIELD MINING

FIGURE #5

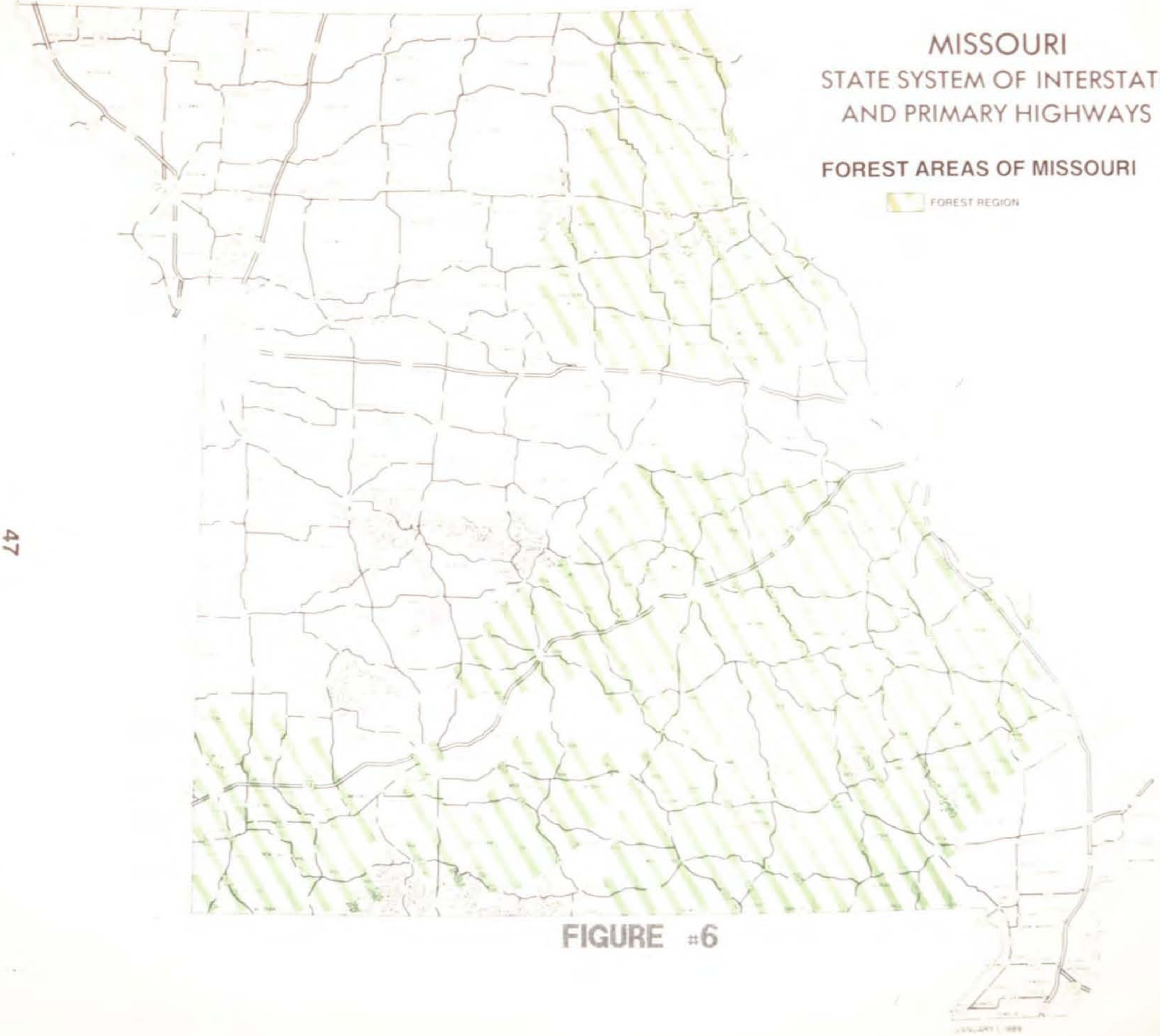

MISSOURI
STATE SYSTEM OF INTERSTATE
AND PRIMARY HIGHWAYS
FOREST AREAS OF MISSOURI
FOREST REGION

FIGURE #6

LIST OF TABLES

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TABLE 1

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	ANDREW	H	8.450	1947
1	ANDREW	H	11.220	1947
1	ANDREW	H	11.550	1947
1	ANDREW	H	11.770	1947
1	ANDREW	H	12.530	1947
1	ANDREW	Z	0.410	1950
1	ANDREW	Z	1.330	1950
1	ANDREW	Z	1.810	1950
1	ANDREW	Z	1.910	1950
1	ANDREW	Z	3.070	1950
1	ANDREW	U	0.180	1962
1	ANDREW	U	0.410	1962
1	ANDREW	U	0.590	1962
1	ANDREW	U	0.680	1962
1	ANDREW	U	0.900	1962
1	ANDREW	RA	0.640	1973
1	ANDREW	RA	0.880	1973
1	ATCHISON	B	7.360	1939
1	ATCHISON	B	8.710	1939
1	ATCHISON	B	9.700	1939
1	ATCHISON	M	1.140	1939
1	ATCHISON	C	7.460	1939
1	ATCHISON	C	7.460	1939
1	ATCHISON	B	3.450	1949
1	ATCHISON	B	3.640	1949
1	ATCHISON	B	5.130	1949
1	ATCHISON	B	5.815	1949
1	ATCHISON	B	5.520	1949
1	ATCHISON	B	5.520	1949
1	ATCHISON	J	1.460	1950
1	ATCHISON	J	1.740	1950
1	ATCHISON	J	2.690	1950
1	ATCHISON	J	3.270	1950
1	ATCHISON	J	3.390	1950
1	ATCHISON	F	0.400	1962
1	ATCHISON	F	0.600	1962
1	ATCHISON	F	0.800	1962
1	ATCHISON	F	1.500	1962
1	ATCHISON	F	2.700	1962
1	ATCHISON	C	1.100	1976
1	ATCHISON	C	1.600	1976
1	ATCHISON	C	2.300	1976
1	ATCHISON	C	3.300	1976
1	ATCHISON	C	3.600	1976
1	BUCHANAN	E	0.280	1931

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	BUCHANAN	E	0.400	1931
1	BUCHANAN	E	2.260	1931
1	BUCHANAN	E	3.510	1931
1	BUCHANAN	H	5.110	1936
1	BUCHANAN	H	11.350	1948
1	BUCHANAN	H	11.500	1948
1	BUCHANAN	H	11.700	1948
1	BUCHANAN	H	13.280	1948
1	BUCHANAN	H	13.420	1948
1	BUCHANAN	HH	0.440	1950
1	BUCHANAN	HH	0.520	1950
1	BUCHANAN	HH	0.510	1954
1	CALDWELL	E	0.560	1936
1	CALDWELL	E	0.790	1936
1	CALDWELL	A	14.190	1937
1	CALDWELL	A	14.510	1937
1	CALDWELL	HH	5.950	1938
1	CALDWELL	A	6.000	1946
1	CALDWELL	A	6.800	1946
1	CALDWELL	F	4.620	1957
1	CALDWELL	F	4.840	1957
1	CALDWELL	F	6.540	1957
1	CALDWELL	F	7.390	1957
1	CALDWELL	F	8.390	1957
1	CALDWELL	K	0.470	1961
1	CALDWELL	K	0.970	1961
1	CALDWELL	K	1.980	1961
1	CALDWELL	K	2.090	1961
1	CALDWELL	K	3.290	1961
1	CLINTON	NN	5.120	1935
1	CLINTON	NN	5.880	1935
1	CLINTON	NN	8.580	1935
1	CLINTON	NN	10.350	1935
1	CLINTON	H	1.160	1949
1	CLINTON	H	3.580	1949
1	CLINTON	H	4.120	1949
1	CLINTON	H	4.200	1949
1	CLINTON	Y	1.410	1956
1	CLINTON	Y	1.720	1956
1	CLINTON	Y	1.920	1956
1	CLINTON	Y	2.500	1956
1	CLINTON	Y	5.350	1956
1	CLINTON	O	1.760	1964
1	CLINTON	O	1.940	1964
1	CLINTON	O	4.170	1964

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	CLINTON	O	5.840	1964
1	CLINTON	J	0.020	1979
1	CLINTON	J	1.330	1979
1	CLINTON	J	1.630	1979
1	CLINTON	J	2.120	1979
1	CLINTON	J	2.300	1979
1	DAVIESS	K	0.050	1936
1	DAVIESS	K	2.480	1936
1	DAVIESS	K	3.420	1936
1	DAVIESS	K	3.970	1936
1	DAVIESS	K	4.910	1936
1	DAVIESS	M	0.110	1946
1	DAVIESS	M	0.460	1946
1	DAVIESS	M	0.670	1946
1	DAVIESS	E	0.670	1955
1	DAVIESS	E	0.860	1955
1	DAVIESS	E	1.710	1955
1	DAVIESS	PP	0.110	1963
1	DAVIESS	PP	0.330	1963
1	DAVIESS	PP	0.430	1963
1	DAVIESS	PP	2.390	1963
1	DAVIESS	PP	2.550	1963
1	DAVIESS	RA	0.150	1972
1	DAVIESS	RA	0.160	1972
1	DAVIESS	RA	0.800	1972
1	DAVIESS	RA	1.620	1972
1	DAVIESS	RA	2.050	1972
1	DEKALB	A	1.520	1936
1	DEKALB	A	1.590	1936
1	DEKALB	A	2.450	1936
1	DEKALB	A	3.530	1936
1	DEKALB	E	9.460	1938
1	DEKALB	E	5.150	1948
1	DEKALB	E	5.360	1948
1	DEKALB	E	5.430	1948
1	DEKALB	E	6.230	1948
1	DEKALB	J	3.400	1950
1	DEKALB	J	3.600	1950
1	DEKALB	J	4.880	1950
1	DEKALB	J	5.180	1950
1	DEKALB	J	5.450	1950
1	DEKALB	E	15.760	1967
1	DEKALB	E	16.550	1967
1	DEKALB	E	16.830	1967

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	DEKALB	E	16.920	1967
1	DEKALB	E	17.070	1967
1	DEKALB	RA	0.020	1971
1	DEKALB	RA	0.210	1971
1	DEKALB	RA	0.300	1971
1	DEKALB	RA	0.900	1971
1	GENTRY	E	5.130	1935
1	GENTRY	H	0.470	1935
1	GENTRY	H	1.500	1935
1	GENTRY	T	0.490	1936
1	GENTRY	T	0.660	1936
1	GENTRY	Z	3.120	1941
1	GENTRY	Z	3.580	1941
1	GENTRY	Z	4.720	1941
1	GENTRY	Z	4.810	1941
1	GENTRY	B	0.250	1958
1	GENTRY	B	0.630	1958
1	GENTRY	B	0.770	1958
1	GENTRY	B	1.070	1958
1	GENTRY	B	2.600	1958
1	GENTRY	BB	0.440	1961
1	GENTRY	BB	1.340	1961
1	GENTRY	BB	1.580	1961
1	GENTRY	BB	1.780	1961
1	GENTRY	BB	3.950	1961
1	HARRISON	D	10.090	1937
1	HARRISON	D	10.750	1937
1	HARRISON	D	11.150	1937
1	HARRISON	146	12.860	1938
1	HARRISON	146	13.660	1938
1	HARRISON	D	7.150	1950
1	HARRISON	D	7.850	1950
1	HARRISON	D	8.650	1950
1	HARRISON	D	8.850	1950
1	HARRISON	A	0.740	1976
1	HARRISON	A	1.100	1976
1	HARRISON	A	1.190	1976
1	HARRISON	A	1.400	1976
1	HARRISON	A	3.300	1976
1	HOLT	113	6.160	1932
1	HOLT	113	6.650	1932
1	HOLT	113	7.810	1932
1	HOLT	113	8.500	1932
1	HOLT	113	11.280	1932

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	HOLT	N	4.100	1948
1	HOLT	N	4.720	1948
1	HOLT	N	5.280	1948
1	HOLT	N	5.780	1948
1	HOLT	N	6.030	1948
1	HOLT	N	2.820	1950
1	HOLT	E	0.350	1955
1	HOLT	E	1.210	1955
1	HOLT	E	1.930	1955
1	HOLT	E	2.150	1955
1	HOLT	U	0.040	1961
1	HOLT	U	2.440	1961
1	HOLT	U	2.910	1961
1	HOLT	U	4.000	1961
1	HOLT	U	4.770	1961
1	HOLT	118	1.260	1974
1	HOLT	118	1.590	1974
1	HOLT	118	2.240	1974
1	HOLT	118	2.990	1974
1	HOLT	118	3.380	1974
1	NODAWAY	113	5.650	1935
1	NODAWAY	113	6.850	1935
1	NODAWAY	C	0.070	1938
1	NODAWAY	C	2.140	1938
1	NODAWAY	246	10.780	1948
1	NODAWAY	E	2.100	1950
1	NODAWAY	E	2.300	1950
1	NODAWAY	E	3.340	1950
1	NODAWAY	E	5.400	1950
1	NODAWAY	E	6.500	1950
1	NODAWAY	N	9.770	1961
1	NODAWAY	N	9.870	1961
1	NODAWAY	N	10.980	1961
1	NODAWAY	N	11.760	1961
1	NODAWAY	N	11.920	1961
1	WORTH	A	1.320	1930
1	WORTH	A	1.470	1930
1	WORTH	A	1.580	1930
1	WORTH	W	6.090	1937
1	WORTH	Y	1.400	1939
1	WORTH	W	3.940	1942
1	WORTH	W	4.950	1942
1	WORTH	W	2.750	1949
1	WORTH	W	3.580	1949

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	WORTH	C	5.420	1952
1	WORTH	Z	0.150	1954
1	WORTH	Z	0.740	1954
1	WORTH	Z	0.870	1954
1	WORTH	Z	2.250	1962
1	WORTH	Z	2.400	1962
1	WORTH	Z	3.100	1962
1	WORTH	Z	3.330	1962
1	WORTH	Z	3.790	1962
2	ADAIR	N	0.560	1934
2	ADAIR	N	1.030	1934
2	ADAIR	N	1.070	1934
2	ADAIR	N	1.150	1934
2	ADAIR	N	3.490	1934
2	ADAIR	E	0.360	1947
2	ADAIR	E	1.310	1947
2	ADAIR	E	1.600	1947
2	ADAIR	E	1.680	1947
2	ADAIR	174A(1)	2.040	1947
2	ADAIR	T	0.180	1955
2	ADAIR	T	1.650	1955
2	ADAIR	T	2.220	1955
2	ADAIR	T	2.630	1955
2	ADAIR	T	3.120	1955
2	ADAIR	N	4.780	1960
2	ADAIR	N	4.880	1960
2	ADAIR	N	5.500	1960
2	ADAIR	N	5.890	1960
2	ADAIR	N	6.430	1960
2	CARROLL	Z	5.720	1937
2	CARROLL	Z	6.020	1937
2	CARROLL	Z	6.740	1937
2	CARROLL	Z	6.860	1937
2	CARROLL	Z	7.290	1937
2	CARROLL	U	0.100	1956
2	CARROLL	U	1.090	1956
2	CARROLL	U	1.720	1956
2	CARROLL	U	3.180	1956
2	CARROLL	U	3.380	1956
2	CHARITON	D	5.200	1935
2	CHARITON	D	6.120	1935
2	CHARITON	D	7.360	1935
2	CHARITON	D	9.570	1935
2	CHARITON	C	4.310	1948

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
2	CHARITON	C	4.350	1948
2	CHARITON	C	4.540	1948
2	CHARITON	C	6.800	1948
2	CHARITON	C	6.860	1948
2	CHARITON	129	21.330	1950
2	CHARITON	129	27.950	1950
2	CHARITON	129	28.620	1950
2	CHARITON	129	28.810	1950
2	CHARITON	129	29.740	1950
2	CHARITON	TT	0.130	1961
2	CHARITON	TT	0.490	1961
2	CHARITON	TT	1.070	1961
2	CHARITON	TT	2.210	1961
2	CHARITON	TT	2.460	1961
2	GRUNDY	W	0.040	1935
2	GRUNDY	W	0.800	1935
2	GRUNDY	W	1.000	1935
2	GRUNDY	W	1.100	1935
2	GRUNDY	W	1.350	1935
2	GRUNDY	SA	2.754	1949
2	GRUNDY	SA	3.824	1949
2	GRUNDY	SA	3.974	1949
2	GRUNDY	SA	4.144	1949
2	GRUNDY	SA	7.354	1949
2	GRUNDY	SB	1.420	1952
2	GRUNDY	SB	2.480	1952
2	GRUNDY	SB	2.790	1952
2	GRUNDY	SB	2.920	1952
2	GRUNDY	SB	3.090	1952
2	GRUNDY	F	1.890	1960
2	GRUNDY	F	2.580	1960
2	GRUNDY	F	3.110	1960
2	GRUNDY	F	3.490	1960
2	GRUNDY	F	4.980	1960
2	HOWARD	SK	0.480	1938
2	HOWARD	SK	2.000	1938
2	HOWARD	SK	2.330	1938
2	HOWARD	SK	2.530	1938
2	HOWARD	SK	2.680	1938
2	HOWARD	SA	4.210	1947
2	HOWARD	SA	4.330	1947
2	HOWARD	SA	4.390	1947
2	HOWARD	SA	4.550	1947
2	HOWARD	SU	4.570	1958

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
2	HOWARD	SU	4.950	1958
2	HOWARD	SU	5.510	1958
2	HOWARD	SU	5.660	1958
2	HOWARD	SU	7.030	1959
2	HOWARD	DD	0.450	1963
2	HOWARD	DD	0.880	1963
2	HOWARD	DD	0.980	1963
2	HOWARD	DD	1.400	1963
2	HOWARD	DD	2.820	1963
2	LINN	139	18.760	1934
2	LINN	139	19.160	1934
2	LINN	139	19.470	1934
2	LINN	139	19.940	1934
2	LINN	139	20.060	1934
2	LINN	B	3.140	1948
2	LINN	B	3.220	1948
2	LINN	B	3.700	1948
2	LINN	B	4.700	1948
2	LINN	B	5.040	1948
2	LINN	TT	1.180	1953
2	LINN	TT	0.390	1958
2	LINN	TT	0.650	1958
2	LINN	TT	1.610	1958
2	LINN	TT	1.880	1958
2	LINN	PP	0.570	1961
2	LINN	PP	0.780	1961
2	LINN	36	0.990	1961
2	LINN	PP	1.150	1961
2	LINN	PP	1.550	1961
2	LIVINGSTON	J	1.840	1933
2	LIVINGSTON	J	0.860	1933
2	LIVINGSTON	J	2.040	1933
2	LIVINGSTON	J	2.380	1933
2	LIVINGSTON	J	2.790	1933
2	LIVINGSTON	B	1.140	1948
2	LIVINGSTON	B	1.450	1948
2	LIVINGSTON	B	3.390	1948
2	LIVINGSTON	B	4.000	1948
2	LIVINGSTON	B	4.280	1948
2	LIVINGSTON	W	0.440	1950
2	LIVINGSTON	W	1.900	1950
2	LIVINGSTON	W	2.900	1950
2	LIVINGSTON	W	3.090	1950
2	LIVINGSTON	W	3.390	1950

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
2	LIVINGSTON	CC	0.110	1961
2	LIVINGSTON	CC	0.330	1961
2	LIVINGSTON	CC	1.370	1961
2	LIVINGSTON	CC	1.700	1961
2	LIVINGSTON	CC	2.470	1961
2	MACON	K	6.860	1933
2	MACON	K	6.960	1933
2	MACON	K	7.480	1933
2	MACON	M	2.430	1935
2	MACON	M	2.580	1935
2	MACON	C	7.850	1947
2	MACON	C	8.310	1947
2	MACON	C	8.570	1947
2	MACON	C	9.040	1947
2	MACON	C	9.200	1947
2	MACON	FF	0.340	1957
2	MACON	FF	0.910	1957
2	MACON	FF	1.770	1957
2	MACON	FF	3.170	1957
2	MACON	FF	4.220	1957
2	MACON	F	0.370	1960
2	MACON	F	0.440	1960
2	MACON	F	0.510	1960
2	MACON	F	0.570	1960
2	MACON	F	0.760	1960
2	MACON	E - 3	21.490	1974
2	MACON	E - 3	21.730	1974
2	MACON	E - 3	21.800	1974
2	MACON	E - 3	22.040	1974
2	MACON	E - 3	22.480	1974
2	MERCER	M	6.170	1936
2	MERCER	M	6.400	1936
2	MERCER	M	6.520	1936
2	MERCER	M	10.020	1936
2	MERCER	M	8.270	1936
2	MERCER	A	0.400	1949
2	MERCER	A	2.150	1949
2	MERCER	A	3.550	1949
2	MERCER	A	4.300	1949
2	MERCER	A	4.500	1949
2	MERCER	DD	0.120	1961
2	MERCER	DD	0.020	1962
2	MERCER	DD	0.360	1962
2	MERCER	DD	0.760	1962

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
2	MERCER	DD	1.720	1962
2	MERCER	E	11.310	1972
2	MERCER	E	12.000	1972
2	MERCER	E	12.520	1972
2	PUTNAM	139(B)	10.140	1933
2	PUTNAM	139(B)	11.270	1933
2	PUTNAM	139(B)	11.780	1933
2	PUTNAM	139(B)	11.910	1933
2	PUTNAM	139(B)	12.200	1933
2	PUTNAM	K	0.050	1948
2	PUTNAM	K	0.080	1948
2	PUTNAM	K	0.840	1948
2	PUTNAM	K	1.670	1948
2	PUTNAM	K	2.320	1948
2	PUTNAM	U	7.010	1950
2	PUTNAM	U	8.590	1950
2	PUTNAM	U	9.940	1950
2	PUTNAM	B(MM)	0.120	1962
2	PUTNAM	B(MM)	1.100	1962
2	PUTNAM	B(MM)	1.690	1962
2	PUTNAM	B(MM)	2.030	1962
2	PUTNAM	B(MM)	2.170	1962
2	RANDOLPH	J	2.660	1933
2	RANDOLPH	J	4.000	1933
2	RANDOLPH	J	5.200	1933
2	RANDOLPH	J	6.610	1933
2	RANDOLPH	J	6.740	1933
2	RANDOLPH	BB	1.170	1959
2	RANDOLPH	BB	1.280	1959
2	RANDOLPH	BB	1.780	1959
2	RANDOLPH	BB	1.850	1959
2	RANDOLPH	BB	2.940	1959
2	RANDOLPH	AA	0.490	1962
2	RANDOLPH	AA	0.850	1962
2	RANDOLPH	AA	2.420	1962
2	RANDOLPH	AA	2.520	1962
2	RANDOLPH	AA	2.650	1962
2	SALINE	D	1.400	1940
2	SALINE	D	1.650	1940
2	SALINE	D	2.040	1940
2	SALINE	D	2.150	1940
2	SALINE	D	2.400	1940
2	SALINE	YY	1.150	1957
2	SALINE	YY	1.400	1957

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
2	SALINE	YY	2.100	1957
2	SALINE	YY	2.600	1957
2	SALINE	YY	2.710	1957
2	SCHUYLER	N	6.250	1938
2	SCHUYLER	N	2.200	1948
2	SCHUYLER	N	6.800	1948
2	SCHUYLER	N	6.980	1948
2	SCHUYLER	N	7.600	1948
2	SCHUYLER	K	1.840	1950
2	SCHUYLER	K	2.940	1950
2	SCHUYLER	K	2.960	1950
2	SCHUYLER	K	3.690	1950
2	SCHUYLER	K	3.880	1950
2	SCHUYLER	V	0.330	1961
2	SCHUYLER	V	1.830	1961
2	SCHUYLER	V	2.070	1961
2	SCHUYLER	V	2.330	1961
2	SCHUYLER	V	2.620	1961
2	SULLIVAN	6	2.920	1932
2	SULLIVAN	6	3.500	1932
2	SULLIVAN	6	4.140	1932
2	SULLIVAN	6	4.190	1932
2	SULLIVAN	6	4.400	1932
2	SULLIVAN	E	6.300	1942
2	SULLIVAN	E	6.580	1942
2	SULLIVAN	E	6.830	1942
2	SULLIVAN	E	7.110	1942
2	SULLIVAN	E	7.290	1942
2	SULLIVAN	M	5.071	1959
2	SULLIVAN	M	5.351	1959
2	SULLIVAN	M	5.771	1959
2	SULLIVAN	M	6.271	1959
2	SULLIVAN	M	7.281	1959
2	SULLIVAN	B(139)	4.790	1965
2	SULLIVAN	B(139)	5.160	1965
2	SULLIVAN	B(139)	5.220	1965
2	SULLIVAN	B(139)	5.430	1965
2	SULLIVAN	B(139)	7.570	1965
3	AUDRAIN	B	5.854	1935
3	AUDRAIN	B	5.855	1935
3	AUDRAIN	B	1.370	1936
3	AUDRAIN	J	16.020	1948
3	AUDRAIN	J	16.120	1948
3	AUDRAIN	J	16.300	1948

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	AUDRAIN	J	14.990	1949
3	AUDRAIN	J	15.000	1949
3	AUDRAIN	ZZ	0.190	1956
3	AUDRAIN	ZZ	1.630	1956
3	AUDRAIN	ZZ	2.520	1956
3	AUDRAIN	ZZ	4.220	1956
3	AUDRAIN	ZZ	4.490	1956
3	AUDRAIN	KK	0.480	1960
3	AUDRAIN	KK	1.780	1960
3	AUDRAIN	KK	2.630	1960
3	AUDRAIN	KK	3.450	1960
3	AUDRAIN	KK	4.560	1960
3	AUDRAIN	RA	0.470	1972
3	AUDRAIN	RA	0.610	1972
3	AUDRAIN	RA	0.650	1972
3	AUDRAIN	RA	0.800	1972
3	AUDRAIN	RA	0.900	1972
3	CLARK	81	20.880	1935
3	CLARK	81	21.810	1935
3	CLARK	81	24.680	1939
3	CLARK	81	24.960	1939
3	CLARK	81	25.600	1939
3	CLARK	D	3.740	1948
3	CLARK	D	4.410	1948
3	CLARK	D	5.010	1948
3	CLARK	D	5.240	1948
3	CLARK	D	5.890	1948
3	CLARK	V	1.640	1950
3	CLARK	V	2.540	1950
3	CLARK	V	3.710	1950
3	CLARK	V	4.070	1950
3	CLARK	V	5.170	1950
3	CLARK	FF	0.490	1963
3	CLARK	FF	0.720	1963
3	CLARK	FF	0.970	1963
3	CLARK	FF	1.840	1963
3	CLARK	FF	1.920	1963
3	KNOX	15	9.330	1922
3	KNOX	K	2.140	1937
3	KNOX	K	2.200	1937
3	KNOX	K	2.400	1937
3	KNOX	E	0.790	1949
3	KNOX	E	1.230	1949
3	KNOX	E	1.940	1949

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	KNOX	E	4.680	1949
3	KNOX	E	4.830	1949
3	KNOX	J	0.260	1950
3	KNOX	J	0.480	1950
3	KNOX	J	0.700	1950
3	KNOX	J	2.270	1950
3	KNOX	J	3.010	1950
3	KNOX	AA	1.100	1961
3	KNOX	AA	1.310	1961
3	KNOX	AA	2.540	1961
3	KNOX	AA	2.660	1961
3	KNOX	AA	4.220	1961
3	KNOX	K	4.330	1971
3	KNOX	K	5.040	1971
3	KNOX	K	7.400	1971
3	KNOX	K	8.360	1971
3	KNOX	K	8.440	1971
3	LEWIS	156	2.640	1935
3	LEWIS	156	3.480	1935
3	LEWIS	D	8.620	1936
3	LEWIS	D	10.700	1936
3	LEWIS	K	3.500	1937
3	LEWIS	J	3.800	1948
3	LEWIS	J	5.360	1948
3	LEWIS	J	6.200	1948
3	LEWIS	J	1.940	1949
3	LEWIS	J	3.420	1949
3	LEWIS	OLD V	0.100	1954
3	LEWIS	V	1.230	1954
3	LEWIS	V	2.160	1954
3	LEWIS	V	4.510	1954
3	LEWIS	V	4.620	1954
3	LEWIS	H	0.410	1962
3	LEWIS	H	1.600	1962
3	LEWIS	H	1.850	1962
3	LEWIS	H	3.960	1962
3	LEWIS	H	4.380	1962
3	LEWIS	61 SERV RD	18.920	1977
3	LINCOLN	D	8.800	1936
3	LINCOLN	D	9.500	1936
3	LINCOLN	D	10.160	1936
3	LINCOLN	D	10.180	1936
3	LINCOLN	D	8.110	1937
3	LINCOLN	A	3.660	1940

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	LINCOLN	A	3.870	1940
3	LINCOLN	A	4.690	1940
3	LINCOLN	A	5.230	1940
3	LINCOLN	A	5.750	1940
3	LINCOLN	Z	4.010	1950
3	LINCOLN	Z	4.110	1950
3	LINCOLN	Z	5.000	1950
3	LINCOLN	Z	1.290	1951
3	LINCOLN	Z	1.940	1951
3	LINCOLN	W	0.800	1964
3	LINCOLN	W	1.170	1964
3	LINCOLN	W	1.200	1964
3	LINCOLN	W	2.220	1964
3	LINCOLN	W	2.480	1964
3	LINCOLN	UU	0.390	1970
3	LINCOLN	UU	0.970	1970
3	LINCOLN	UU	1.420	1970
3	LINCOLN	UU	2.430	1970
3	LINCOLN	UU	4.400	1970
3	MARION	E	5.580	1936
3	MARION	E	6.650	1936
3	MARION	E	7.220	1936
3	MARION	C	11.270	1940
3	MARION	C	13.590	1940
3	MARION	C	14.600	1940
3	MARION	C	14.900	1940
3	MARION	C	15.090	1940
3	MARION	J	0.040	1958
3	MARION	J	0.770	1958
3	MARION	J	0.950	1958
3	MARION	J	2.600	1958
3	MARION	J	3.560	1958
3	MARION	CC	1.170	1960
3	MARION	CC	1.880	1960
3	MARION	CC	4.050	1960
3	MARION	CC	5.030	1960
3	MARION	CC	0.200	1969
3	MONROE	M	2.860	1933
3	MONROE	151	2.470	1935
3	MONROE	151	3.800	1935
3	MONROE	151	3.890	1935
3	MONROE	J	4.990	1935
3	MONROE	V	5.260	1948
3	MONROE	V	4.510	1949

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	MONROE	V	4.990	1949
3	MONROE	V	5.260	1949
3	MONROE	V	6.810	1949
3	MONROE	V	7.330	1949
3	MONROE	CC	0.560	1957
3	MONROE	CC	0.840	1957
3	MONROE	CC	2.070	1957
3	MONROE	CC	2.490	1957
3	MONROE	CC	5.100	1957
3	MONROE	FF	1.520	1964
3	MONROE	FF	1.810	1964
3	MONROE	FF	2.040	1964
3	MONROE	FF	3.230	1964
3	MONROE	FF	4.270	1964
3	MONROE	U	8.180	1979
3	MONROE	U	8.320	1979
3	MONROE	U	8.510	1979
3	MONROE	U	8.720	1979
3	MONROE	U	8.910	1979
3	MONTGOMERY	19	25.740	1929
3	MONTGOMERY	19	28.280	1929
3	MONTGOMERY	19	28.330	1929
3	MONTGOMERY	19	31.550	1929
3	MONTGOMERY	19(45)	32.130	1929
3	MONTGOMERY	161	21.910	1939
3	MONTGOMERY	161	22.190	1939
3	MONTGOMERY	161	22.300	1939
3	MONTGOMERY	161	22.480	1939
3	MONTGOMERY	B	0.150	1948
3	MONTGOMERY	B	0.200	1948
3	MONTGOMERY	B	2.220	1948
3	MONTGOMERY	B	2.260	1948
3	MONTGOMERY	B	3.060	1948
3	MONTGOMERY	K	0.120	1950
3	MONTGOMERY	K	0.590	1950
3	MONTGOMERY	K	1.680	1950
3	MONTGOMERY	T	0.540	1963
3	MONTGOMERY	T	2.320	1963
3	MONTGOMERY	T	2.550	1963
3	MONTGOMERY	T	3.490	1963
3	MONTGOMERY	T	5.130	1963
3	MONTGOMERY	RB	0.730	1971
3	MONTGOMERY	RB	2.300	1971
3	MONTGOMERY	RB	2.370	1971

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	MONTGOMERY	RB	2.410	1971
3	MONTGOMERY	RA	0.760	1972
3	PIKE	OLD AA	0.300	1936
3	PIKE	B	1.920	1948
3	PIKE	B	3.100	1948
3	PIKE	B	0.930	1949
3	PIKE	B	1.040	1949
3	PIKE	B	1.120	1949
3	PIKE	K	0.450	1950
3	PIKE	K	0.690	1950
3	PIKE	K	1.850	1950
3	PIKE	K	2.260	1950
3	PIKE	K	3.270	1950
3	PIKE	UU	0.870	1963
3	PIKE	UU	0.990	1963
3	PIKE	UU	2.130	1963
3	PIKE	UU	3.980	1963
3	PIKE	UU	6.210	1963
3	PIKE	UU	7.290	1963
3	RALLS	M	2.250	1936
3	RALLS	M	2.860	1936
3	RALLS	M	3.130	1936
3	RALLS	M	3.270	1936
3	RALLS	M	3.650	1936
3	RALLS	H	0.710	1949
3	RALLS	H	0.820	1949
3	RALLS	H	1.050	1949
3	RALLS	H	1.400	1949
3	RALLS	H	1.470	1949
3	RALLS	N	0.200	1958
3	RALLS	N	0.420	1958
3	RALLS	N	0.550	1958
3	RALLS	N	2.040	1958
3	RALLS	N	2.380	1958
3	RALLS	CC	0.650	1962
3	RALLS	CC	0.850	1962
3	RALLS	CC	1.040	1962
3	RALLS	CC	1.960	1962
3	RALLS	CC	3.240	1962
3	RALLS	J	12.920	1978
3	RALLS	J	12.980	1978
3	RALLS	J	7.470	1979
3	RALLS	J	9.000	1979
3	RALLS	J	9.200	1979

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	SCOTLAND	B	11.170	1937
3	SCOTLAND	B	12.560	1937
3	SCOTLAND	B	12.780	1937
3	SCOTLAND	B	12.930	1937
3	SCOTLAND	H	11.620	1939
3	SCOTLAND	H	12.300	1947
3	SCOTLAND	B	7.320	1950
3	SCOTLAND	B	7.490	1950
3	SCOTLAND	B	7.780	1950
3	SCOTLAND	B	9.280	1950
3	SCOTLAND	B	9.420	1950
3	SCOTLAND	DD	0.440	1962
3	SCOTLAND	DD	1.410	1962
3	SCOTLAND	DD	2.800	1962
3	SCOTLAND	DD	3.330	1962
3	SCOTLAND	DD	4.420	1962
3	SCOTLAND	RA	1.050	1971
3	SCOTLAND	A	12.520	1972
3	SCOTLAND	A	12.580	1972
3	SCOTLAND	A	12.900	1972
3	SCOTLAND	Y	2.800	1972
3	SHELBY	T	0.680	1935
3	SHELBY	T	2.820	1935
3	SHELBY	T	4.210	1935
3	SHELBY	T	6.360	1935
3	SHELBY	151	7.710	1947
3	SHELBY	151	8.390	1947
3	SHELBY	151	9.680	1947
3	SHELBY	151	9.840	1947
3	SHELBY	151	10.500	1947
3	SHELBY	J	3.100	1957
3	SHELBY	J	4.270	1957
3	SHELBY	J	4.780	1957
3	SHELBY	J	8.020	1958
3	SHELBY	J	10.100	1958
3	SHELBY	JJ	0.950	1961
3	SHELBY	JJ	0.170	1961
3	SHELBY	JJ	0.800	1961
3	SHELBY	JJ	2.460	1961
3	SHELBY	JJ	2.650	1961
3	WARREN	47	16.800	1921
3	WARREN	47	21.210	1929
3	WARREN	47	21.330	1929
3	WARREN	47	21.410	1929

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	WARREN	47	21.870	1929
3	WARREN	94	11.170	1935
3	WARREN	94	11.580	1935
3	WARREN	94	11.820	1935
3	WARREN	94	13.560	1935
3	WARREN	94	13.680	1935
3	WARREN	94	7.190	1941
3	WARREN	94	5.240	1949
3	WARREN	94	5.420	1949
3	WARREN	94	6.540	1949
3	WARREN	94	6.670	1949
3	WARREN	O	8.060	1956
3	WARREN	O	9.210	1956
3	WARREN	O	9.480	1956
3	WARREN	O	9.570	1956
3	WARREN	O	10.000	1956
3	WARREN	Y	0.810	1964
3	WARREN	Y	0.900	1964
3	WARREN	Y	2.630	1964
3	WARREN	Y	2.960	1964
3	WARREN	Y	3.090	1964
3	WARREN	94	17.030	1976
3	WARREN	94	23.610	1979
3	WARREN	94	23.920	1979
3	WARREN	94	24.100	1979
3	WARREN	94	24.220	1979
3	WARREN	94	24.250	1979
4	CASS	B	4.600	1936
4	CASS	B	4.750	1936
4	CASS	B	5.600	1936
4	CASS	B	6.800	1936
4	CASS	58	6.500	1937
4	CASS	D	3.850	1947
4	CASS	D	4.000	1947
4	CASS	D	6.450	1947
4	CASS	D	6.850	1947
4	CASS	D	6.950	1947
4	CASS	D	17.700	1952
4	CASS	D	18.600	1952
4	CASS	D	19.900	1952
4	CASS	D	15.300	1953
4	CASS	D	16.200	1953
4	CASS	71	18.000	1967
4	CASS	71	18.100	1967

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
4	CASS	71	18.101	1967
4	CASS	71	18.190	1967
4	CASS	71	20.200	1967
4	CASS	2	4.850	1975
4	CASS	2	5.230	1975
4	CASS	2	5.500	1975
4	CASS	2	5.860	1975
4	CASS	2	6.010	1975
4	CLAY	92	18.210	1934
4	CLAY	92	18.710	1934
4	CLAY	92	19.070	1934
4	CLAY	C	0.150	1948
4	CLAY	C	0.250	1948
4	CLAY	C	0.700	1948
4	CLAY	C	1.500	1948
4	CLAY	C	2.200	1948
4	CLAY	A	5.430	1954
4	CLAY	169	11.820	1958
4	CLAY	169	11.960	1958
4	CLAY	169	12.310	1958
4	CLAY	169	14.200	1958
4	CLAY	I-35	0.150	1966
4	CLAY	I-35	0.260	1966
4	CLAY	I-35	1.510	1966
4	CLAY	I-35	1.840	1966
4	CLAY	I-35	1.870	1966
4	CLAY	J	0.040	1979
4	CLAY	J	0.360	1979
4	CLAY	J	0.550	1979
4	CLAY	J	0.680	1979
4	CLAY	J	1.010	1979
4	HENRY	J	1.020	1936
4	HENRY	J	1.210	1936
4	HENRY	J	2.050	1936
4	HENRY	J	3.360	1936
4	HENRY	J	5.250	1936
4	HENRY	C	4.270	1948
4	HENRY	C	5.010	1948
4	HENRY	C	5.200	1948
4	HENRY	C	5.590	1948
4	HENRY	CC	0.360	1957
4	HENRY	CC	1.290	1957
4	HENRY	CC	1.640	1957
4	HENRY	CC	3.310	1957

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
4	HENRY	CC	3.580	1957
4	HENRY	MM	0.690	1960
4	HENRY	MM	1.350	1960
4	HENRY	MM	1.520	1960
4	HENRY	MM	3.560	1960
4	HENRY	MM	3.710	1960
4	HENRY	T	3.490	1973
4	HENRY	T	3.900	1973
4	HENRY	T	4.110	1973
4	HENRY	T	8.410	1973
4	HENRY	T	8.450	1973
4	JACKSON	I-70	21.020	1965
4	JACKSON	I-70	22.420	1965
4	JACKSON	I-70	23.060	1965
4	JACKSON	I-70	24.000	1965
4	JACKSON	I-70	24.500	1965
4	JACKSON	RA	0.400	1972
4	JACKSON	RA	0.680	1972
4	JACKSON	RA	0.920	1972
4	JACKSON	RA	1.400	1972
4	JOHNSON	2	0.030	1935
4	JOHNSON	2	0.580	1935
4	JOHNSON	2	2.200	1935
4	JOHNSON	2	2.490	1935
4	JOHNSON	2	2.940	1935
4	JOHNSON	E	11.900	1949
4	JOHNSON	E	12.000	1949
4	JOHNSON	E	12.200	1949
4	JOHNSON	E	12.350	1949
4	JOHNSON	E	12.400	1949
4	JOHNSON	O	0.200	1950
4	JOHNSON	O	0.500	1950
4	JOHNSON	O	0.850	1950
4	JOHNSON	O	1.700	1950
4	JOHNSON	DD	5.000	1963
4	JOHNSON	DD	5.150	1963
4	JOHNSON	DD	6.190	1963
4	JOHNSON	DD	7.800	1963
4	JOHNSON	DD	8.000	1963
4	JOHNSON	50 OR LT	18.460	1970
4	JOHNSON	50 OR LT	18.470	1970
4	JOHNSON	50 OR LT.	18.390	1970
4	JOHNSON	50 OR RT	19.060	1970
4	LAFAYETTE	M	4.770	1948

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
4	LAFAYETTE	M	6.250	1948
4	LAFAYETTE	M	6.380	1948
4	LAFAYETTE	FF	10.570	1958
4	LAFAYETTE	FF	10.810	1958
4	LAFAYETTE	FF	12.200	1958
4	LAFAYETTE	FF	12.340	1958
4	LAFAYETTE	FF	9.360	1959
4	LAFAYETTE	U	2.840	1960
4	LAFAYETTE	U	3.020	1960
4	LAFAYETTE	U	3.630	1960
4	LAFAYETTE	U	3.810	1960
4	LAFAYETTE	U	3.900	1960
4	PLATTE	Z	7.920	1932
4	PLATTE	Z	8.000	1932
4	PLATTE	Z	8.200	1932
4	PLATTE	H	1.500	1933
4	PLATTE	H	1.700	1933
4	PLATTE	JJ	0.830	1949
4	PLATTE	JJ	0.920	1949
4	PLATTE	JJ	1.400	1949
4	PLATTE	JJ	1.490	1949
4	PLATTE	JJ	1.910	1949
4	PLATTE	M	0.250	1957
4	PLATTE	M	0.580	1957
4	PLATTE	M	2.000	1957
4	PLATTE	M	2.530	1957
4	PLATTE	M	2.820	1957
4	PLATTE	DD	2.870	1962
4	PLATTE	DD	3.540	1962
4	PLATTE	DD	3.630	1962
4	PLATTE	DD	4.290	1962
4	PLATTE	DD	5.150	1962
4	PLATTE	I-435	15.650	1979
4	PLATTE	I-435	16.290	1979
4	PLATTE	I-435	16.490	1979
4	PLATTE	I-435	16.610	1979
4	RAY	A	1.240	1932
4	RAY	A	1.280	1932
4	RAY	A	3.330	1932
4	RAY	A	3.640	1932
4	RAY	A	3.730	1932
4	RAY	C	8.550	1948
4	RAY	C	8.800	1948
4	RAY	C	8.900	1948

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
4	RAY	C	9.250	1948
4	RAY	C	9.450	1948
4	RAY	B	0.290	1950
4	RAY	B	0.500	1950
4	RAY	B	0.790	1950
4	RAY	B	1.160	1950
4	RAY	B	3.160	1950
4	RAY	K	0.310	1960
4	RAY	K	0.540	1960
4	RAY	K	1.140	1960
4	RAY	K	1.920	1960
4	RAY	K	2.730	1960
4	RAY	J	1.400	1972
5	BENTON	83, OLD E	0.014	1935
5	BENTON	83,(OLD E)	0.600	1935
5	BENTON	83,(OLD E)	2.722	1935
5	BENTON	P	1.000	1947
5	BENTON	P	1.350	1947
5	BENTON	P	1.750	1947
5	BENTON	P	2.000	1947
5	BENTON	P	2.250	1947
5	BENTON	DD	2.590	1954
5	BENTON	DD	2.940	1954
5	BENTON	DD	3.640	1954
5	BENTON	DD	3.740	1954
5	BENTON	AC	0.350	1960
5	BENTON	AC	0.450	1960
5	BENTON	AC	0.650	1960
5	BENTON	AC	1.000	1960
5	BENTON	AC	1.500	1960
5	BENTON	T	4.253	1975
5	BENTON	T	4.787	1975
5	BENTON	T	4.862	1975
5	BENTON	T	5.572	1975
5	BENTON	T	5.910	1975
5	BOONE	Z	16.570	1936
5	BOONE	Z	17.820	1936
5	BOONE	Z	19.450	1936
5	BOONE	Y	0.830	1957
5	BOONE	Y	2.670	1957
5	BOONE	Y	3.060	1957
5	BOONE	Y	3.830	1957
5	BOONE	Y	4.110	1957
5	BOONE	OO	2.660	1961

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	BOONE	OO	3.470	1961
5	BOONE	OO	3.870	1961
5	BOONE	OO	4.180	1961
5	BOONE	OO	4.277	1961
5	BOONE	A	0.030	1976
5	BOONE	A	0.270	1976
5	BOONE	A	0.730	1976
5	BOONE	A	0.850	1976
5	BOONE	A	1.070	1976
5	CALLAWAY	T	1.300	1937
5	CALLAWAY	N	0.490	1948
5	CALLAWAY	N	0.890	1948
5	CALLAWAY	N	2.340	1948
5	CALLAWAY	CC	2.000	1957
5	CALLAWAY	CC	2.320	1957
5	CALLAWAY	CC	4.400	1957
5	CALLAWAY	VV	0.440	1960
5	CALLAWAY	VV	0.740	1960
5	CALLAWAY	VV	0.960	1960
5	CALLAWAY	VV	1.340	1960
5	CALLAWAY	VV	2.160	1960
5	CALLAWAY	CC	0.300	1976
5	CALLAWAY	CC	0.450	1976
5	CALLAWAY	CC	0.650	1976
5	CALLAWAY	CC	1.150	1976
5	CALLAWAY	CC	1.300	1976
5	CAMDEN	73	1.050	1926
5	CAMDEN	73	1.250	1926
5	CAMDEN	J	0.060	1937
5	CAMDEN	J	0.160	1937
5	CAMDEN	J	0.340	1937
5	CAMDEN	J	1.990	1937
5	CAMDEN	J	2.100	1937
5	CAMDEN	7	2.900	1949
5	CAMDEN	7	3.800	1949
5	CAMDEN	7	3.900	1949
5	CAMDEN	7	4.100	1949
5	CAMDEN	7	4.600	1949
5	CAMDEN	O	0.500	1956
5	CAMDEN	O	1.000	1956
5	CAMDEN	O	2.100	1956
5	CAMDEN	O	2.700	1956
5	CAMDEN	O	0.900	1958
5	CAMDEN	D	3.100	1960

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	CAMDEN	D	8.100	1960
5	CAMDEN	D	8.500	1960
5	CAMDEN	D	9.300	1960
5	CAMDEN	D	9.400	1960
5	CAMDEN	RA	0.900	1974
5	CAMDEN	RA	1.200	1974
5	CAMDEN	RA	1.500	1974
5	CAMDEN	RA	1.700	1974
5	COLE	H	2.330	1937
5	COLE	H	2.650	1937
5	COLE	H	4.150	1937
5	COLE	H	4.560	1937
5	COLE	H	4.830	1937
5	COLE	U	0.340	1948
5	COLE	U	1.360	1948
5	COLE	U	6.630	1948
5	COLE	U	7.180	1948
5	COLE	U	7.650	1948
5	COLE	BB	0.010	1955
5	COLE	BB	0.410	1955
5	COLE	BB	1.380	1955
5	COLE	BB	3.660	1955
5	COLE	BB	4.360	1955
5	COLE	T	0.310	1961
5	COLE	T	0.870	1961
5	COLE	T	1.000	1961
5	COLE	T	1.570	1961
5	COLE	T	2.680	1961
5	COLE	C	8.520	1976
5	COLE	C	9.470	1976
5	COLE	C	9.770	1976
5	COLE	C	9.920	1976
5	COLE	C	10.070	1976
5	COOPER	135	8.660	1938
5	COOPER	135	8.960	1938
5	COOPER	135	9.280	1938
5	COOPER	135	9.550	1938
5	COOPER	179	0.470	1946
5	COOPER	179	0.470	1946
5	COOPER	179	0.730	1946
5	COOPER	179	0.980	1946
5	COOPER	179	1.780	1946
5	COOPER	Z	2.834	1957
5	COOPER	Z	3.160	1957

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	COOPER	Z	3.390	1957
5	COOPER	Z	3.599	1957
5	COOPER	Z	3.639	1957
5	COOPER	JJ	0.322	1964
5	COOPER	JJ	0.653	1964
5	COOPER	JJ	0.673	1964
5	COOPER	JJ	0.802	1964
5	COOPER	JJ	0.968	1964
5	GASCONADE	B	3.550	1937
5	GASCONADE	B	4.650	1937
5	GASCONADE	B	6.850	1939
5	GASCONADE	B	7.000	1939
5	GASCONADE	100	0.500	1941
5	GASCONADE	100	0.800	1941
5	GASCONADE	B	7.900	1948
5	GASCONADE	A	2.460	1955
5	GASCONADE	A	3.000	1955
5	GASCONADE	A	3.210	1955
5	GASCONADE	U	0.860	1962
5	GASCONADE	100	8.100	1969
5	GASCONADE	100	8.800	1969
5	GASCONADE	T	1.740	1972
5	MARIES	28	12.261	1928
5	MARIES	28	12.661	1928
5	MARIES	28	12.761	1928
5	MARIES	28	12.811	1928
5	MARIES	28	13.186	1928
5	MARIES	M	4.287	1935
5	MARIES	M	4.507	1935
5	MARIES	M	4.667	1935
5	MARIES	M	4.847	1935
5	MARIES	M	5.017	1935
5	MARIES	C	0.147	1947
5	MARIES	C	0.189	1947
5	MARIES	C	0.631	1947
5	MARIES	C	0.697	1947
5	MARIES	C	1.718	1947
5	MARIES	AA	0.150	1959
5	MARIES	AA	0.187	1959
5	MARIES	AA	0.824	1959
5	MARIES	AA	2.525	1959
5	MARIES	AA	2.651	1959
5	MARIES	V	0.512	1961
5	MARIES	V	2.677	1961

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	MARIES	V	4.270	1961
5	MARIES	V	5.036	1961
5	MARIES	V	5.100	1961
5	MARIES	42	16.121	1971
5	MARIES	42	16.304	1971
5	MARIES	42	16.711	1971
5	MARIES	42	17.093	1971
5	MILLER	42	26.280	1935
5	MILLER	42	26.430	1935
5	MILLER	42	26.780	1935
5	MILLER	42	27.060	1935
5	MILLER	42	27.280	1935
5	MILLER	KK	0.330	1955
5	MILLER	KK	1.020	1955
5	MILLER	KK	1.140	1955
5	MILLER	KK	1.270	1955
5	MILLER	KK	1.910	1955
5	MONITEAU	87	30.688	1932
5	MONITEAU	87	30.530	1932
5	MONITEAU	87	30.688	1932
5	MONITEAU	87	31.112	1932
5	MONITEAU	87	31.466	1932
5	MONITEAU	C	4.870	1946
5	MONITEAU	C	5.350	1946
5	MONITEAU	C	5.480	1946
5	MONITEAU	C	5.820	1946
5	MONITEAU	C	5.920	1946
5	MONITEAU	179 OLD H	1.890	1950
5	MONITEAU	179 OLD H	2.190	1950
5	MONITEAU	MM	0.752	1962
5	MONITEAU	MM	0.947	1962
5	MONITEAU	MM	1.585	1962
5	MONITEAU	MM	2.039	1962
5	MONITEAU	MM	2.336	1962
5	MORGAN	D	15.581	1938
5	MORGAN	D	16.421	1938
5	MORGAN	D	16.811	1938
5	MORGAN	D	17.301	1938
5	MORGAN	D	17.811	1938
5	MORGAN	E	3.544	1946
5	MORGAN	E	3.734	1946
5	MORGAN	E	3.994	1946
5	MORGAN	E	4.974	1946
5	MORGAN	E	5.504	1946

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	MORGAN	Z	5.490	1958
5	MORGAN	Z	5.740	1958
5	MORGAN	Z	6.040	1958
5	MORGAN	Z	2.880	1959
5	MORGAN	Z	3.240	1959
5	OSAGE	89 SPUR	0.750	1926
5	OSAGE	89 SPUR	0.800	1926
5	OSAGE	89 SPUR	1.025	1926
5	OSAGE	89 SPUR	1.200	1926
5	OSAGE	133	15.330	1935
5	OSAGE	133	15.410	1935
5	OSAGE	133	15.710	1935
5	OSAGE	133	15.860	1935
5	OSAGE	N	1.345	1947
5	OSAGE	N	1.840	1947
5	OSAGE	N	2.096	1947
5	OSAGE	N	3.696	1947
5	OSAGE	CC	0.975	1959
5	OSAGE	CC	0.125	1959
5	OSAGE	CC	0.650	1959
5	OSAGE	CC	1.050	1959
5	OSAGE	CC	4.525	1959
5	OSAGE	W	6.509	1963
5	OSAGE	W	6.575	1963
5	OSAGE	W	6.996	1963
5	OSAGE	W	7.075	1963
5	OSAGE	W	7.250	1963
5	OSAGE	RA	0.575	1973
5	OSAGE	RA	0.850	1973
5	OSAGE	RA	1.850	1973
5	OSAGE	RA	1.900	1973
5	OSAGE	RA	2.300	1973
5	PETTIS	127	4.880	1935
5	PETTIS	127	7.480	1935
5	PETTIS	127	8.080	1935
5	PETTIS	127	9.130	1935
5	PETTIS	127	9.130	1935
5	PETTIS	B	10.148	1947
5	PETTIS	B	10.298	1947
5	PETTIS	B	10.773	1947
5	PETTIS	B	11.198	1947
5	PETTIS	B	12.373	1947
5	PETTIS	HH	6.960	1959

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	PETTIS	HH	7.210	1959
5	PETTIS	HH	7.410	1959
5	PETTIS	HH	8.860	1959
5	PETTIS	HH	9.210	1959
5	PETTIS	MM	0.025	1960
5	PETTIS	MM	0.100	1960
5	PETTIS	MM	0.350	1960
5	PETTIS	MM	0.425	1960
5	PETTIS	MM	0.550	1960
5	PETTIS	RB	0.100	1972
5	PETTIS	RB	0.375	1972
5	PETTIS	RB	0.500	1972
5	PETTIS	MM	0.100	1972
6	FRANKLIN	Y	12.480	1935
6	FRANKLIN	Y	12.500	1935
6	FRANKLIN	Y	12.780	1935
6	FRANKLIN	Y	13.430	1935
6	FRANKLIN	Y	14.180	1935
6	FRANKLIN	K	1.100	1956
6	FRANKLIN	K	1.250	1956
6	FRANKLIN	K	8.850	1956
6	FRANKLIN	K	9.950	1956
6	FRANKLIN	K	10.800	1956
6	FRANKLIN	AJ	3.710	1961
6	FRANKLIN	AJ	5.170	1961
6	FRANKLIN	AJ	5.280	1961
6	FRANKLIN	AJ	5.390	1961
6	FRANKLIN	AJ	5.580	1961
6	FRANKLIN	I-44OR	2.720	1973
6	FRANKLIN	I-44OR	4.780	1973
6	FRANKLIN	I-44OR	5.070	1973
6	FRANKLIN	I-44OR	8.400	1973
6	FRANKLIN	I-44 NOR	8.600	1973
6	JEFFERSON	AA	1.000	1935
6	JEFFERSON	AA	3.300	1935
6	JEFFERSON	AA	3.500	1935
6	JEFFERSON	AA	4.300	1935
6	JEFFERSON	AA	4.700	1935
6	JEFFERSON	Y	1.450	1942
6	JEFFERSON	Y	2.100	1942
6	JEFFERSON	Y	2.400	1942
6	JEFFERSON	Y	12.900	1949
6	JEFFERSON	Y	15.800	1949
6	JEFFERSON	Y	7.500	1956

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
6	JEFFERSON	Y	6.450	1957
6	JEFFERSON	Y	9.350	1957
6	JEFFERSON	Y	9.360	1957
6	JEFFERSON	Y	9.650	1957
6	JEFFERSON	I-55OR W	9.400	1965
6	JEFFERSON	I-55OR W	10.100	1965
6	JEFFERSON	I-55OR W	10.900	1965
6	JEFFERSON	I-55OR W	11.400	1965
6	JEFFERSON	I-55OR W	11.600	1965
6	JEFFERSON	I-55 AA	0.200	1970
6	JEFFERSON	I-55ORW	1.550	1970
6	JEFFERSON	I-55ORW	1.600	1970
6	JEFFERSON	I-55ORW	1.650	1970
6	JEFFERSON	I-55ORE	19.840	1971
6	ST. CHARLES	H	0.100	1938
6	ST. CHARLES	H	0.300	1938
6	ST. CHARLES	H	1.100	1938
6	ST. CHARLES	H	1.120	1938
6	ST. CHARLES	H	1.150	1938
6	ST. CHARLES	T	10.650	1949
6	ST. CHARLES	T	12.250	1949
6	ST. CHARLES	T	12.450	1949
6	ST. CHARLES	T	14.050	1949
6	ST. CHARLES	T	14.150	1949
6	ST. CHARLES	N	11.700	1958
6	ST. CHARLES	N	11.800	1958
6	ST. CHARLES	N	13.100	1958
6	ST. CHARLES	N	13.200	1958
6	ST. CHARLES	N	14.200	1958
6	ST. CHARLES	W	1.700	1960
6	ST. CHARLES	W	1.900	1960
6	ST. CHARLES	W	2.700	1960
6	ST. CHARLES	W	3.200	1960
6	ST. CHARLES	W	3.900	1960
6	ST. LOUIS	109	4.600	1934
6	ST. LOUIS	109	6.350	1934
6	ST. LOUIS	CC	3.350	1934
6	ST. LOUIS	I-270	33.280	1963
6	ST. LOUIS	100 N O R	2.350	1975
6	ST. LOUIS	100 N O R	2.450	1975
6	ST. LOUIS	100 N O R	2.500	1975
6	ST. LOUIS	100 N O R	2.650	1975
7	BARRY	M	4.710	1935
7	BARRY	M	5.750	1935

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	BARRY	M	6.060	1935
7	BARRY	M	6.256	1935
7	BARRY	M	4.000	1936
7	BARRY	Z	0.238	1947
7	BARRY	Z	1.365	1947
7	BARRY	Z	1.983	1947
7	BARRY	Z	2.641	1947
7	BARRY	Z	2.894	1947
7	BARRY	CC	1.375	1957
7	BARRY	CC	2.259	1957
7	BARRY	CC	2.642	1957
7	BARRY	CC	3.265	1957
7	BARRY	CC	3.821	1957
7	BARRY	YY	0.292	1962
7	BARRY	YY	0.428	1962
7	BARRY	YY	0.599	1962
7	BARRY	YY	1.988	1962
7	BARRY	YY	2.485	1962
7	BARRY	RA	0.179	1970
7	BARRY	RA	0.599	1970
7	BARRY	RA	0.705	1970
7	BARRY	RA	1.257	1970
7	BARRY	RA	1.799	1970
7	BARTON	126	1.537	1934
7	BARTON	126	2.386	1934
7	BARTON	126	5.035	1934
7	BARTON	126	7.476	1934
7	BARTON	126	7.727	1934
7	BARTON	J	5.663	1947
7	BARTON	J	6.500	1947
7	BARTON	J	6.542	1947
7	BARTON	J	6.878	1947
7	BARTON	J	7.559	1947
7	BARTON	U	0.249	1956
7	BARTON	U	0.857	1956
7	BARTON	U	0.928	1956
7	BARTON	U	1.000	1956
7	BARTON	U	2.301	1956
7	BARTON	126	2.708	1960
7	BARTON	W	0.670	1968
7	BATES	18	0.250	1936
7	BATES	18	0.500	1936
7	BATES	18	0.700	1936
7	BATES	18	0.850	1936

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	BATES	18	1.300	1936
7	BATES	H	8.160	1947
7	BATES	H	8.530	1947
7	BATES	H	8.826	1947
7	BATES	H	9.181	1947
7	BATES	H	9.359	1947
7	BATES	T	0.142	1950
7	BATES	T	0.295	1950
7	BATES	T	0.630	1950
7	BATES	T	1.175	1950
7	BATES	T	1.470	1950
7	BATES	AA	0.644	1960
7	BATES	AA	1.650	1960
7	BATES	AA	1.721	1960
7	BATES	AA	2.222	1960
7	BATES	AA	2.400	1960
7	CEDAR	97	3.639	1936
7	CEDAR	97	7.795	1936
7	CEDAR	97	8.040	1936
7	CEDAR	97	9.744	1936
7	CEDAR	N	0.609	1949
7	CEDAR	N	0.806	1949
7	CEDAR	N	1.133	1949
7	CEDAR	N	2.750	1949
7	CEDAR	N	5.151	1949
7	CEDAR	O	0.329	1955
7	CEDAR	O	0.852	1955
7	CEDAR	O	1.269	1955
7	CEDAR	O	1.765	1955
7	CEDAR	O	1.956	1955
7	CEDAR	Z	0.084	1962
7	CEDAR	Z	0.483	1962
7	CEDAR	Z	2.774	1962
7	CEDAR	Z	4.684	1962
7	CEDAR	Z	4.983	1962
7	CEDAR	32	0.293	1970
7	CEDAR	32	0.369	1970
7	CEDAR	32	0.638	1970
7	CEDAR	32	1.067	1970
7	DADE	M	0.541	1934
7	DADE	M	0.997	1934
7	DADE	M	1.662	1934
7	DADE	A	2.955	1948
7	DADE	D	0.046	1955

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	DADE	D	0.075	1955
7	DADE	D	1.003	1955
7	DADE	D	2.012	1955
7	DADE	D	3.932	1955
7	DADE	BB	1.109	1961
7	DADE	BB	2.036	1961
7	DADE	BB	2.601	1961
7	DADE	BB	3.025	1961
7	DADE	BB	4.129	1961
7	JASPER	N	1.440	1947
7	JASPER	N	4.102	1947
7	JASPER	N	4.608	1947
7	JASPER	N	6.984	1947
7	JASPER	JJ	0.008	1958
7	JASPER	JJ	0.517	1958
7	JASPER	JJ	2.008	1958
7	JASPER	JJ	2.412	1958
7	JASPER	JJ	3.018	1958
7	JASPER	P	2.534	1961
7	JASPER	U	3.524	1964
7	JASPER	BB	4.272	1968
7	LAWRENCE	97	0.318	1935
7	LAWRENCE	97	2.137	1935
7	LAWRENCE	97	3.687	1935
7	LAWRENCE	97	3.791	1935
7	LAWRENCE	97	4.045	1935
7	LAWRENCE	WW	0.611	1959
7	LAWRENCE	WW	0.970	1959
7	LAWRENCE	WW	1.053	1959
7	LAWRENCE	WW	1.710	1959
7	LAWRENCE	WW	1.942	1959
7	LAWRENCE	V	0.296	1961
7	LAWRENCE	V	0.426	1961
7	LAWRENCE	V	0.758	1961
7	LAWRENCE	V	2.704	1961
7	LAWRENCE	V	3.254	1961
7	MCDONALD	59	3.400	1927
7	MCDONALD	59	3.471	1927
7	MCDONALD	59	4.460	1927
7	MCDONALD	43	0.104	1935
7	MCDONALD	43	0.261	1935
7	MCDONALD	43	1.169	1935
7	MCDONALD	43	5.777	1935
7	MCDONALD	D	1.052	1940

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	MCDONALD	D	1.222	1940
7	MCDONALD	D	1.364	1940
7	MCDONALD	D	1.501	1940
7	MCDONALD	E	6.288	1947
7	MCDONALD	B	0.001	1959
7	MCDONALD	B	0.397	1959
7	MCDONALD	B	0.904	1959
7	MCDONALD	B	1.049	1959
7	MCDONALD	B	2.481	1959
7	MCDONALD	KK	0.284	1963
7	MCDONALD	KK	0.644	1963
7	MCDONALD	KK	1.840	1963
7	MCDONALD	KK	4.487	1963
7	MCDONALD	KK	4.703	1963
7	NEWTON	V	0.177	1936
7	NEWTON	V	1.058	1936
7	NEWTON	V	1.933	1936
7	NEWTON	V	4.085	1939
7	NEWTON	V	4.712	1939
7	NEWTON	K	3.065	1947
7	NEWTON	K	3.167	1947
7	NEWTON	K	3.224	1947
7	NEWTON	K	3.258	1947
7	NEWTON	K	3.352	1947
7	NEWTON	O	3.250	1951
7	NEWTON	O	3.434	1951
7	NEWTON	O	4.652	1951
7	NEWTON	O	5.302	1951
7	NEWTON	O	7.378	1951
7	NEWTON	D	3.449	1969
7	NEWTON	D	3.575	1969
7	NEWTON	D	7.528	1969
7	NEWTON	D	7.910	1969
7	NEWTON	D	8.643	1969
7	ST. CLAIR	H	4.620	1935
7	ST. CLAIR	H	0.850	1949
7	ST. CLAIR	H	1.250	1949
7	ST. CLAIR	H	0.200	1949
7	ST. CLAIR	H	3.400	1949
7	ST. CLAIR	H	3.800	1949
7	ST. CLAIR	B	2.050	1954
7	ST. CLAIR	B	2.850	1954
7	ST. CLAIR	B	3.030	1954
7	ST. CLAIR	B	3.420	1954

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	ST. CLAIR	B	3.520	1954
7	ST. CLAIR	ZZ	1.253	1964
7	ST. CLAIR	ZZ	3.505	1964
7	ST. CLAIR	ZZ	4.575	1964
7	ST. CLAIR	ZZ	4.711	1964
7	ST. CLAIR	ZZ	5.133	1964
7	ST. CLAIR	ZZ	0.276	1978
7	ST. CLAIR	ZZ	0.684	1978
7	ST. CLAIR	ZZ	0.872	1978
7	ST. CLAIR	ZZ	1.160	1978
7	ST. CLAIR	ZZ	1.400	1978
7	VERNON	E	7.020	1936
7	VERNON	E	7.190	1936
7	VERNON	E	7.420	1936
7	VERNON	E	7.470	1936
7	VERNON	E	8.070	1936
7	VERNON	V	0.400	1942
7	VERNON	V	0.440	1942
7	VERNON	V	0.520	1942
7	VERNON	V	1.580	1942
7	VERNON	T	2.680	1951
7	VERNON	T	3.830	1951
7	VERNON	T	4.730	1951
8	STONE	13(43)	25.150	1924
8	CHRISTIAN	14	15.730	1926
8	CHRISTIAN	14	15.340	1926
8	CHRISTIAN	14	16.020	1926
8	CHRISTIAN	14	16.520	1926
8	CHRISTIAN	14	16.710	1926
8	CHRISTIAN	14	5.450	1932
8	CHRISTIAN	14	6.580	1932
8	CHRISTIAN	14	8.060	1932
8	CHRISTIAN	160	0.650	1934
8	CHRISTIAN	160	2.400	1934
8	CHRISTIAN	125(C)	9.420	1946
8	CHRISTIAN	125(C)	8.010	1946
8	CHRISTIAN	125(C)	7.840	1946
8	CHRISTIAN	125(C)	6.580	1946
8	CHRISTIAN	125(C)	6.450	1946
8	CHRISTIAN	T	7.750	1955
8	CHRISTIAN	T	5.260	1955
8	CHRISTIAN	T	3.750	1955
8	CHRISTIAN	T	3.550	1955
8	CHRISTIAN	T	3.280	1955

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	CHRISTIAN	UU	10.200	1961
8	CHRISTIAN	UU	2.500	1961
8	CHRISTIAN	UU	0.350	1961
8	CHRISTIAN	F	1.060	1962
8	CHRISTIAN	F	1.930	1962
8	DALLAS	38(H)	7.830	1935
8	DALLAS	38(H)	7.310	1935
8	DALLAS	38(H)	6.550	1935
8	DALLAS	38(H)	6.080	1935
8	DALLAS	38(H)	5.810	1935
8	DALLAS	64(C)	2.010	1947
8	DALLAS	64(C)	1.250	1947
8	DALLAS	64(C)	0.170	1947
8	DALLAS	64(C)	0.060	1947
8	DALLAS	F	1.010	1959
8	DALLAS	F	1.100	1959
8	DALLAS	F	2.530	1959
8	DALLAS	F	2.920	1959
8	DALLAS	F	6.480	1959
8	DALLAS	WW	7.010	1960
8	DALLAS	WW	6.410	1960
8	DALLAS	WW	0.600	1960
8	DALLAS	WW	0.210	1960
8	DALLAS	WW	0.140	1960
8	DALLAS	D	5.520	1976
8	DALLAS	D	5.270	1976
8	DALLAS	D	4.770	1976
8	DALLAS	D	3.800	1976
8	DOUGLAS	14	40.920	1932
8	DOUGLAS	14	41.520	1932
8	DOUGLAS	14	41.720	1932
8	DOUGLAS	14	41.820	1932
8	DOUGLAS	14	41.990	1932
8	DOUGLAS	76(F)	20.360	1947
8	DOUGLAS	76(F)	20.710	1947
8	DOUGLAS	76(F)	21.280	1947
8	DOUGLAS	76(F)	22.050	1947
8	DOUGLAS	76(F)	22.710	1947
8	DOUGLAS	WW	1.190	1958
8	DOUGLAS	WW	1.320	1958
8	DOUGLAS	WW	1.580	1958
8	DOUGLAS	WW	1.650	1958
8	DOUGLAS	WW	2.380	1958
8	DOUGLAS	AA	0.070	1960

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	DOUGLAS	AA	0.510	1960
8	DOUGLAS	AA	2.040	1960
8	DOUGLAS	AA	2.240	1960
8	DOUGLAS	AA	2.400	1960
8	GREENE	V	5.060	1935
8	GREENE	V	5.830	1935
8	GREENE	V	5.940	1935
8	GREENE	V	2.300	1936
8	GREENE	V	2.450	1936
8	GREENE	CC	8.810	1948
8	GREENE	CC	8.610	1948
8	GREENE	CC	8.190	1948
8	GREENE	CC	5.280	1948
8	GREENE	CC	4.970	1948
8	GREENE	AB	0.620	1955
8	GREENE	AB	1.330	1955
8	GREENE	AB	3.330	1955
8	GREENE	AB	3.550	1955
8	GREENE	AB	4.850	1955
8	GREENE	CC	10.500	1977
8	HICKORY	D	5.300	1936
8	HICKORY	D	4.000	1936
8	HICKORY	D	3.650	1936
8	HICKORY	D	0.080	1936
8	HICKORY	P	1.350	1949
8	HICKORY	P	1.520	1949
8	HICKORY	P	2.230	1949
8	HICKORY	P	3.830	1949
8	HICKORY	P	5.400	1949
8	HICKORY	HH	3.900	1955
8	HICKORY	HH	2.600	1955
8	HICKORY	HH	0.840	1955
8	HICKORY	NN	4.580	1957
8	HICKORY	NN	1.590	1957
8	HICKORY	648	2.070	1962
8	HICKORY	64B	1.950	1962
8	HICKORY	64B	1.850	1962
8	HICKORY	64B	1.045	1962
8	HICKORY	64B	1.340	1962
8	LACLEDE	32	14.800	1932
8	LACLEDE	32	14.900	1932
8	LACLEDE	32	14.500	1932
8	LACLEDE	32	13.600	1932
8	LACLEDE	32	14.000	1932

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	LACLEDE	B	8.500	1941
8	LACLEDE	B	8.300	1941
8	LACLEDE	B	8.200	1941
8	LACLEDE	B	8.100	1941
8	LACLEDE	B	7.700	1941
8	LACLEDE	J	5.300	1948
8	LACLEDE	32	3.000	1954
8	LACLEDE	32	3.100	1954
8	LACLEDE	32	3.300	1954
8	LACLEDE	32	4.000	1954
8	LACLEDE	32	1.300	1954
8	LACLEDE	YY	3.200	1960
8	LACLEDE	YY	3.000	1960
8	LACLEDE	YY	2.800	1960
8	LACLEDE	YY	2.700	1960
8	LACLEDE	WW	0.300	1962
8	LACLEDE	I-44	20.400	1974
8	LACLEDE	I-44	20.700	1974
8	LACLEDE	I-44	21.700	1974
8	LACLEDE	I-44	22.500	1974
8	OZARK	160	25.720	1920
8	OZARK	160	26.040	1920
8	OZARK	160	26.980	1920
8	OZARK	160	27.490	1920
8	OZARK	160	28.960	1920
8	OZARK	95	15.660	1932
8	OZARK	95	16.900	1932
8	OZARK	95	21.770	1932
8	OZARK	160	2.960	1937
8	OZARK	160	3.070	1937
8	OZARK	J	5.350	1948
8	OZARK	J	5.350	1948
8	OZARK	J	5.760	1948
8	OZARK	J	5.910	1948
8	OZARK	J	6.130	1948
8	OZARK	95(MM)	2.810	1958
8	OZARK	95(MM)	2.050	1958
8	OZARK	95(MM)	1.460	1958
8	OZARK	95(MM)	1.390	1958
8	OZARK	95(MM)	1.170	1958
8	OZARK	95(DD)	10.170	1961
8	OZARK	95(DD)	9.110	1961
8	OZARK	95(DD)	8.500	1961
8	OZARK	95(DD)	7.650	1961

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	OZARK	95(DD)	7.490	1961
8	OZARK	CC	5.220	1973
8	OZARK	CC	5.320	1973
8	OZARK	CC	5.420	1973
8	OZARK	CC	5.720	1973
8	OZARK	CC	5.920	1973
8	POLK	H	11.100	1936
8	POLK	H	13.650	1936
8	POLK	H	13.740	1936
8	POLK	H	13.810	1936
8	POLK	H	12.260	1936
8	POLK	N	2.190	1947
8	POLK	J (123)	1.800	1948
8	POLK	215	9.250	1953
8	POLK	215	8.880	1953
8	POLK	215	8.890	1953
8	POLK	215	8.500	1953
8	POLK	215	8.720	1953
8	POLK	WW	0.257	1962
8	POLK	WW	0.412	1962
8	POLK	WW	0.623	1962
8	POLK	A	0.110	1962
8	POLK	A	0.870	1962
8	STONE	13(43)	30.000	1924
8	STONE	13-43	25.150	1924
8	STONE	13(43)	25.150	1924
8	STONE	248(43)	0.300	1926
8	STONE	13(43)	24.010	1928
8	STONE	13(43)	23.890	1928
8	STONE	160	1.670	1932
8	STONE	160	2.050	1932
8	STONE	173(C)	4.340	1933
8	STONE	173(C)	3.870	1933
8	STONE	173(C)	3.770	1933
8	STONE	V	6.140	1949
8	STONE	V	5.820	1949
8	STONE	V	5.580	1949
8	STONE	V	5.240	1949
8	STONE	V	5.190	1949
8	STONE	V	4.500	1952
8	STONE	V	4.500	1953
8	STONE	V	4.530	1953
8	STONE	V	4.700	1953
8	STONE	39(8)	5.690	1954

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	STONE	39(P)	4.340	1954
8	STONE	JJ	2.300	1960
8	STONE	JJ	3.130	1960
8	STONE	JJ	4.990	1960
8	STONE	JJ	0.410	1971
8	STONE	JJ	0.530	1971
8	STONE	JJ	0.750	1971
8	TANEY	160	8.700	1926
8	TANEY	160	8.600	1926
8	TANEY	160	8.300	1926
8	TANEY	160	8.200	1926
8	TANEY	160	8.000	1926
8	TANEY	76	29.400	1932
8	TANEY	76	31.800	1932
8	TANEY	76	31.100	1932
8	TANEY	76	29.600	1932
8	TANEY	76	29.500	1932
8	TANEY	F	3.000	1948
8	TANEY	F	2.300	1948
8	TANEY	T	5.300	1957
8	TANEY	T	5.600	1957
8	TANEY	T	6.300	1957
8	TANEY	T	6.100	1957
8	TANEY	T	5.800	1957
8	TANEY	265	0.900	1960
8	TANEY	KK	1.600	1962
8	TANEY	HH	2.100	1962
8	TANEY	HH	0.500	1962
8	TANEY	HH	0.200	1962
8	WEBSTER	C	4.000	1936
8	WEBSTER	C	4.300	1936
8	WEBSTER	C	4.500	1936
8	WEBSTER	C	6.400	1937
8	WEBSTER	C	5.400	1937
8	WEBSTER	W	3.600	1947
8	WEBSTER	W	7.100	1947
8	WEBSTER	W	9.500	1947
8	WEBSTER	Z	4.200	1948
8	WEBSTER	B	6.700	1950
8	WEBSTER	B	6.600	1950
8	WEBSTER	B	4.100	1950
8	WEBSTER	B	6.100	1950
8	WEBSTER	B	2.200	1950
8	WEBSTER	KK	8.700	1962

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	WEBSTER	KK	8.500	1962
8	WEBSTER	KK	7.500	1962
8	WEBSTER	KK	7.300	1962
8	WEBSTER	KK	0.800	1963
8	WEBSTER	I-44	3.600	1970
8	WEBSTER	I-44	4.000	1970
8	WEBSTER	I-44	3.400	1970
8	WEBSTER	I-44	4.000	1970
8	WEBSTER	I-44	4.100	1970
8	WRIGHT	5	15.100	1927
8	WRIGHT	5	16.500	1927
8	WRIGHT	5	17.000	1927
8	WRIGHT	5	17.400	1927
8	WRIGHT	5	17.700	1927
8	WRIGHT	38	5.700	1935
8	WRIGHT	38	6.300	1935
8	WRIGHT	38	7.300	1935
8	WRIGHT	38	7.400	1935
8	WRIGHT	38	8.100	1935
8	WRIGHT	H	4.700	1948
8	WRIGHT	H	4.900	1948
8	WRIGHT	H	4.700	1948
8	WRIGHT	H	2.400	1948
8	WRIGHT	H	1.500	1948
8	WRIGHT	95	4.400	1955
8	WRIGHT	95	4.300	1955
8	WRIGHT	95	4.100	1955
8	WRIGHT	95	4.000	1955
8	WRIGHT	95	3.700	1955
8	WRIGHT	CC	0.100	1961
8	WRIGHT	CC	0.500	1961
8	WRIGHT	CC	1.100	1961
8	WRIGHT	CC	1.800	1961
8	WRIGHT	60	0.400	1964
9	CARTER	J	0.100	1935
9	CARTER	J	0.200	1935
9	CARTER	J	0.300	1935
9	CARTER	J	0.500	1935
9	CARTER	J	1.500	1935
9	CARTER	E	0.100	1947
9	CARTER	E	0.250	1947
9	CARTER	E	0.400	1947
9	CARTER	E	0.500	1947
9	CARTER	E	1.800	1947

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	CARTER	P	1.630	1952
9	CARTER	P	1.710	1952
9	CARTER	P	1.880	1952
9	CARTER	P	1.930	1952
9	CARTER	P	2.030	1952
9	CARTER	Z	0.900	1960
9	CARTER	Z	0.970	1960
9	CARTER	Z	3.200	1960
9	CARTER	Z	3.300	1960
9	CARTER	Z	4.200	1960
9	CRAWFORD	M	0.350	1935
9	CRAWFORD	M	0.400	1935
9	CRAWFORD	M	0.900	1935
9	CRAWFORD	M	0.950	1935
9	CRAWFORD	M	2.600	1935
9	CRAWFORD	F	14.347	1940
9	CRAWFORD	F	12.047	1942
9	CRAWFORD	F	12.347	1942
9	CRAWFORD	F	13.047	1942
9	CRAWFORD	F	13.597	1942
9	CRAWFORD	PP	0.050	1958
9	CRAWFORD	PP	1.500	1958
9	CRAWFORD	PP	2.000	1958
9	CRAWFORD	PP	2.100	1958
9	CRAWFORD	PP	3.600	1958
9	CRAWFORD	JJ	0.200	1960
9	CRAWFORD	JJ	0.500	1960
9	CRAWFORD	JJ	0.700	1960
9	CRAWFORD	JJ	1.000	1960
9	CRAWFORD	JJ	1.100	1960
9	DENT	B	3.100	1936
9	DENT	B	3.300	1936
9	DENT	B	3.400	1936
9	DENT	B	3.500	1936
9	DENT	B	3.850	1936
9	DENT	F	0.010	1948
9	DENT	F	1.300	1948
9	DENT	F	1.450	1948
9	DENT	F	2.100	1948
9	DENT	F	2.400	1948
9	DENT	P	0.400	1957
9	DENT	P	0.900	1957
9	DENT	P	2.600	1957
9	DENT	P	2.950	1957

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	DENT	P	3.250	1957
9	DENT	WW	0.150	1961
9	DENT	WW	0.450	1961
9	DENT	WW	0.600	1961
9	DENT	WW	0.700	1961
9	DENT	WW	0.900	1961
9	HOWELL	76	0.100	1939
9	HOWELL	76	1.900	1939
9	HOWELL	76	2.300	1939
9	HOWELL	76	2.400	1939
9	HOWELL	76	2.500	1939
9	HOWELL	U	0.900	1948
9	HOWELL	U	1.200	1948
9	HOWELL	U	1.360	1948
9	HOWELL	U	1.950	1948
9	HOWELL	U	2.050	1948
9	HOWELL	AD	0.650	1957
9	HOWELL	AD	1.200	1957
9	HOWELL	AD	1.300	1957
9	HOWELL	AD	1.400	1957
9	HOWELL	AD	2.200	1957
9	HOWELL	JJ	8.050	1962
9	HOWELL	JJ	8.350	1962
9	HOWELL	JJ	9.550	1962
9	HOWELL	JJ	9.600	1962
9	HOWELL	JJ	11.500	1962
9	HOWELL	CC	0.100	1972
9	HOWELL	CC	0.280	1972
9	HOWELL	CC	0.500	1972
9	HOWELL	CC	0.700	1972
9	HOWELL	CC	1.000	1972
9	IRON	49	15.240	1924
9	IRON	49	16.030	1924
9	IRON	49	16.190	1924
9	IRON	49	16.590	1924
9	IRON	49	16.890	1924
9	IRON	143	0.950	1935
9	IRON	143	1.300	1935
9	IRON	143	1.400	1935
9	IRON	143	1.600	1935
9	IRON	143	3.750	1935
9	IRON	M	0.950	1948
9	IRON	M	1.300	1948
9	IRON	M	1.450	1948

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	IRON	M	1.600	1948
9	IRON	M	2.100	1948
9	IRON	Z	0.750	1959
9	IRON	Z	0.900	1959
9	IRON	Z	1.500	1959
9	IRON	Z	1.550	1959
9	IRON	Z	1.600	1959
9	IRON	BB	0.250	1962
9	IRON	BB	0.500	1962
9	IRON	BB	0.950	1962
9	IRON	BB	2.650	1962
9	IRON	BB	4.100	1962
9	OREGON	M	0.100	1936
9	OREGON	M	2.200	1936
9	OREGON	M	2.500	1936
9	OREGON	M	3.200	1936
9	OREGON	M	3.900	1936
9	OREGON	M	5.750	1948
9	OREGON	M	5.850	1948
9	OREGON	M	6.200	1948
9	OREGON	M	6.400	1948
9	OREGON	M	6.740	1948
9	OREGON	W	0.700	1959
9	OREGON	W	0.850	1959
9	OREGON	W	1.050	1959
9	OREGON	W	1.150	1959
9	OREGON	W	1.350	1959
9	OREGON	CC	0.470	1962
9	OREGON	CC	1.100	1962
9	OREGON	CC	1.450	1962
9	OREGON	CC	2.890	1962
9	OREGON	CC	4.090	1962
9	PHELPS	O	1.300	1939
9	PHELPS	O	1.650	1939
9	PHELPS	O	3.150	1939
9	PHELPS	O	4.350	1939
9	PHELPS	O	6.600	1939
9	PHELPS	Y	0.150	1956
9	PHELPS	Y	0.600	1956
9	PHELPS	Y	0.600	1956
9	PHELPS	Y	1.350	1956
9	PHELPS	Y	1.350	1956
9	PHELPS	K	0.530	1960
9	PHELPS	K	0.760	1960

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	PHELPS	K	0.940	1960
9	PHELPS	K	1.850	1960
9	PHELPS	K	1.860	1960
9	PULASKI	17	2.620	1024
9	PULASKI	17	2.850	1924
9	PULASKI	17	3.120	1924
9	PULASKI	17	3.770	1924
9	PULASKI	17	4.180	1924
9	PULASKI	H	4.100	1935
9	PULASKI	H	4.200	1935
9	PULASKI	H	5.000	1935
9	PULASKI	H	5.200	1935
9	PULASKI	H	5.400	1935
9	PULASKI	DD	0.020	1954
9	PULASKI	DD	3.000	1954
9	PULASKI	DD	3.050	1954
9	PULASKI	DD	3.250	1954
9	PULASKI	DD	3.700	1954
9	PULASKI	K	0.060	1961
9	PULASKI	K	0.200	1961
9	PULASKI	K	0.400	1961
9	PULASKI	K	0.450	1961
9	PULASKI	K	0.600	1961
9	PULASKI	T	4.300	1975
9	PULASKI	T	4.700	1975
9	PULASKI	T	5.200	1975
9	PULASKI	T	5.300	1975
9	PULASKI	T	5.550	1975
9	REYNOLDS	1	9.210	1936
9	REYNOLDS	N	8.560	1936
9	REYNOLDS	N	8.660	1936
9	REYNOLDS	N	9.060	1936
9	REYNOLDS	N	10.010	1936
9	REYNOLDS	N	5.390	1942
9	REYNOLDS	N	5.540	1942
9	REYNOLDS	N	6.340	1942
9	REYNOLDS	N	6.540	1942
9	REYNOLDS	N	7.140	1942
9	REYNOLDS	J	3.100	1953
9	REYNOLDS	J	3.300	1953
9	REYNOLDS	J	3.900	1953
9	REYNOLDS	J	4.050	1953
9	REYNOLDS	J	4.120	1953
9	REYNOLDS	Y	2.300	1964

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	REYNOLDS	Y	2.400	1964
9	REYNOLDS	Y	3.100	1964
9	REYNOLDS	Y	3.400	1964
9	REYNOLDS	Y	4.850	1964
9	REYNOLDS	49	6.730	1979
9	REYNOLDS	49	6.830	1979
9	REYNOLDS	49	7.030	1979
9	REYNOLDS	49	7.430	1979
9	REYNOLDS	49	7.680	1979
9	RIPLEY	21	2.500	1929
9	RIPLEY	21	3.980	1929
9	RIPLEY	21	4.480	1929
9	RIPLEY	21	4.750	1929
9	RIPLEY	21	5.620	1929
9	RIPLEY	142(D)	11.300	1936
9	RIPLEY	142(D)	11.800	1936
9	RIPLEY	142(D)	12.200	1936
9	RIPLEY	142(D)	13.400	1936
9	RIPLEY	142(D)	14.800	1936
9	RIPLEY	142(B)	27.190	1947
9	RIPLEY	142(B)	27.740	1947
9	RIPLEY	142(B)	28.740	1947
9	RIPLEY	142(B)	28.990	1947
9	RIPLEY	142(B)	29.390	1947
9	RIPLEY	EE	0.640	1955
9	RIPLEY	EE	1.180	1955
9	RIPLEY	EE	3.540	1955
9	RIPLEY	EE	4.000	1955
9	RIPLEY	EE	4.150	1955
9	RIPLEY	V	1.200	1962
9	RIPLEY	V	1.400	1962
9	RIPLEY	V	1.600	1962
9	RIPLEY	V	2.600	1962
9	RIPLEY	V	3.050	1962
9	SHANNON	19	22.820	1928
9	SHANNON	19	22.920	1928
9	SHANNON	19	23.070	1928
9	SHANNON	19	23.170	1928
9	SHANNON	19	23.420	1928
9	SHANNON	D	0.300	1936
9	SHANNON	D	0.450	1936
9	SHANNON	D	4.650	1936
9	SHANNON	D	8.620	1936
9	SHANNON	H	3.850	1948

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	SHANNON	H	5.750	1948
9	SHANNON	H	5.900	1948
9	SHANNON	H	6.000	1948
9	SHANNON	H	6.100	1948
9	SHANNON	A	1.900	1950
9	SHANNON	A	2.050	1950
9	SHANNON	A	2.570	1950
9	SHANNON	A	3.250	1950
9	SHANNON	A	3.350	1950
9	SHANNON	EE	0.250	1962
9	SHANNON	EE	0.540	1962
9	SHANNON	EE	0.650	1962
9	SHANNON	EE	0.780	1962
9	SHANNON	EE	2.190	1962
9	SHANNON	106	29.940	1975
9	SHANNON	106	30.170	1975
9	SHANNON	106	30.940	1975
9	SHANNON	106	31.290	1975
9	SHANNON	106	32.040	1975
9	TEXAS	17	64.580	1929
9	TEXAS	17	64.930	1929
9	TEXAS	17	65.030	1929
9	TEXAS	17	65.130	1929
9	TEXAS	17	65.250	1929
9	TEXAS	38	6.000	1936
9	TEXAS	38	10.000	1936
9	TEXAS	38	11.450	1936
9	TEXAS	38	12.000	1936
9	TEXAS	38	12.100	1936
9	TEXAS	TT	1.000	1948
9	TEXAS	TT	0.450	1949
9	TEXAS	TT	0.760	1949
9	TEXAS	TT	1.550	1949
9	TEXAS	TT	1.850	1949
9	TEXAS	ZZ	0.600	1953
9	TEXAS	ZZ	0.950	1953
9	TEXAS	ZZ	2.180	1953
9	TEXAS	ZZ	2.250	1953
9	TEXAS	ZZ	2.300	1953
9	TEXAS	AE	2.650	1960
9	TEXAS	AE	3.050	1960
9	TEXAS	AE	4.500	1960
9	TEXAS	AE	5.450	1960
9	TEXAS	AE	5.750	1960

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	WASHINGTON	M	0.800	1936
9	WASHINGTON	M	1.050	1936
9	WASHINGTON	M	1.200	1936
9	WASHINGTON	M	2.050	1936
9	WASHINGTON	M	2.800	1936
9	WASHINGTON	104	1.450	1941
9	WASHINGTON	104	1.550	1941
9	WASHINGTON	104	1.650	1941
9	WASHINGTON	104	1.950	1941
9	WASHINGTON	104	2.000	1941
9	WASHINGTON	A	0.090	1959
9	WASHINGTON	A	0.300	1959
9	WASHINGTON	A	1.090	1959
9	WASHINGTON	A	2.110	1959
9	WASHINGTON	A	2.600	1959
9	WASHINGTON	AA	3.890	1960
9	WASHINGTON	AA	4.030	1960
9	WASHINGTON	AA	4.090	1960
9	WASHINGTON	AA	4.320	1960
9	WASHINGTON	AA	4.390	1960
10	BOLLINGER	51	34.700	1928
10	BOLLINGER	51	32.175	1928
10	BOLLINGER	51	32.461	1928
10	BOLLINGER	51	33.308	1928
10	BOLLINGER	51	35.900	1929
10	BOLLINGER	K	6.056	1935
10	BOLLINGER	F	0.120	1938
10	BOLLINGER	F	0.540	1938
10	BOLLINGER	F	0.950	1938
10	BOLLINGER	F	1.220	1938
10	BOLLINGER	E	3.612	1941
10	BOLLINGER	E	3.572	1941
10	BOLLINGER	E	3.476	1941
10	BOLLINGER	E	2.547	1948
10	BOLLINGER	E	1.950	1948
10	BOLLINGER	Y	1.623	1953
10	BOLLINGER	Y	0.417	1953
10	BOLLINGER	Y	0.279	1953
10	BOLLINGER	Y	0.174	1953
10	BOLLINGER	Y	0.076	1953
10	BOLLINGER	W	3.116	1961
10	BOLLINGER	W	2.827	1961
10	BOLLINGER	W	0.318	1961
10	BOLLINGER	W	0.182	1961

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
10	BOLLINGER	W	0.014	1961
10	BUTLER	142	15.122	1933
10	BUTLER	T	0.110	1939
10	BUTLER	HH	1.920	1955
10	BUTLER	HH	2.870	1955
10	BUTLER	HH	3.050	1955
10	BUTLER	HH	3.420	1955
10	BUTLER	HH	9.600	1955
10	CAPE GIR.	25	4.447	1928
10	CAPE GIR.	25	2.086	1928
10	CAPE GIR.	25	1.589	1928
10	CAPE GIR.	25	1.429	1928
10	CAPE GIR.	25	1.180	1928
10	CAPE GIR.	E	1.500	1940
10	CAPE GIR.	E	1.160	1940
10	CAPE GIR.	E	0.490	1940
10	CAPE GIR.	E	0.100	1940
10	CAPE GIR.	E	0.010	1940
10	CAPE GIR.	U	10.776	1950
10	CAPE GIR.	U	10.114	1950
10	CAPE GIR.	U	8.959	1950
10	CAPE GIR.	CC	2.168	1968
10	CAPE GIR.	CC	1.323	1968
10	CAPE GIR.	CC	0.814	1968
10	CAPE GIR.	CC	0.672	1968
10	CAPE GIR.	CC	0.173	1968
10	DUNKLIN	B	3.400	1935
10	MADISON	F	1.513	1939
10	MADISON	F	0.985	1939
10	MADISON	F	0.873	1939
10	MADISON	F	0.693	1939
10	MADISON	F	0.263	1939
10	MADISON	E	11.450	1948
10	MADISON	E	11.060	1948
10	MADISON	E	10.610	1948
10	MADISON	E	10.190	1948
10	MADISON	E	10.050	1948
10	MADISON	F	2.762	1955
10	MADISON	F	2.448	1955
10	MADISON	F	2.359	1955
10	MADISON	F	2.212	1955
10	MADISON	F	2.172	1955
10	MADISON	E	16.081	1963
10	MADISON	E	16.500	1963

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
10	MADISON	E	16.850	1963
10	MISSISSIPPI	DD	6.360	1936
10	MISSISSIPPI	DD	3.480	1936
10	MISSISSIPPI	DD	2.380	1936
10	MISSISSIPPI	DD	1.530	1936
10	MISSISSIPPI	DD	1.130	1936
10	MISSISSIPPI	HH	4.530	1952
10	MISSISSIPPI	HH	3.940	1952
10	MISSISSIPPI	HH	3.820	1952
10	NEW MADRID	E	12.050	1935
10	NEW MADRID	E	12.600	1935
10	NEW MADRID	E	13.300	1935
10	NEW MADRID	E	14.350	1935
10	NEW MADRID	80	6.320	1940
10	NEW MADRID	80	5.370	1940
10	NEW MADRID	80	4.420	1940
10	NEW MADRID	80	4.000	1940
10	NEW MADRID	EE	5.600	1958
10	NEW MADRID	EE	5.250	1958
10	NEW MADRID	EE	4.200	1958
10	NEW MADRID	EE	3.974	1958
10	NEW MADRID	EE	3.400	1958
10	NEW MADRID	U	5.040	1964
10	NEW MADRID	U	5.840	1964
10	NEW MADRID	U	7.180	1964
10	NEW MADRID	U	9.000	1964
10	NEW MADRID	U	8.930	1964
10	PEMISCOT	K	7.400	1935
10	PEMISCOT	K	7.540	1935
10	PEMISCOT	A	12.650	1936
10	PEMISCOT	P	2.130	1940
10	PEMISCOT	P	2.230	1940
10	PEMISCOT	P	2.290	1940
10	PEMISCOT	P	2.470	1940
10	PEMISCOT	P	2.640	1940
10	PEMISCOT	BB	3.400	1955
10	PEMISCOT	BB	2.400	1955
10	PEMISCOT	BB	1.200	1955
10	PEMISCOT	DD	0.996	1957
10	PEMISCOT	DD	0.409	1957
10	PERRY	C	6.750	1934
10	PERRY	C	6.452	1934
10	PERRY	C	6.450	1934
10	PERRY	C	4.950	1934

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
10	PERRY	C	0.150	1934
10	PERRY	E	3.120	1948
10	PERRY	E	2.600	1948
10	PERRY	E	8.650	1950
10	PERRY	E	8.820	1950
10	PERRY	E	8.100	1950
10	PERRY	D	1.770	1962
10	PERRY	D	1.300	1962
10	PERRY	D	0.940	1962
10	PERRY	D	0.440	1962
10	PERRY	D	0.530	1962
10	ST FRANCOIS	K	1.020	1935
10	ST FRANCOIS	K	1.560	1935
10	ST FRANCOIS	K	1.660	1935
10	ST FRANCOIS	K	3.760	1935
10	ST FRANCOIS	K	4.260	1935
10	ST FRANCOIS	E	0.050	1948
10	ST FRANCOIS	E	0.410	1948
10	ST FRANCOIS	E	2.380	1948
10	ST FRANCOIS	E	5.480	1948
10	ST FRANCOIS	E	5.530	1948
10	ST FRANCOIS	Y	7.910	1953
10	ST FRANCOIS	Y	8.150	1953
10	ST FRANCOIS	Y	0.470	1953
10	ST FRANCOIS	Y	0.800	1953
10	ST FRANCOIS	Y	5.530	1953
10	ST FRANCOIS	O	1.170	1969
10	ST FRANCOIS	O	1.310	1969
10	ST FRANCOIS	O	1.720	1969
10	ST GENEVIEVE	D	0.150	1934
10	ST GENEVIEVE	D	1.700	1934
10	ST GENEVIEVE	D	2.440	1934
10	ST GENEVIEVE	D	2.990	1934
10	ST.GENEVIEVE	D	1.700	1934
10	ST GENEVIEVE	F	4.970	1940
10	ST GENEVIEVE	F	5.100	1940
10	ST GENEVIEVE	F	5.540	1940
10	ST GENEVIEVE	F	6.470	1940
10	ST GENEVIEVE	F	6.560	1940
10	ST GENEVIEVE	Y	1.900	1952
10	ST GENEVIEVE	Y	1.220	1952
10	ST GENEVIEVE	Y	0.920	1952
10	ST GENEVIEVE	Y	0.750	1952
10	ST GENEVIEVE	Y	0.590	1952

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
10	ST GENEVIEVE	MM	1.140	1963
10	ST GENEVIEVE	MM	0.700	1963
10	ST GENEVIEVE	MM	0.590	1963
10	ST GENEVIEVE	MM	0.510	1963
10	SCOTT	A	4.030	1935
10	SCOTT	A	7.160	1935
10	SCOTT	A	7.731	1935
10	SCOTT	A	8.490	1935
10	SCOTT	Z	2.332	1936
10	SCOTT	NN	2.700	1940
10	SCOTT	NN	2.600	1940
10	SCOTT	NN	0.400	1940
10	SCOTT	E	4.080	1956
10	SCOTT	E	2.331	1956
10	SCOTT	E	2.330	1956
10	SCOTT	E	2.420	1956
10	SCOTT	E	0.772	1956
10	STODDARD	J	6.166	1938
10	STODDARD	J	4.176	1938
10	STODDARD	V	1.437	1939
10	STODDARD	V	1.537	1939
10	STODDARD	D	6.250	1940
10	STODDARD	D	7.900	1940
10	STODDARD	D	8.634	1940
10	STODDARD	AC	2.050	1960
10	STODDARD	AC	1.840	1960
10	STODDARD	AC	1.680	1960
10	STODDARD	AC	0.390	1960
10	STODDARD	AC	0.060	1960
10	WAYNE	34	35.344	1927
10	WAYNE	34	35.134	1927
10	WAYNE	34	35.074	1927
10	WAYNE	34	34.194	1927
10	WAYNE	34	33.484	1927
10	WAYNE	E	10.960	1936
10	WAYNE	E	11.180	1936
10	WAYNE	E	11.350	1936
10	WAYNE	E	11.420	1936
10	WAYNE	E	11.470	1936
10	WAYNE	E	13.930	1948
10	WAYNE	E	13.780	1948
10	WAYNE	E	13.570	1948
10	WAYNE	E	3.540	1948
10	WAYNE	E	3.200	1948

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
10	WAYNE	P	0.815	1950
10	WAYNE	P	0.770	1950
10	WAYNE	P	0.720	1950
10	WAYNE	P	0.610	1950
10	WAYNE	P	0.290	1950
10	WAYNE	143	1.120	1964
10	WAYNE	143	2.070	1964
10	WAYNE	143	3.090	1964
10	WAYNE	143	3.200	1964
10	WAYNE	143	3.270	1964

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE		LOG MILE	DATE INSTALLED
1	ANDREW	48		9.700	1933
1	ANDREW	48		11.110	1933
1	ANDREW	48		11.690	1933
1	ANDREW	48		12.000	1933
1	ANDREW	48		12.060	1933
1	ANDREW	I-29		12.870	1964
1	ANDREW	I-29		13.320	1964
1	ANDREW	I-29		14.650	1964
1	ANDREW	I-29		14.730	1964
1	ANDREW	I-29		15.150	1964
1	ANDREW	E		0.230	1976
1	ANDREW	E		0.640	1976
1	ANDREW	E		1.200	1976
1	ANDREW	E		1.340	1976
1	ANDREW	E		2.080	1976
1	ATCHISON	59	(1)	14.010	1923
1	ATCHISON	59	(1)	16.900	1927
1	ATCHISON	59	(1)	17.100	1927
1	ATCHISON	59	(1)	18.160	1927
1	ATCHISON	59	(1)	18.210	1927
1	ATCHISON	275		0.054	1952
1	ATCHISON	275		0.560	1952
1	ATCHISON	275		0.860	1952
1	ATCHISON	275		1.080	1952
1	ATCHISON	275		1.180	1952
1	ATCHISON	136		3.200	1965
1	ATCHISON	136		3.400	1965
1	ATCHISON	136		3.800	1965
1	ATCHISON	136		4.100	1965
1	ATCHISON	136		4.400	1965
1	ATCHISON	I-29		3.700	1971
1	ATCHISON	I-29		8.700	1971
1	ATCHISON	I-29		11.900	1971
1	ATCHISON	I-29		12.100	1971
1	ATCHISON	I-29		12.500	1971
1	BUCHANAN	50		10.960	1924
1	BUCHANAN	50		12.531	1924
1	BUCHANAN	A		0.260	1935
1	BUCHANAN	A		0.300	1935
1	BUCHANAN	A		0.950	1935
1	BUCHANAN	A		2.670	1935
1	BUCHANAN	A		3.230	1935
1	BUCHANAN	NN		0.296	1941
1	BUCHANAN	NN		2.000	1941

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	BUCHANAN	K	0.004	1949
1	BUCHANAN	K	0.570	1949
1	BUCHANAN	371	1.676	1954
1	BUCHANAN	371	2.500	1954
1	BUCHANAN	371	3.790	1954
1	BUCHANAN	371	6.200	1954
1	BUCHANAN	36	3.280	1964
1	BUCHANAN	36	4.390	1964
1	BUCHANAN	36	9.640	1964
1	BUCHANAN	36	12.020	1964
1	BUCHANAN	36	13.730	1964
1	CALDWELL	13	12.900	1942
1	CALDWELL	13	13.100	1942
1	CALDWELL	13	13.380	1942
1	CALDWELL	13	13.500	1942
1	CALDWELL	13	14.140	1942
1	CALDWELL	36	0.450	1965
1	CALDWELL	36	1.200	1965
1	CALDWELL	36	1.480	1965
1	CALDWELL	36	1.580	1965
1	CALDWELL	36	4.190	1965
1	CALDWELL	116	4.220	1974
1	CALDWELL	116	4.400	1974
1	CALDWELL	116	4.590	1974
1	CALDWELL	116	4.780	1974
1	CALDWELL	116	4.880	1974
1	CLINTON	36	1.140	1927
1	CLINTON	C	4.500	1939
1	CLINTON	C	5.800	1939
1	CLINTON	C	6.090	1939
1	CLINTON	C	6.790	1939
1	CLINTON	169	8.340	1940
1	CLINTON	169	11.120	1940
1	CLINTON	169	11.430	1940
1	CLINTON	169	1.820	1955
1	CLINTON	169	2.000	1955
1	CLINTON	169	3.410	1955
1	CLINTON	I-35	7.550	1966
1	CLINTON	I-35	8.750	1966
1	CLINTON	I-35	13.190	1966
1	CLINTON	I-35	16.050	1966
1	CLINTON	I-35	17.450	1966
1	DAVIESS	13	4.960	1934
1	DAVIESS	13	5.210	1934

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	DAVIESS	B	2.810	1937
1	DAVIESS	13	0.380	1938
1	DAVIESS	B	2.560	1938
1	DAVIESS	B	14.860	1942
1	DAVIESS	B	15.910	1942
1	DAVIESS	M	1.350	1947
1	DAVIESS	M	1.450	1947
1	DAVIESS	M	2.930	1947
1	DAVIESS	6	23.910	1964
1	DAVIESS	6	23.990	1964
1	DAVIESS	6	24.280	1964
1	DAVIESS	6	24.400	1964
1	DAVIESS	6	25.980	1964
1	DAVIESS	I-35	0.800	1974
1	DAVIESS	I-35	1.400	1974
1	DAVIESS	I-35	3.250	1974
1	DAVIESS	I-35	3.380	1974
1	DAVIESS	I-35	3.690	1974
1	DEKALB	33	9.230	1934
1	DEKALB	33	9.800	1934
1	DEKALB	169	0.920	1951
1	DEKALB	169	0.980	1951
1	DEKALB	31	0.350	1959
1	DEKALB	31	0.420	1959
1	DEKALB	31	1.060	1959
1	DEKALB	33	0.710	1961
1	DEKALB	33	1.400	1961
1	DEKALB	33	2.030	1961
1	DEKALB	33	2.250	1961
1	DEKALB	33	2.800	1961
1	GENTRY	169	16.710	1922
1	GENTRY	169	20.400	1922
1	GENTRY	169	21.100	1922
1	GENTRY	136	16.200	1938
1	GENTRY	136	16.400	1938
1	GENTRY	136	17.100	1938
1	GENTRY	169	29.050	1939
1	GENTRY	169	26.250	1940
1	GENTRY	169	26.840	1940
1	GENTRY	169	27.950	1940
1	GENTRY	169	28.050	1940
1	GENTRY	169	28.650	1940
1	GENTRY	136	9.530	1957
1	GENTRY	136	10.700	1957

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	GENTRY	136	11.490	1957
1	GENTRY	136	11.960	1957
1	GENTRY	136	12.240	1957
1	HARRISON	13	4.140	1938
1	HARRISON	13	5.450	1938
1	HARRISON	13	5.580	1938
1	HARRISON	13	6.040	1938
1	HARRISON	13	7.200	1938
1	HARRISON	136	11.100	1943
1	HARRISON	136	11.990	1943
1	HARRISON	136	13.100	1943
1	HARRISON	136	14.400	1943
1	HARRISON	136	14.880	1943
1	HARRISON	136	9.400	1954
1	HARRISON	136	9.750	1954
1	HARRISON	136	9.760	1954
1	HARRISON	136	10.050	1954
1	HARRISON	136	10.310	1954
1	HARRISON	136	1.600	1967
1	HARRISON	136	3.000	1967
1	HARRISON	136	3.250	1967
1	HARRISON	136	3.380	1967
1	HARRISON	136	3.750	1967
1	HARRISON	I-35	8.100	1975
1	HARRISON	I-35	10.340	1975
1	HARRISON	I-35	12.080	1975
1	HARRISON	I-35	12.500	1975
1	HARRISON	I-35	15.300	1975
1	HOLT	59	23.520	1925
1	HOLT	59	23.890	1925
1	HOLT	59	26.680	1925
1	HOLT	59	26.710	1925
1	HOLT	I-29	24.690	1971
1	HOLT	I-29	24.970	1971
1	HOLT	I-29	26.610	1971
1	HOLT	I-29	29.240	1971
1	HOLT	I-29	29.390	1971
1	NODAWAY	F	1.200	1936
1	NODAWAY	F	1.700	1936
1	NODAWAY	F	1.900	1936
1	NODAWAY	F	2.900	1936
1	NODAWAY	F	4.400	1936
1	NODAWAY	46	16.660	1941
1	NODAWAY	71	26.000	1956

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	NODAWAY	71	26.200	1956
1	NODAWAY	71	26.400	1956
1	NODAWAY	71	26.600	1956
1	NODAWAY	71	26.900	1956
1	WORTH	29	0.560	1923
1	WORTH	29	0.920	1923
1	WORTH	29	2.330	1923
1	WORTH	29	4.970	1924
1	WORTH	W	7.910	1936
1	WORTH	W	8.110	1936
1	WORTH	W	8.950	1936
1	WORTH	169	10.330	1963
1	WORTH	169	10.650	1963
1	WORTH	169	11.330	1963
1	WORTH	169	11.590	1963
1	WORTH	169	12.200	1963
2	ADAIR	63	4.910	1942
2	ADAIR	63	6.690	1942
2	ADAIR	63	6.700	1942
2	ADAIR	63	7.210	1942
2	ADAIR	63	7.310	1942
2	ADAIR	63	14.110	1956
2	ADAIR	63	14.180	1956
2	ADAIR	63	14.990	1956
2	ADAIR	63	15.180	1956
2	ADAIR	63	16.130	1956
2	ADAIR	6	10.390	1975
2	ADAIR	6	12.130	1975
2	ADAIR	6	12.160	1975
2	ADAIR	6	13.540	1975
2	ADAIR	6	13.710	1975
2	CHARITON	24	23.590	1947
2	CHARITON	24	23.740	1947
2	CHARITON	24	24.570	1947
2	CHARITON	24	24.670	1947
2	CHARITON	24	25.100	1947
2	GRUNDY	6	0.910	1964
2	GRUNDY	6	1.010	1964
2	GRUNDY	6	1.820	1964
2	GRUNDY	6	6.380	1964
2	GRUNDY	6	4.160	1964
2	GRUNDY	65	11.620	1972
2	GRUNDY	65	11.850	1972
2	GRUNDY	65	12.510	1972

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
2	GRUNDY	65	13.120	1972
2	GRUNDY	65	13.810	1972
2	LINN	11	12.280	1934
2	LINN	11	12.310	1934
2	LINN	11	12.530	1934
2	LINN	11	19.790	1934
2	LINN	11	20.560	1934
2	LINN	36	21.590	1956
2	LINN	36	21.950	1956
2	LINN	36	18.800	1956
2	LINN	36	17.800	1956
2	LINN	36	19.470	1956
2	LINN	36	12.090	1969
2	LINN	36	12.620	1969
2	LINN	36	12.810	1969
2	LINN	36	13.050	1969
2	LINN	36	13.060	1969
2	LINN	36	2.130	1976
2	LINN	36	2.320	1976
2	LINN	36	8.000	1976
2	LINN	36	8.150	1976
2	LIVINGSTON	139	2.030	1947
2	LIVINGSTON	139	0.580	1947
2	LIVINGSTON	139	1.080	1947
2	LIVINGSTON	139	1.380	1947
2	LIVINGSTON	139	1.480	1947
2	LIVINGSTON	36	0.220	1959
2	LIVINGSTON	36	1.050	1959
2	LIVINGSTON	36	2.600	1959
2	LIVINGSTON	36	4.410	1959
2	LIVINGSTON	36	4.560	1959
2	LIVINGSTON	36 EBL	14.350	1966
2	LIVINGSTON	36 EBL	15.730	1966
2	LIVINGSTON	36 EBL	17.080	1966
2	LIVINGSTON	36 EBL	20.880	1966
2	MACON	P	0.430	1935
2	MACON	P	0.670	1935
2	MACON	P	2.840	1935
2	MACON	P	0.670	1935
2	MACON	P	1.120	1935
2	MACON	T	5.640	1951
2	MACON	T	5.880	1951
2	MACON	T	6.540	1951
2	MACON	T	8.560	1951

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
2	MACON	T	8.790	1951
2	MACON	36	22.210	1971
2	MACON	36	21.630	1971
2	MACON	36 EBL	22.070	1971
2	MACON	36	22.930	1971
2	MACON	36	23.330	1971
2	MERCER	65	15.830	1941
2	MERCER	65	15.730	1941
2	MERCER	65	16.580	1941
2	MERCER	65	17.180	1941
2	MERCER	65	17.530	1941
2	MERCER	65	6.120	1955
2	MERCER	65	6.300	1955
2	MERCER	65	9.600	1955
2	MERCER	136	8.140	1973
2	MERCER	136	8.330	1973
2	MERCER	136	9.170	1973
2	MERCER	136	9.820	1973
2	MERCER	136	9.880	1973
2	PUTNAM	5	9.480	1932
2	PUTNAM	5	7.580	1932
2	PUTNAM	5	4.210	1939
2	PUTNAM	5	4.300	1939
2	PUTNAM	136	23.320	1956
2	PUTNAM	136	23.590	1956
2	PUTNAM	136	23.930	1956
2	PUTNAM	136	24.550	1956
2	PUTNAM	136	25.320	1956
2	PUTNAM	136	32.900	1966
2	PUTNAM	136	34.700	1966
2	PUTNAM	136	34.920	1966
2	PUTNAM	136	35.130	1966
2	PUTNAM	136	35.230	1966
2	RANDOLPH	24	19.900	1949
2	RANDOLPH	24	20.100	1949
2	RANDOLPH	24	20.380	1949
2	RANDOLPH	24	20.980	1949
2	RANDOLPH	24	21.210	1949
2	RANDOLPH	63	15.420	1962
2	RANDOLPH	63	15.450	1962
2	RANDOLPH	63	16.430	1962
2	RANDOLPH	63	16.870	1962
2	RANDOLPH	63	18.930	1962
2	RANDOLPH	C	5.720	1976

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
2	RANDOLPH	C	7.120	1976
2	RANDOLPH	C	7.990	1976
2	RANDOLPH	C	8.220	1976
2	RANDOLPH	C	8.710	1976
2	SALINE	OLD HWY 40	0.060	1929
2	SALINE	OLD HWY 40	0.850	1929
2	SALINE	OLD HWY 40	2.550	1929
2	SALINE	OLD HWY 40	3.620	1929
2	SALINE	A(20)	9.880	1969
2	SALINE	A(20)	10.980	1969
2	SALINE	A(20)	11.370	1969
2	SALINE	A(20)	12.080	1969
2	SALINE	A(20)	12.620	1969
2	SALINE	240	3.450	1975
2	SALINE	240	4.180	1975
2	SCHUYLER	63	4.920	1948
2	SCHUYLER	63	6.540	1948
2	SCHUYLER	63	6.870	1948
2	SCHUYLER	63	6.940	1948
2	SCHUYLER	63	7.000	1948
2	SCHUYLER	136	19.730	1959
2	SCHUYLER	136	20.860	1959
2	SCHUYLER	136	22.830	1959
2	SCHUYLER	136	23.340	1959
2	SCHUYLER	136	23.460	1959
2	SULLIVAN	6	12.960	1957
2	SULLIVAN	6	13.070	1957
2	SULLIVAN	6	13.160	1957
2	SULLIVAN	6	15.710	1957
2	SULLIVAN	6	16.340	1957
2	SULLIVAN	6	13.380	1964
2	SULLIVAN	6	13.460	1964
2	SULLIVAN	6	13.750	1964
2	SULLIVAN	6	13.850	1964
2	SULLIVAN	6	14.270	1964
2	SULLIVAN	A(129)	11.720	1972
2	SULLIVAN	A(129)	12.010	1972
2	SULLIVAN	A(129)	12.110	1972
2	SULLIVAN	A(129)	12.350	1972
2	SULLIVAN	A(129)	12.620	1972
3	AUDRAIN	54	33.640	1934
3	AUDRAIN	54	33.810	1934
3	AUDRAIN	54	34.810	1934
3	AUDRAIN	54	35.060	1934

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	AUDRAIN	54	36.430	1934
3	AUDRAIN	22	15.840	1941
3	AUDRAIN	19	2.330	1962
3	AUDRAIN	19	2.780	1962
3	AUDRAIN	J	0.750	1971
3	AUDRAIN	J	1.620	1971
3	AUDRAIN	J	1.680	1971
3	AUDRAIN	J	2.530	1971
3	AUDRAIN	J	2.630	1971
3	CLARK	61	3.510	1936
3	CLARK	61	3.690	1936
3	CLARK	61	4.180	1936
3	CLARK	61	4.430	1936
3	CLARK	61	6.210	1936
3	CLARK	136	8.980	1969
3	CLARK	136	10.100	1969
3	CLARK	136	11.370	1969
3	CLARK	136	13.120	1969
3	CLARK	136	13.980	1969
3	CLARK	61	10.440	1975
3	CLARK	61	10.600	1975
3	CLARK	61	11.050	1975
3	CLARK	61	13.700	1975
3	CLARK	61	13.960	1975
3	KNOX	15	0.770	1926
3	KNOX	15	28.320	1937
3	KNOX	15	29.360	1937
3	KNOX	15	29.560	1937
3	KNOX	15	29.860	1937
3	KNOX	15	30.060	1937
3	LEWIS	16	11.720	1938
3	LEWIS	16	12.280	1938
3	LEWIS	16	12.700	1938
3	LEWIS	16	13.170	1938
3	LEWIS	16	13.400	1938
3	LEWIS	61	6.510	1977
3	LEWIS	61	19.370	1977
3	LEWIS	61	19.940	1977
3	LEWIS	61	20.180	1977
3	LEWIS	61	21.190	1977
3	LINCOLN	79	5.200	1939
3	LINCOLN	79	5.270	1939
3	LINCOLN	79	5.320	1939
3	LINCOLN	79	5.480	1939

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	LINCOLN	79	6.190	1939
3	LINCOLN	79	17.060	1940
3	LINCOLN	61	7.980	1978
3	LINCOLN	61	11.860	1978
3	LINCOLN	61	12.000	1978
3	LINCOLN	61	12.290	1978
3	LINCOLN	61	12.740	1978
3	MARION	W	0.100	1926
3	MARION	W	1.070	1926
3	MARION	W	1.530	1926
3	MARION	W	1.900	1926
3	MARION	24	0.160	1935
3	MARION	24	1.320	1935
3	MARION	24	1.490	1935
3	MARION	24	1.940	1935
3	MARION	24	2.030	1935
3	MARION	36	13.830	1959
3	MARION	36	14.930	1959
3	MARION	36	15.700	1959
3	MARION	36	18.220	1959
3	MARION	36	18.340	1959
3	MARION	61	14.590	1964
3	MARION	61	15.050	1964
3	MARION	61	15.890	1964
3	MARION	61	16.160	1964
3	MARION	61	19.220	1964
3	MARION	61	2.100	1971
3	MARION	61	0.940	1977
3	MARION	61	0.940	1977
3	MARION	61	0.940	1977
3	MARION	61	0.940	1977
3	MONROE	24	27.650	1934
3	MONROE	24	27.800	1934
3	MONROE	24	14.860	1970
3	MONROE	24	15.340	1970
3	MONROE	24	15.410	1970
3	MONROE	24	16.400	1970
3	MONROE	24	16.980	1970
3	MONTGOMERY	19	1.570	1934
3	MONTGOMERY	19	16.000	1934
3	MONTGOMERY	19	13.240	1935
3	MONTGOMERY	WW	1.470	1935
3	MONTGOMERY	WW	2.160	1935
3	MONTGOMERY	19	28.400	1940

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	MONTGOMERY	19	28.990	1940
3	MONTGOMERY	19	29.040	1940
3	MONTGOMERY	19	30.800	1940
3	MONTGOMERY	19	31.270	1940
3	MONTGOMERY	19	16.780	1965
3	MONTGOMERY	19	17.340	1965
3	MONTGOMERY	19	17.580	1965
3	MONTGOMERY	19	18.420	1965
3	MONTGOMERY	19	19.170	1965
3	MONTGOMERY	19	31.880	1978
3	PIKE	OLD 61	0.780	1927
3	PIKE	61	6.760	1942
3	PIKE	61	8.280	1942
3	PIKE	61	9.570	1942
3	PIKE	61	9.610	1942
3	PIKE	61	2.460	1951
3	PIKE	61	0.690	1954
3	PIKE	61	1.040	1954
3	PIKE	61	1.180	1954
3	PIKE	61	1.330	1954
3	PIKE	54	21.800	1968
3	PIKE	54	22.670	1968
3	PIKE	54	23.160	1968
3	PIKE	54	23.220	1968
3	PIKE	54	23.600	1968
3	PIKE	61	0.150	1979
3	PIKE	61	12.940	1979
3	PIKE	61	13.130	1979
3	PIKE	61	13.950	1979
3	PIKE	61	15.280	1979
3	RALLS	OLD 61	0.600	1927
3	RALLS	OLD 61	1.280	1927
3	RALLS	OLD 61	1.880	1927
3	RALLS	154	2.770	1932
3	RALLS	154	3.100	1932
3	RALLS	154	3.520	1932
3	RALLS	BUS 61	1.750	1932
3	RALLS	19	7.190	1937
3	RALLS	19	8.420	1938
3	RALLS	61	11.200	1953
3	RALLS	61	11.290	1953
3	RALLS	61	12.290	1953
3	RALLS	61	12.580	1953
3	RALLS	61	12.860	1953

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	RALLS	79	0.820	1966
3	RALLS	79	2.570	1966
3	RALLS	79	4.280	1966
3	RALLS	79	5.030	1966
3	RALLS	79	5.200	1966
3	RALLS	79	5.990	1971
3	RALLS	79	6.540	1971
3	RALLS	79	6.590	1971
3	RALLS	79	7.180	1971
3	RALLS	79	8.710	1971
3	SCOTLAND	15	18.070	1926
3	SCOTLAND	15	18.170	1926
3	SCOTLAND	15	18.580	1926
3	SCOTLAND	15	18.660	1926
3	SCOTLAND	15	19.240	1926
3	SCOTLAND	136	10.320	1949
3	SCOTLAND	136	10.510	1949
3	SCOTLAND	136	11.170	1949
3	SCOTLAND	136	11.350	1949
3	SCOTLAND	A	12.660	1972
3	SCOTLAND	15	10.730	1979
3	SHELBY	36	22.930	1952
3	SHELBY	36	23.260	1952
3	SHELBY	36	23.550	1952
3	SHELBY	36	23.690	1952
3	SHELBY	36	24.190	1952
3	SHELBY	15	19.210	1965
3	SHELBY	15	15.010	1966
3	SHELBY	15	16.180	1966
3	SHELBY	15	18.380	1966
3	SHELBY	15	18.860	1966
3	SHELBY	151	22.350	1974
3	SHELBY	151	22.760	1974
3	WARREN	I-70	3.860	1926
3	WARREN	47	24.430	1932
3	WARREN	47	25.620	1932
3	WARREN	47	28.740	1933
3	WARREN	47	29.090	1933
3	WARREN	47	29.360	1933
3	WARREN	94	4.820	1948
3	WARREN	94	4.960	1949
3	WARREN	94	5.310	1949
3	WARREN	94	5.920	1949
3	WARREN	94	6.150	1949

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	WARREN	I-70	7.870	1964
3	WARREN	I-70	10.450	1964
3	WARREN	I-70	11.060	1964
3	WARREN	I-70	11.070	1964
3	WARREN	I-70	12.740	1979
3	WARREN	I-70	12.860	1979
3	WARREN	I-70	12.920	1979
3	WARREN	I-70	12.950	1979
4	CASS	58	12.200	1936
4	CASS	58	13.500	1936
4	CASS	58	13.700	1936
4	CASS	58	15.500	1936
4	CASS	58	16.400	1936
4	CASS	58	0.220	1943
4	CASS	58	0.250	1943
4	CASS	58	0.251	1943
4	CASS	58	0.800	1943
4	CASS	7	3.500	1950
4	CASS	7	4.850	1950
4	CASS	71	19.300	1967
4	CASS	71	19.500	1967
4	CASS	71	19.600	1967
4	CASS	71	19.604	1967
4	CASS	71	20.200	1967
4	CASS	71	21.880	1972
4	CASS	71	21.881	1972
4	CASS	71	22.610	1972
4	CASS	71	22.611	1972
4	CASS	71	22.800	1972
4	CLAY	291	0.600	1936
4	CLAY	291	0.700	1936
4	CLAY	291	1.150	1936
4	CLAY	291	3.500	1936
4	CLAY	291	3.600	1936
4	CLAY	169	11.820	1958
4	CLAY	169	11.960	1958
4	CLAY	169	12.310	1958
4	CLAY	169	12.430	1958
4	CLAY	169	14.200	1958
4	CLAY	I-35	5.190	1966
4	CLAY	I-35	6.550	1966
4	CLAY	I-35	6.580	1966
4	CLAY	I-35	6.880	1966
4	CLAY	I-35	7.040	1966

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
4	CLAY	W	0.670	1979
4	CLAY	W	1.020	1979
4	CLAY	W	3.170	1979
4	CLAY	W	3.750	1979
4	HENRY	13	1.400	1922
4	HENRY	13	2.400	1922
4	HENRY	13	2.700	1922
4	HENRY	13	3.100	1922
4	HENRY	K	3.000	1936
4	HENRY	K	3.700	1936
4	HENRY	K	3.900	1936
4	HENRY	K	4.000	1936
4	HENRY	K	4.900	1936
4	HENRY	18	16.560	1949
4	HENRY	7	22.780	1959
4	HENRY	7	24.620	1959
4	HENRY	13	14.500	1966
4	HENRY	13	16.630	1966
4	HENRY	13	16.740	1966
4	HENRY	13	16.830	1966
4	HENRY	13	23.090	1966
4	HENRY	18	12.570	1973
4	HENRY	18	12.810	1973
4	HENRY	18	14.230	1973
4	HENRY	18	15.030	1973
4	HENRY	18	15.170	1973
4	JACKSON	BB	2.000	1929
4	JACKSON	BB	1.490	1929
4	JACKSON	BB	1.700	1929
4	JACKSON	291	3.930	1936
4	JACKSON	291	5.000	1936
4	JACKSON	291	5.110	1936
4	JACKSON	40 EB	11.500	1942
4	JACKSON	40 EB	12.100	1942
4	JACKSON	40 EB	12.400	1942
4	JACKSON	40 EB	12.900	1942
4	JACKSON	291(ABAND)	0.020	1956
4	JACKSON	291(ABAND)	0.420	1956
4	JACKSON	291(ABAND)	0.550	1956
4	JACKSON	I-70	21.000	1965
4	JACKSON	I-70	22.400	1965
4	JACKSON	I-70	23.060	1965
4	JACKSON	I-70	24.400	1965
4	JACKSON	I-70	24.420	1965

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
4	JACKSON	50	0.570	1976
4	JACKSON	24	15.820	1977
4	JACKSON	24	16.200	1978
4	JACKSON	24	16.510	1978
4	JACKSON	7	0.180	1978
4	JOHNSON	13	0.130	1925
4	JOHNSON	13	0.610	1925
4	JOHNSON	13	6.070	1925
4	JOHNSON	13	6.620	1925
4	JOHNSON	13	6.990	1925
4	JOHNSON	2	8.080	1938
4	JOHNSON	2	8.110	1938
4	JOHNSON	2	9.680	1938
4	JOHNSON	2	9.980	1938
4	JOHNSON	2	11.280	1938
4	JOHNSON	50	3.640	1955
4	JOHNSON	50	3.740	1955
4	JOHNSON	50	4.480	1955
4	JOHNSON	50	16.310	1955
4	JOHNSON	50	11.060	1967
4	JOHNSON	50	11.240	1967
4	JOHNSON	50	11.600	1967
4	JOHNSON	50	13.300	1967
4	JOHNSON	50	14.000	1967
4	JOHNSON	50	18.220	1970
4	JOHNSON	50	18.300	1970
4	JOHNSON	50	19.210	1970
4	JOHNSON	50	19.580	1970
4	JOHNSON	50	19.840	1970
4	LAFAYETTE	13	20.100	1925
4	LAFAYETTE	13	22.100	1925
4	LAFAYETTE	13	22.900	1925
4	LAFAYETTE	13	23.300	1925
4	LAFAYETTE	23	7.910	1934
4	LAFAYETTE	23	8.000	1934
4	LAFAYETTE	23	8.330	1934
4	LAFAYETTE	23	8.730	1934
4	LAFAYETTE	23	9.360	1934
4	LAFAYETTE	24	13.100	1958
4	LAFAYETTE	24	13.500	1958
4	LAFAYETTE	24	14.350	1958
4	LAFAYETTE	24	14.430	1958
4	LAFAYETTE	24	15.000	1958
4	LAFAYETTE	I-70	13.250	1962

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
4	LAFAYETTE	I-70	16.400	1962
4	LAFAYETTE	I-70	17.440	1962
4	LAFAYETTE	I-70	17.500	1962
4	LAFAYETTE	I-70	18.820	1962
4	LAFAYETTE	131	0.320	1970
4	LAFAYETTE	24	21.700	1974
4	PLATTE	371	0.110	1925
4	PLATTE	371	0.380	1925
4	PLATTE	371	0.560	1925
4	PLATTE	371	0.960	1925
4	PLATTE	371	1.200	1925
4	PLATTE	45	9.430	1937
4	PLATTE	45	11.150	1937
4	PLATTE	J	0.080	1947
4	PLATTE	J	0.380	1947
4	PLATTE	J	1.010	1947
4	PLATTE	J	2.500	1947
4	PLATTE	J	2.550	1947
4	PLATTE	I-29	0.200	1959
4	PLATTE	I-29	0.360	1959
4	PLATTE	I-29	2.430	1959
4	PLATTE	45	33.030	1968
4	PLATTE	45	33.300	1968
4	PLATTE	45	33.810	1968
4	PLATTE	45	34.550	1968
4	PLATTE	45	34.720	1968
4	PLATTE	I-435	14.560	1979
4	PLATTE	I-435	14.710	1979
4	PLATTE	I-435	14.740	1979
4	PLATTE	I-435	14.780	1979
4	PLATTE	I-435	14.830	1979
4	RAY	210	6.570	1935
4	RAY	13	1.600	1943
4	RAY	13	7.070	1943
4	RAY	13	9.900	1943
4	RAY	13	10.400	1943
4	RAY	13	12.400	1943
4	RAY	10	0.650	1965
4	RAY	10	0.980	1965
4	RAY	10	1.790	1965
4	RAY	10	1.880	1965
4	RAY	10	2.240	1965
5	BENTON	B	0.200	1950
5	BENTON	B	1.250	1950

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	BENTON	B	3.500	1950
5	BENTON	B	4.100	1950
5	BENTON	B	4.400	1950
5	BENTON	65	19.331	1976
5	BENTON	65	20.119	1976
5	BENTON	65	20.413	1976
5	BENTON	65	22.744	1976
5	BENTON	65,NB RAMP	20.119	1976
5	BOONE	M	0.630	1935
5	BOONE	M	0.770	1935
5	BOONE	M	0.860	1935
5	BOONE	M	1.860	1935
5	BOONE	M	2.330	1935
5	BOONE	240	0.132	1949
5	BOONE	240	1.020	1949
5	BOONE	240	1.648	1949
5	BOONE	240	3.092	1949
5	BOONE	I-70	1.607	1959
5	BOONE	I-70	3.142	1959
5	BOONE	I-70	3.583	1959
5	BOONE	I-70	3.654	1959
5	BOONE	I-70	4.617	1959
5	CALLAWAY	54	27.071	1965
5	CALLAWAY	54	28.191	1965
5	CALLAWAY	54	28.441	1965
5	CALLAWAY	54	29.811	1965
5	CALLAWAY	54	31.151	1965
5	CALLAWAY	54	16.350	1975
5	CALLAWAY	54	16.600	1975
5	CALLAWAY	54	17.200	1975
5	CALLAWAY	54	18.250	1975
5	CALLAWAY	54	19.250	1975
5	CAMDEN	5	7.300	1935
5	CAMDEN	5	8.200	1935
5	CAMDEN	5	8.600	1935
5	CAMDEN	5	8.700	1935
5	CAMDEN	5	8.800	1935
5	CAMDEN	54	24.060	1958
5	CAMDEN	54	24.160	1958
5	CAMDEN	54	24.660	1958
5	CAMDEN	54	24.960	1958
5	CAMDEN	54	25.160	1958
5	CAMDEN	54	16.520	1967
5	CAMDEN	54	16.620	1967

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	CAMDEN	54	16.720	1967
5	CAMDEN	54	15.320	1968
5	CAMDEN	54	16.120	1968
5	COLE	50	0.600	1931
5	COLE	50	0.800	1931
5	COLE	50	0.950	1931
5	COLE	50	1.050	1931
5	COLE	50	1.700	1931
5	COLE	50	6.870	1977
5	COLE	50-63	7.600	1977
5	COLE	50-63	8.150	1977
5	COLE	50-63	8.340	1977
5	COLE	50-63	10.010	1977
5	COOPER	135	13.820	1936
5	COOPER	135	13.910	1936
5	COOPER	135	14.040	1936
5	COOPER	135	14.740	1936
5	COOPER	135	15.490	1936
5	COOPER	Z (OLD 40)	0.290	1950
5	COOPER	M (OLD 40)	0.575	1950
5	COOPER	M (OLD 40)	1.225	1950
5	COOPER	Z (OLD 40)	1.490	1950
5	COOPER	M (OLD 40)	1.625	1950
5	COOPER	I-70	20.846	1960
5	COOPER	I-70	21.235	1960
5	COOPER	I-70	21.470	1960
5	COOPER	I-70	23.537	1960
5	COOPER	I-70	24.936	1960
5	COOPER	B	0.732	1972
5	COOPER	B	0.951	1972
5	COOPER	B	1.165	1972
5	COOPER	B	1.857	1972
5	GASCONADE	28	1.825	1947
5	GASCONADE	28	3.850	1947
5	GASCONADE	28	4.000	1947
5	GASCONADE	28	4.350	1947
5	GASCONADE	28	5.100	1947
5	GASCONADE	28	1.600	1947
5	GASCONADE	50	0.940	1979
5	GASCONADE	50	0.980	1979
5	MARIES	T	6.321	1937
5	MARIES	T	6.621	1937
5	MARIES	T	6.721	1937
5	MARIES	T	6.821	1937

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	MARIES	T	7.171	1937
5	MARIES	63	15.589	1979
5	MARIES	63	15.876	1979
5	MARIES	63	15.965	1979
5	MARIES	63	17.080	1979
5	MARIES	63	17.338	1979
5	MILLER	54	2.956	1966
5	MILLER	54	3.075	1966
5	MILLER	54	4.106	1966
5	MILLER	54	4.258	1966
5	MILLER	54	4.757	1966
5	MILLER	54	19.556	1976
5	MILLER	54	20.106	1976
5	MILLER	54	20.181	1976
5	MILLER	54	20.331	1976
5	MILLER	54	22.456	1976
5	MONITEAU	E	3.990	1936
5	MONITEAU	E	4.800	1936
5	MONITEAU	E	4.810	1936
5	MONITEAU	E	5.460	1936
5	MONITEAU	E	5.580	1936
5	MORGAN	5	4.510	1938
5	MORGAN	5	4.920	1938
5	MORGAN	5	5.400	1938
5	MORGAN	5	6.570	1938
5	MORGAN	5	7.600	1938
5	MORGAN	M	1.210	1947
5	MORGAN	M	1.980	1947
5	MORGAN	M	2.270	1947
5	MORGAN	M	2.590	1947
5	MORGAN	5	14.120	1965
5	MORGAN	5	14.720	1965
5	MORGAN	5	16.640	1965
5	MORGAN	5	17.310	1965
5	MORGAN	5	17.740	1965
5	MORGAN	50	0.440	1975
5	MORGAN	50	1.560	1975
5	MORGAN	50	1.710	1975
5	MORGAN	50	1.930	1975
5	MORGAN	50	2.730	1975
5	OSAGE	J	0.080	1936
5	OSAGE	J	1.775	1936
5	OSAGE	J	1.910	1936
5	OSAGE	J	1.925	1936

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
5	OSAGE	J	2.250	1936
5	OSAGE	28	2.574	1946
5	OSAGE	28	2.686	1946
5	OSAGE	28	3.403	1946
5	OSAGE	28	3.701	1946
5	OSAGE	28	3.766	1946
5	OSAGE	50	3.748	1971
5	OSAGE	50	4.048	1971
5	PETTIS	135	1.400	1936
5	PETTIS	135	2.450	1936
5	PETTIS	135	2.700	1936
5	PETTIS	135	2.900	1936
5	PETTIS	135	3.100	1936
5	PETTIS	50	21.966	1965
5	PETTIS	50	22.142	1965
5	PETTIS	50	23.363	1965
5	PETTIS	50	24.051	1965
5	PETTIS	50	24.453	1965
5	PETTIS	50	9.100	1972
5	PETTIS	50	10.250	1972
5	PETTIS	50	10.475	1972
5	PETTIS	50 EBL	6.950	1972
5	PETTIS	50 EBL	7.200	1972
6	FRANKLIN	185	16.800	1936
6	FRANKLIN	185	25.450	1936
6	FRANKLIN	RT 185	15.600	1936
6	FRANKLIN	RT 185	22.945	1936
6	FRANKLIN	47	11.680	1947
6	FRANKLIN	47	12.230	1947
6	FRANKLIN	47	12.330	1947
6	FRANKLIN	47	12.380	1947
6	FRANKLIN	47	13.380	1947
6	FRANKLIN	50	23.600	1959
6	FRANKLIN	50	24.700	1959
6	FRANKLIN	50	25.750	1959
6	FRANKLIN	50	26.550	1959
6	FRANKLIN	50	26.850	1959
6	FRANKLIN	47	2.300	1962
6	FRANKLIN	47	2.850	1962
6	FRANKLIN	47	2.940	1962
6	FRANKLIN	47	3.290	1962
6	FRANKLIN	47	3.740	1962
6	FRANKLIN	100	30.940	1972
6	FRANKLIN	100	31.500	1972

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
6	FRANKLIN	100	31.600	1972
6	FRANKLIN	100	33.520	1972
6	FRANKLIN	100	33.720	1972
6	JEFFERSON	61	23.200	1939
6	JEFFERSON	61	25.100	1939
6	JEFFERSON	61	27.300	1939
6	JEFFERSON	61	27.700	1939
6	JEFFERSON	61	28.700	1939
6	JEFFERSON	21	6.030	1940
6	JEFFERSON	21	6.040	1940
6	JEFFERSON	21	6.520	1940
6	JEFFERSON	21	17.740	1940
6	JEFFERSON	21	17.940	1940
6	JEFFERSON	I-55	6.400	1967
6	JEFFERSON	I-55	9.300	1968
6	JEFFERSON	I-55	10.750	1968
6	JEFFERSON	I-55	11.500	1968
6	JEFFERSON	I-55	14.590	1968
6	JEFFERSON	A	7.820	1976
6	JEFFERSON	A	7.970	1976
6	JEFFERSON	A	8.370	1976
6	JEFFERSON	A	8.970	1976
6	JEFFERSON	A	9.370	1976
6	ST. CHARLES	OLD 40	1.000	1924
6	ST. CHARLES	OLD 40	3.300	1924
6	ST. CHARLES	OLD 40	3.400	1924
6	ST. CHARLES	OLD 40	5.100	1924
6	ST. CHARLES	OLD 40	5.300	1924
6	ST. CHARLES	D	3.820	1936
6	ST. CHARLES	D	5.820	1936
6	ST. CHARLES	D	6.220	1936
6	ST. CHARLES	D	6.620	1936
6	ST. CHARLES	D	7.120	1936
6	ST. CHARLES	DD	0.600	1944
6	ST. CHARLES	DD	0.900	1944
6	ST. CHARLES	DD	1.900	1944
6	ST. CHARLES	DD	2.000	1944
6	ST. CHARLES	DD	3.200	1944
6	ST. CHARLES	I-70	7.500	1952
6	ST. CHARLES	I-70	8.400	1952
6	ST. CHARLES	I-70	10.000	1953
6	ST. CHARLES	I-70	10.700	1953
6	ST. CHARLES	I-70	12.500	1953
6	ST. CHARLES	40 EBL	10.800	1967

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
6	ST. CHARLES	40 EBL	11.500	1967
6	ST. CHARLES	40 EBL	12.100	1967
6	ST. CHARLES	40 EBL	12.200	1967
6	ST. CHARLES	40 EBL	12.600	1967
6	ST. CHARLES	40 EBL	1.100	1971
6	ST. CHARLES	40 EBL	1.500	1971
6	ST. CHARLES	40 EBL	3.600	1971
6	ST. CHARLES	40 EBL	4.200	1971
6	ST. CHARLES	40 EBL	4.500	1971
6	ST. LOUIS	OLD 100	0.350	1924
6	ST. LOUIS	OLD 100	0.900	1924
6	ST. LOUIS	109	2.200	1934
6	ST. LOUIS	231	11.110	1936
6	ST. LOUIS	231	11.510	1936
6	ST. LOUIS	231	11.810	1936
6	ST. LOUIS	40	5.650	1936
6	ST. LOUIS	T	0.050	1941
6	ST. LOUIS	T	0.100	1941
6	ST. LOUIS	T	0.300	1941
6	ST. LOUIS	T	1.400	1941
6	ST. LOUIS	T	1.500	1941
6	ST. LOUIS	TT	0.800	1952
6	ST. LOUIS	TT	0.900	1952
6	ST. LOUIS	TT	2.000	1952
6	ST. LOUIS	I-44	4.750	1956
6	ST. LOUIS	I-44	4.950	1956
6	ST. LOUIS	I-55	16.050	1965
6	ST. LOUIS	I-55	16.051	1965
6	ST. LOUIS	I-55	16.100	1965
6	ST. LOUIS	I-55	16.150	1965
6	ST. LOUIS	I-55	16.669	1965
6	ST. LOUIS	I-55	12.800	1965
6	ST. LOUIS	30	2.050	1971
6	ST. LOUIS	30	3.800	1971
6	ST. LOUIS	30	3.150	1971
6	ST. LOUIS	30	3.450	1971
6	ST. LOUIS	30	3.700	1971
6	ST. LOUIS	231	11.650	1987
7	BARRY	60	3.035	1926
7	BARRY	W	5.967	1942
7	BARRY	W	6.202	1942
7	BARRY	W	6.553	1942
7	BARRY	W	7.091	1942
7	BARRY	W	7.593	1942

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	BARRY	60	1.530	1958
7	BARRY	60	1.603	1958
7	BARRY	60	2.126	1958
7	BARRY	60	2.481	1958
7	BARRY	37	0.592	1965
7	BARRY	37	1.040	1965
7	BARRY	37	1.138	1965
7	BARRY	37	1.354	1965
7	BARRY	37	1.912	1965
7	BARTON	K	4.379	1938
7	BARTON	37	0.723	1968
7	BARTON	43	8.020	1972
7	BARTON	43	8.096	1972
7	BARTON	43	0.726	1974
7	BARTON	43	4.548	1974
7	BARTON	43	5.359	1974
7	BATES	18	0.650	1936
7	BATES	18	0.730	1936
7	BATES	18	1.020	1936
7	BATES	18	1.220	1936
7	BATES	18	2.090	1936
7	BATES	52	1.590	1942
7	BATES	52	1.670	1942
7	BATES	52	15.660	1942
7	BATES	52	15.620	1942
7	BATES	52	15.550	1942
7	BATES	F	0.990	1953
7	BATES	F	1.790	1953
7	BATES	F	2.740	1953
7	BATES	F	3.080	1953
7	BATES	F	4.850	1953
7	BATES	71 NBL	1.550	1964
7	BATES	71 NBL OR	2.690	1964
7	BATES	71 NBL	4.380	1969
7	BATES	71	2.730	1971
7	BATES	71	3.320	1971
7	BATES	71	4.960	1971
7	BATES	71	5.130	1971
7	BATES	71	6.600	1971
7	CEDAR	97	3.377	1936
7	CEDAR	97	5.208	1936
7	CEDAR	97	5.303	1936
7	CEDAR	97	5.595	1936
7	CEDAR	39	0.651	1947

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	CEDAR	39	5.796	1947
7	CEDAR	39	6.024	1947
7	CEDAR	32	0.074	1968
7	CEDAR	32	0.610	1968
7	CEDAR	32	1.038	1968
7	CEDAR	32	1.220	1968
7	CEDAR	32	1.263	1968
7	DADE	97	0.653	1970
7	DADE	97	0.994	1970
7	DADE	97	1.017	1970
7	DADE	97	1.557	1970
7	DADE	97	3.219	1970
7	JASPER	H	4.051	1934
7	JASPER	H	4.134	1934
7	JASPER	H	6.301	1934
7	JASPER	H	6.663	1934
7	JASPER	BB	0.014	1949
7	JASPER	66	0.450	1951
7	JASPER	66	1.400	1951
7	JASPER	171	0.697	1956
7	JASPER	171	1.258	1956
7	JASPER	171	1.388	1956
7	JASPER	171	1.559	1956
7	JASPER	I-44	0.364	1962
7	JASPER	I-44	0.864	1962
7	JASPER	I-44	1.477	1962
7	JASPER	I-44	2.426	1962
7	JASPER	I-44	3.570	1962
7	JASPER	71 ALT	0.722	1970
7	JASPER	71 ALT	1.234	1970
7	JASPER	71 ALT	2.285	1970
7	JASPER	71 ALT	2.501	1970
7	JASPER	71 ALT NBL	1.330	1970
7	LAWRENCE	174	0.500	1947
7	LAWRENCE	174	0.600	1947
7	LAWRENCE	174	0.700	1947
7	LAWRENCE	174	5.450	1948
7	LAWRENCE	174	5.550	1948
7	LAWRENCE	F	4.300	1951
7	LAWRENCE	F	4.440	1951
7	LAWRENCE	F	5.070	1951
7	LAWRENCE	F	5.610	1951
7	LAWRENCE	60	0.332	1963
7	LAWRENCE	60	0.540	1963

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	LAWRENCE	60	1.146	1963
7	LAWRENCE	60	1.529	1963
7	LAWRENCE	60	1.620	1963
7	MCDONALD	76	1.911	1933
7	MCDONALD	76	3.078	1933
7	MCDONALD	76	3.380	1933
7	MCDONALD	76	5.574	1933
7	MCDONALD	76	3.596	1933
7	MCDONALD	71	2.598	1945
7	MCDONALD	71	3.531	1945
7	MCDONALD	71	5.298	1945
7	MCDONALD	71	6.013	1945
7	MCDONALD	71	3.617	1945
7	MCDONALD	90	2.395	1950
7	MCDONALD	90	2.519	1950
7	MCDONALD	90	2.937	1950
7	MCDONALD	90	3.016	1950
7	MCDONALD	90	3.082	1950
7	MCDONALD	71	0.001	1967
7	MCDONALD	71	0.347	1967
7	MCDONALD	71	1.250	1967
7	MCDONALD	71	3.772	1967
7	MCDONALD	71	4.008	1967
7	NEWTON	71	0.169	1940
7	NEWTON	71	0.796	1940
7	NEWTON	71	2.213	1940
7	NEWTON	714	0.521	1940
7	NEWTON	O	2.476	1950
7	NEWTON	43	0.119	1957
7	NEWTON	43	0.225	1957
7	NEWTON	43	0.275	1957
7	NEWTON	43	0.987	1957
7	NEWTON	43	0.158	1962
7	NEWTON	43	1.145	1962
7	NEWTON	43	1.463	1962
7	NEWTON	43	1.521	1962
7	NEWTON	43	2.543	1962
7	ST. CLAIR	E	3.100	1935
7	ST. CLAIR	E	3.400	1935
7	ST. CLAIR	E	3.510	1935
7	ST. CLAIR	E	3.650	1935
7	ST. CLAIR	E	3.900	1935
7	ST. CLAIR	54	0.190	1940
7	ST. CLAIR	54	0.240	1940

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	ST. CLAIR	54	0.790	1940
7	ST. CLAIR	54	3.110	1940
7	ST. CLAIR	54	0.540	1940
7	ST. CLAIR	VV	0.060	1959
7	ST. CLAIR	VV	0.150	1959
7	ST. CLAIR	VV	1.610	1959
7	ST. CLAIR	VV	2.000	1959
7	ST. CLAIR	VV	2.120	1959
7	ST. CLAIR	13	6.920	1963
7	ST. CLAIR	13	7.150	1963
7	ST. CLAIR	13	7.240	1963
7	ST. CLAIR	13	7.380	1963
7	ST. CLAIR	13	9.440	1963
7	ST. CLAIR	82	0.660	1977
7	ST. CLAIR	82	1.080	1977
7	ST. CLAIR	82	1.450	1977
7	ST. CLAIR	82	1.710	1977
7	ST. CLAIR	82	0.120	1977
7	VERNON	W	2.200	1940
7	VERNON	71	0.280	1960
7	VERNON	71	0.310	1960
7	VERNON	71	0.490	1960
7	VERNON	71	2.590	1960
7	VERNON	43	0.980	1970
7	VERNON	43	1.040	1970
7	VERNON	43	3.250	1970
7	VERNON	43	3.960	1970
7	VERNON	43	5.350	1970
8	CHRISTIAN	125(C)	1.430	1935
8	CHRISTIAN	125(C)	1.230	1935
8	CHRISTIAN	125(6)	0.970	1935
8	CHRISTIAN	125(C)	0.490	1935
8	CHRISTIAN	125(C)	0.370	1935
8	CHRISTIAN	60	6.380	1943
8	CHRISTIAN	60	6.510	1943
8	CHRISTIAN	60	6.840	1943
8	CHRISTIAN	60	7.280	1943
8	CHRISTIAN	60	7.430	1943
8	CHRISTIAN	60	3.210	1953
8	CHRISTIAN	60	1.920	1953
8	CHRISTIAN	60	1.460	1953
8	CHRISTIAN	60	1.210	1953
8	CHRISTIAN	60	0.340	1953
8	CHRISTIAN	160	6.490	1968

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	CHRISTIAN	160	5.990	1968
8	CHRISTIAN	160	5.820	1968
8	CHRISTIAN	160	4.780	1968
8	CHRISTIAN	160	4.190	1968
8	DALLAS	73	2.330	1938
8	DALLAS	73	2.710	1938
8	DALLAS	73	2.830	1938
8	DALLAS	73	2.930	1938
8	DALLAS	73	4.100	1938
8	DALLAS	32(64)	0.630	1948
8	DALLAS	32(64)	2.110	1948
8	DALLAS	32(64)	2.860	1948
8	DALLAS	32(64)	3.160	1948
8	DOUGLAS	76(HH)	43.430	1936
8	DOUGLAS	76(HH)	43.270	1936
8	DOUGLAS	76(HH)	42.820	1936
8	DOUGLAS	76(HH)	42.630	1936
8	DOUGLAS	76(HH)	42.340	1936
8	DOUGLAS	5	2.900	1959
8	DOUGLAS	5	3.370	1959
8	DOUGLAS	5	5.030	1959
8	DOUGLAS	5	3.210	1959
8	DOUGLAS	5	5.980	1959
8	DOUGLAS	5	8.830	1961
8	DOUGLAS	5	10.100	1961
8	DOUGLAS	5	10.900	1961
8	DOUGLAS	5	11.000	1961
8	DOUGLAS	5	11.490	1961
8	GREENE	F	7.040	1936
8	GREENE	F	7.320	1936
8	GREENE	F	7.720	1936
8	GREENE	F	8.110	1936
8	GREENE	F	9.180	1936
8	GREENE	174	7.000	1942
8	GREENE	CC	7.630	1948
8	GREENE	CC	7.300	1948
8	GREENE	CC	5.350	1948
8	GREENE	60	20.800	1955
8	GREENE	60	21.370	1967
8	GREENE	60	21.610	1967
8	GREENE	60	21.760	1967
8	GREENE	60	22.110	1967
8	GREENE	60	22.340	1967
8	GREENE	65	2.900	1977

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	GREENE	65	3.500	1977
8	GREENE	65	4.400	1977
8	GREENE	65	5.100	1977
8	GREENE	65	5.900	1977
8	HICKORY	54	24.590	1933
8	HICKORY	54	25.110	1933
8	HICKORY	54	26.040	1933
8	HICKORY	54	27.270	1933
8	HICKORY	64	1.680	1969
8	HICKORY	64	2.130	1969
8	HICKORY	64	2.280	1969
8	HICKORY	64	2.730	1969
8	HICKORY	64	3.030	1969
8	LACLEDE	5	24.600	1933
8	LACLEDE	5	22.500	1933
8	LACLEDE	5	22.700	1933
8	LACLEDE	5	23.400	1933
8	LACLEDE	5	24.100	1933
8	LACLEDE	I-44	31.200	1957
8	LACLEDE	I-44	29.900	1957
8	LACLEDE	I-44	26.600	1957
8	LACLEDE	I-44	26.800	1957
8	LACLEDE	I-44	27.900	1957
8	LACLEDE	I-44	25.700	1957
8	LACLEDE	I-44	20.100	1974
8	LACLEDE	I-44	20.300	1974
8	LACLEDE	I-44	21.700	1974
8	OZARK	5	0.730	1969
8	OZARK	5	1.000	1969
8	OZARK	5	1.650	1969
8	OZARK	5	1.850	1969
8	OZARK	5	1.930	1969
8	OZARK	5	16.290	1975
8	OZARK	5	16.250	1975
8	OZARK	5	16.190	1975
8	OZARK	5	14.990	1975
8	POLK	13	1.390	1934
8	POLK	13	28.940	1936
8	POLK	13	31.040	1936
8	POLK	13	25.050	1936
8	POLK	13	27.220	1936
8	POLK	215	8.180	1953
8	POLK	13	9.430	1959
8	POLK	13	9.480	1959

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	POLK	13	9.640	1959
8	POLK	13	17.860	1959
8	POLK	D	8.230	1967
8	POLK	D	7.380	1967
8	POLK	D	7.780	1967
8	POLK	D	11.780	1972
8	POLK	D	11.500	1972
8	POLK	D	10.910	1972
8	POLK	D	12.290	1972
8	POLK	64	4.140	1975
8	STONE	248(43)	0.110	1926
8	STONE	173(E)	9.080	1937
8	STONE	173(E)	8.980	1937
8	STONE	173(E)	7.880	1937
8	STONE	173(E)	6.920	1937
8	STONE	173(E)	9.290	1937
8	STONE	M	0.640	1947
8	STONE	V	5.950	1949
8	STONE	V	6.060	1949
8	STONE	V	5.450	1949
8	STONE	V	5.310	1949
8	STONE	V	4.910	1949
8	STONE	13	33.420	1963
8	STONE	13	33.250	1963
8	STONE	13	33.100	1963
8	STONE	13	32.990	1963
8	STONE	13	32.860	1963
8	STONE	RB	0.350	1971
8	STONE	RB	0.260	1971
8	STONE	RB	0.200	1971
8	STONE	RB	0.000	1971
8	TANEY	65	10.200	1965
8	TANEY	65	18.900	1979
8	TANEY	65	19.000	1979
8	TANEY	65	16.200	1979
8	TANEY	65	15.600	1979
8	TANEY	65	14.800	1979
8	WEBSTER	W	7.600	1947
8	WEBSTER	W	8.100	1947
8	WEBSTER	I-44	19.340	1952
8	WEBSTER	I-44	18.500	1952
8	WEBSTER	I-44	18.300	1952
8	WEBSTER	I-44	17.600	1952
8	WEBSTER	I-44	16.620	1952

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	WEBSTER	60	1.800	1969
8	WEBSTER	60	1.600	1969
8	WEBSTER	60	0.500	1969
8	WEBSTER	60	0.400	1969
8	WEBSTER	60	0.200	1971
8	WEBSTER	60	0.300	1971
8	WEBSTER	60	0.500	1971
8	WEBSTER	60	0.800	1971
8	WEBSTER	60	1.100	1971
8	WRIGHT	5	1.300	1931
8	WRIGHT	5	1.400	1931
8	WRIGHT	5	5.100	1931
8	WRIGHT	5	32.700	1954
8	WRIGHT	5	31.400	1959
8	WRIGHT	5	32.300	1959
8	WRIGHT	5	33.100	1959
8	WRIGHT	5	33.400	1959
8	WRIGHT	60	0.400	1964
8	WRIGHT	60	0.400	1964
8	WRIGHT	60	1.300	1964
8	WRIGHT	60	1.600	1964
8	WRIGHT	60	2.800	1964
8	WRIGHT	60	9.400	1975
8	WRIGHT	60	9.900	1975
8	WRIGHT	60	10.700	1975
8	WRIGHT	60	11.700	1975
8	WRIGHT	60	21.900	1975
9	CARTER	60	19.180	1947
9	CARTER	60	19.280	1947
9	CARTER	60	19.700	1947
9	CARTER	60	20.550	1947
9	CARTER	60	20.700	1947
9	CARTER	60	40.900	1955
9	CARTER	60	41.010	1955
9	CARTER	60	41.070	1955
9	CARTER	60	41.170	1955
9	CARTER	60	41.270	1955
9	CRAWFORD	19	27.000	1934
9	CRAWFORD	19	27.100	1934
9	CRAWFORD	19	27.200	1934
9	CRAWFORD	19	27.300	1934
9	CRAWFORD	19	27.500	1934
9	CRAWFORD	F	6.897	1945
9	CRAWFORD	F	7.747	1945

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	CRAWFORD	F	7.947	1945
9	CRAWFORD	F	7.947	1945
9	CRAWFORD	F	8.347	1945
9	CRAWFORD	J	1.000	1951
9	CRAWFORD	J	1.200	1951
9	CRAWFORD	J	1.500	1951
9	CRAWFORD	J	2.000	1951
9	CRAWFORD	J	2.300	1951
9	DENT	B	5.500	1936
9	DENT	B	6.050	1936
9	DENT	B	6.080	1936
9	DENT	B	6.400	1936
9	DENT	B	7.000	1936
9	HOWELL	63	0.550	1937
9	HOWELL	63	1.150	1937
9	HOWELL	63	1.900	1937
9	HOWELL	63	2.200	1937
9	HOWELL	63	3.100	1937
9	HOWELL	63	4.240	1948
9	HOWELL	63	4.800	1948
9	HOWELL	63	4.900	1948
9	HOWELL	63	5.200	1948
9	HOWELL	63	5.430	1948
9	HOWELL	63	24.700	1953
9	HOWELL	63	24.960	1953
9	HOWELL	63	25.160	1953
9	HOWELL	63	25.460	1953
9	HOWELL	63	25.660	1953
9	HOWELL	63	17.560	1963
9	HOWELL	63	18.000	1963
9	HOWELL	63	18.540	1963
9	HOWELL	63	19.450	1963
9	HOWELL	63	19.850	1963
9	IRON	32	0.010	1933
9	IRON	32	0.170	1933
9	IRON	32	0.360	1933
9	IRON	32	0.420	1933
9	IRON	32	0.570	1933
9	IRON	M	1.500	1948
9	IRON	M	1.550	1948
9	IRON	M	1.700	1948
9	IRON	M	2.000	1948
9	IRON	D	0.050	1950
9	IRON	D	1.600	1950

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	IRON	D	2.400	1950
9	IRON	D	3.850	1950
9	IRON	D	3.900	1950
9	IRON	21	9.090	1970
9	IRON	21	10.970	1970
9	IRON	21	11.170	1970
9	IRON	21	11.520	1970
9	IRON	21	12.340	1970
9	OREGON	142(D)	24.990	1935
9	OREGON	142(D)	25.890	1935
9	OREGON	142(D)	26.890	1935
9	OREGON	142(D)	27.290	1935
9	OREGON	142(D)	27.390	1935
9	OREGON	63	0.290	1955
9	OREGON	63	0.900	1955
9	OREGON	63	0.150	1955
9	OREGON	63	2.250	1955
9	OREGON	63	4.000	1955
9	OREGON	63	5.680	1960
9	OREGON	63	6.060	1960
9	OREGON	63	6.110	1960
9	OREGON	63	7.520	1960
9	OREGON	63	8.200	1960
9	PHELPS	21	11.950	1940
9	PHELPS	63	10.200	1940
9	PHELPS	63	12.250	1940
9	PHELPS	63	12.400	1940
9	PHELPS	63	12.550	1940
9	PHELPS	63	33.330	1962
9	PHELPS	63	33.650	1962
9	PHELPS	63	34.000	1962
9	PHELPS	63	34.050	1962
9	PHELPS	63	34.200	1962
9	PULASKI	28	3.500	1935
9	PULASKI	28	3.850	1935
9	PULASKI	28	4.360	1935
9	PULASKI	17	25.620	1957
9	PULASKI	17	26.370	1957
9	PULASKI	17	31.820	1957
9	PULASKI	17	33.420	1957
9	PULASKI	17	33.920	1957
9	PULASKI	I-44	14.580	1963
9	PULASKI	I-44	14.830	1963
9	PULASKI	I-44	15.230	1963

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	PULASKI	I-44	15.330	1963
9	PULASKI	I-44	16.010	1963
9	REYNOLDS	21	43.010	1942
9	REYNOLDS	21	43.640	1942
9	REYNOLDS	21	43.840	1942
9	REYNOLDS	21	44.090	1942
9	REYNOLDS	21	44.150	1942
9	REYNOLDS	21	28.570	1969
9	REYNOLDS	21	28.850	1969
9	REYNOLDS	21	28.950	1969
9	REYNOLDS	21	29.530	1969
9	REYNOLDS	21	29.680	1969
9	REYNOLDS	21	15.350	1970
9	REYNOLDS	21	15.800	1970
9	REYNOLDS	21	16.330	1970
9	REYNOLDS	21	17.950	1970
9	REYNOLDS	21	18.750	1970
9	RIPLEY	160	27.900	1924
9	RIPLEY	160	28.000	1924
9	RIPLEY	160	28.400	1924
9	RIPLEY	160	28.680	1924
9	RIPLEY	160	27.720	1924
9	RIPLEY	142	0.350	1947
9	RIPLEY	142	0.620	1947
9	RIPLEY	142	0.660	1947
9	RIPLEY	160	20.440	1966
9	RIPLEY	160	20.670	1966
9	RIPLEY	160	21.220	1966
9	RIPLEY	160	21.380	1966
9	RIPLEY	160	21.940	1966
9	RIPLEY	160	23.100	1975
9	RIPLEY	160	23.900	1975
9	RIPLEY	160	24.300	1975
9	RIPLEY	160	24.750	1975
9	RIPLEY	160	26.150	1975
9	SHANNON	60	13.790	1966
9	SHANNON	60	12.340	1969
9	SHANNON	60	14.140	1969
9	SHANNON	60	14.170	1969
9	SHANNON	60	14.540	1969
9	TEXAS	17	42.670	1933
9	TEXAS	17	42.770	1933
9	TEXAS	17	43.870	1933
9	TEXAS	17	44.520	1933

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	TEXAS	17	44.900	1933
9	TEXAS	63	27.990	1943
9	TEXAS	63	28.590	1943
9	TEXAS	63	29.270	1943
9	TEXAS	63	30.040	1943
9	TEXAS	63	30.770	1943
9	TEXAS	63	22.590	1956
9	TEXAS	63	22.990	1956
9	TEXAS	63	23.240	1956
9	TEXAS	63	23.690	1956
9	TEXAS	63	23.840	1956
9	TEXAS	63	0.010	1963
9	TEXAS	63	0.300	1963
9	TEXAS	63	2.400	1963
9	TEXAS	63	4.000	1963
9	TEXAS	63	4.700	1963
9	TEXAS	60	6.530	1973
9	TEXAS	60	7.110	1973
9	TEXAS	60	7.410	1973
9	TEXAS	60	7.930	1973
9	TEXAS	60	9.980	1973
9	WASHINGTON	21	5.750	1934
9	WASHINGTON	21	7.330	1934
9	WASHINGTON	21	13.650	1934
9	WASHINGTON	21	13.975	1934
9	WASHINGTON	21	14.100	1934
9	WASHINGTON	21	15.650	1958
9	WASHINGTON	21	15.740	1958
9	WASHINGTON	21	15.950	1958
9	WASHINGTON	21	16.000	1958
9	WASHINGTON	21	16.620	1958
9	WASHINGTON	8	9.670	1967
9	WASHINGTON	8	11.550	1967
9	WASHINGTON	8	11.850	1967
9	WASHINGTON	8	12.200	1967
9	WASHINGTON	8	12.280	1967
9	WASHINGTON	8	21.700	1971
9	WASHINGTON	8	22.300	1971
9	WASHINGTON	8	22.800	1971
9	WASHINGTON	8	23.400	1971
9	WASHINGTON	8	23.500	1971
10	BOLLINGER	72	14.770	1925
10	BOLLINGER	72	15.720	1925
10	BOLLINGER	72	16.850	1925

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
10	BOLLINGER	72	1.525	1926
10	BOLLINGER	72	3.098	1926
10	BOLLINGER	34	23.001	1940
10	BOLLINGER	34	23.501	1940
10	BOLLINGER	34	23.591	1940
10	BOLLINGER	34	23.881	1940
10	BOLLINGER	34	24.351	1940
10	BUTLER	67	12.180	1936
10	BUTLER	67	13.180	1936
10	BUTLER	67	13.330	1936
10	BUTLER	67	13.450	1936
10	BUTLER	53	16.156	1937
10	BUTLER	67	20.300	1942
10	BUTLER	67	20.460	1942
10	BUTLER	67	20.540	1942
10	BUTLER	67	20.750	1942
10	BUTLER	67	20.990	1942
10	BUTLER	60	0.182	1955
10	BUTLER	60	0.238	1955
10	BUTLER	60	1.209	1955
10	BUTLER	60	1.837	1955
10	BUTLER	60	2.276	1955
10	CAPE GIR.	72	0.193	1924
10	CAPE GIR.	72	2.786	1924
10	CAPE GIR.	72	3.797	1924
10	CAPE GIR.	72	4.322	1924
10	CAPE GIR.	RT. 72	6.317	1924
10	CAPE GIR.	61	1.130	1937
10	CAPE GIR.	61	1.460	1937
10	CAPE GIR.	61	2.010	1937
10	CAPE GIR.	61	3.650	1937
10	CAPE GIR.	61	4.260	1937
10	CAPE GIR.	34	0.776	1940
10	CAPE GIR.	34	0.845	1940
10	CAPE GIR.	I-55	20.241	1963
10	CAPE GIR.	I-55 NBL	21.648	1963
10	CAPE GIR.	I-55 SBL	20.050	1963
10	CAPE GIR.	I-55 NBL	5.380	1972
10	CAPE GIR.	I-55 SBL	2.000	1972
10	CAPE GIR.	I-55 SBL	5.900	1972
10	DUNKLIN	53	5.578	1940
10	DUNKLIN	E	0.260	1949
10	DUNKLIN	E	1.350	1949
10	DUNKLIN	412	13.870	1965

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
10	DUNKLIN	412	16.760	1965
10	DUNKLIN	412	17.720	1965
10	DUNKLIN	412	21.105	1965
10	DUNKLIN	412	21.522	1965
10	MADISON	67	8.400	1939
10	MADISON	67	8.445	1939
10	MADISON	67	9.730	1939
10	MADISON	67	9.840	1939
10	MADISON	67	9.960	1940
10	MADISON	67	11.340	1940
10	MADISON	67	11.530	1940
10	MADISON	67	11.730	1940
10	MADISON	67	11.960	1940
10	MADISON	67	7.104	1964
10	MADISON	67	7.700	1964
10	MADISON	67	7.992	1964
10	MADISON	67 SBL	0.366	1979
10	MADISON	67 SBL	0.705	1979
10	MADISON	67 SBL	1.364	1979
10	MADISON	67 SBL	2.045	1979
10	MADISON	67 SBL	3.239	1979
10	MISSISSIPPI	J	2.705	1926
10	MISSISSIPPI	J	2.915	1926
10	MISSISSIPPI	J	3.115	1926
10	MISSISSIPPI	80	11.750	1940
10	MISSISSIPPI	60	5.195	1942
10	MISSISSIPPI	RT 60	3.456	1942
10	MISSISSIPPI	105	2.840	1967
10	MISSISSIPPI	105	3.080	1967
10	MISSISSIPPI	105	5.065	1967
10	MISSISSIPPI	105	5.735	1967
10	MISSISSIPPI	105	6.530	1967
10	NEW MADRID	114	1.880	1926
10	NEW MADRID	114	2.230	1926
10	NEW MADRID	60	7.470	1959
10	NEW MADRID	60	0.690	1960
10	NEW MADRID	60	2.400	1960
10	NEW MADRID	60	2.600	1960
10	NEW MADRID	60	4.380	1960
10	NEW MADRID	60	0.680	1960
10	NEW MADRID	25	0.070	1979
10	NEW MADRID	25	0.120	1979
10	NEW MADRID	25	0.620	1979
10	NEW MADRID	25	0.720	1979

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
10	NEW MADRID	25	0.730	1979
10	PEMISCOT	61	6.750	1926
10	PEMISCOT	I-155	4.450	1976
10	PEMISCOT	I-155	4.750	1976
10	PEMISCOT	I-155	5.250	1976
10	PEMISCOT	I-155	7.144	1976
10	PEMISCOT	I-155	7.428	1976
10	PERRY	61	4.870	1934
10	PERRY	61	7.370	1934
10	PERRY	61	7.770	1934
10	PERRY	61	8.020	1934
10	PERRY	61	9.070	1934
10	PERRY	51	5.840	1959
10	PERRY	51	7.610	1959
10	PERRY	51	7.730	1959
10	PERRY	51	8.350	1959
10	ST FRANCOIS	32	15.450	1933
10	ST FRANCOIS	32	16.650	1933
10	ST FRANCOIS	32	17.450	1933
10	ST FRANCOIS	32	17.750	1933
10	ST FRANCOIS	32	18.000	1933
10	ST GENEVIEVE	61	29.620	1934
10	ST GENEVIEVE	61	30.910	1934
10	ST GENEVIEVE	61	31.820	1934
10	ST GENEVIEVE	61	31.870	1934
10	ST GENEVIEVE	61	32.540	1934
10	ST GENEVIEVE	61	0.100	1940
10	ST GENEVIEVE	61	0.300	1940
10	ST GENEVIEVE	61	0.500	1940
10	ST GENEVIEVE	61	0.700	1940
10	ST GENEVIEVE	61	0.750	1940
10	STODDARD	25	15.540	1938
10	STODDARD	25	16.300	1938
10	STODDARD	25	2.178	1942
10	STODDARD	25	5.223	1948
10	STODDARD	25	7.434	1948
10	STODDARD	25	7.953	1948
10	STODDARD	25	8.036	1948
10	STODDARD	60	1.950	1959
10	STODDARD	60	17.335	1962
10	STODDARD	60	18.501	1962
10	STODDARD	60	19.587	1962
10	STODDARD	60	21.318	1962
10	STODDARD	60	22.741	1962

TABLE 1 (Continued)

SUMMARY OF SURVEYED PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
10	WAYNE	34	4.420	1933
10	WAYNE	34	5.800	1933
10	WAYNE	34	6.540	1933
10	WAYNE	34	7.600	1933
10	WAYNE	34	8.320	1933
10	WAYNE	67	12.700	1949
10	WAYNE	67	16.200	1949
10	WAYNE	67	19.270	1949
10	WAYNE	67	0.280	1959
10	WAYNE	67	0.420	1959
10	WAYNE	67	0.690	1959
10	WAYNE	67	0.940	1959
10	WAYNE	67	1.120	1959

TABLE 2

SUMMARY OF FIELD TEST PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	ANDREW	H	11.220	1947
1	ANDREW	H	11.550	1947
1	ANDREW	Z	1.330	1950
1	ANDREW	Z	1.910	1950
1	ATCHISON	J	1.460	1950
1	ATCHISON	J	3.270	1950
1	GENTRY	BB	0.440	1961
1	GENTRY	BB	1.780	1961
1	GENTRY	Z	3.120	1941
1	GENTRY	Z	3.580	1941
1	HOLT	U	0.040	1961
1	HOLT	U	4.000	1961
2	ADAIR	N	1.030	1934
2	ADAIR	N	1.070	1934
2	HOWARD	DD	0.450	1963
2	HOWARD	DD	0.880	1963
2	HOWARD	SA	4.330	1947
2	HOWARD	SA	4.390	1947
2	HOWARD	SK	2.530	1938
2	HOWARD	SK	2.680	1938
2	HOWELL	CC	0.280	1972
2	HOWELL	CC	0.500	1972
2	LIVINGSTON	J	2.040	1933
2	LIVINGSTON	J	2.380	1933
2	MERCER	A	0.400	1949
2	MERCER	A	2.150	1949
2	MERCER	M	6.400	1936
2	MERCER	M	6.520	1936
2	RANDOLPH	AA	0.490	1962
2	RANDOLPH	AA	0.850	1962
2	SALINE	YY	1.150	1957
2	SALINE	YY	2.600	1957
3	CLARK	FF	0.490	1963
3	CLARK	FF	1.920	1963
3	KNOX	E	1.940	1949
3	KNOX	E	4.680	1949
3	KNOX	K	4.330	1971
3	KNOX	K	5.040	1971
3	LEWIS	H	1.600	1962
3	LEWIS	H	1.850	1962
3	LEWIS	J	1.940	1949
3	MARION	E	5.580	1936
3	MARION	E	6.650	1936
3	RALLS	J	7.470	1979

TABLE 2 (Continued)

SUMMARY OF FIELD TEST PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
3	RALLS	J	9.000	1979
3	RALLS	N	0.420	1958
3	RALLS	N	2.380	1958
4	CASS	58	6.500	1937
4	CASS	B	6.800	1936
4	CASS	D	3.850	1947
4	CASS	D	4.000	1947
4	HENRY	CC	1.640	1957
4	HENRY	CC	3.310	1957
4	JASPER	JJ	0.517	1958
4	JASPER	JJ	2.008	1958
4	LAFAYETTE	FF	12.200	1958
4	LAFAYETTE	M	4.770	1948
4	LAFAYETTE	M	6.250	1948
4	LAFAYETTE	U	3.020	1960
4	LAFAYETTE	U	3.630	1960
4	RAY	C	8.900	1948
4	RAY	C	9.250	1948
4	RAY	K	0.310	1960
4	RAY	K	0.540	1960
5	CALLAWAY	CC	0.650	1976
5	CALLAWAY	CC	1.300	1976
5	CALLAWAY	CC	2.000	1957
5	CALLAWAY	CC	2.320	1957
5	COLE	BB	0.010	1955
5	COLE	BB	3.660	1955
5	COLE	C	8.520	1976
5	COLE	C	9.920	1976
5	COLE	U	0.340	1948
5	COLE	U	6.630	1948
5	MARIES	42	16.711	1971
5	MARIES	42	17.093	1971
5	MILLER	42	26.780	1935
5	MILLER	42	27.060	1935
5	OSAGE	RA	1.850	1973
5	OSAGE	RA	2.300	1973
6	FRANKLIN	AJ	5.280	1961
6	FRANKLIN	AJ	5.580	1961
6	FRANKLIN	K	8.850	1956
6	FRANKLIN	K	9.950	1956
6	JEFFERSON	I-55	10.100	1965
6	JEFFERSON	I-55	11.600	1965
6	ST. LOUIS	100	2.350	1975
6	ST. LOUIS	100	2.650	1975

TABLE 2 (Continued)

SUMMARY OF FIELD TEST PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
7	BARRY	CC	1.375	1957
7	BARRY	CC	2.259	1957
7	BARTON	J	6.542	1947
7	BARTON	J	7.559	1947
7	BATES	AA	1.650	1960
7	BATES	AA	2.400	1960
7	CEDAR	32	0.369	1970
7	CEDAR	32	0.638	1970
7	DADE	D	0.046	1955
7	DADE	D	2.012	1955
7	LAWRENCE	WW	0.611	1959
7	LAWRENCE	WW	0.970	1959
7	MCDONALD	43	1.169	1935
7	MCDONALD	43	5.777	1935
8	CHRISTIAN	14	15.340	1926
8	CHRISTIAN	14	16.710	1926
8	DALLAS	WW	0.210	1960
8	DALLAS	WW	0.600	1960
8	GREENE	AB	3.330	1955
8	GREENE	AB	3.550	1955
8	HICKORY	D	3.650	1936
8	HICKORY	D	4.000	1936
8	LACLEDE	YY	2.800	1960
8	LACLEDE	YY	3.200	1960
8	OZARK	95(DD)	10.170	1961
8	OZARK	95(DD)	8.500	1961
8	POLK	215	8.890	1953
8	POLK	215	9.250	1953
8	POLK	A	0.110	1962
8	POLK	A	0.870	1962
8	STONE	V	4.500	1953
8	STONE	V	4.530	1953
8	WEBSTER	I-44	3.400	1970
8	WEBSTER	I-44	4.000	1970
9	CRAWFORD	M	0.400	1935
9	CRAWFORD	M	0.900	1935
9	DENT	B	3.100	1936
9	DENT	B	3.300	1936
9	DENT	F	1.300	1948
9	OREGON	M	5.750	1948
9	OREGON	M	6.400	1948
9	REYNOLDS	N	6.340	1942
9	REYNOLDS	N	7.140	1942

TABLE 2 (Continued)

SUMMARY OF FIELD TEST PIPE LOCATIONS FOR CSP AND RCP

PART A - CSP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
9	REYNOLDS	Y	2.300	1964
9	REYNOLDS	Y	2.400	1964
9	SHANNON	106	29.940	1975
9	SHANNON	106	31.290	1975
9	SHANNON	19	22.820	1928
9	SHANNON	19	23.070	1928
10	BOLLINGER	W	0.320	1961
10	BOLLINGER	W	2.830	1961
10	BOLLINGER	Y	0.280	1953
10	BOLLINGER	Y	0.420	1953
10	CAPE GIRARDEAU	CC	0.670	1968
10	CAPE GIRARDEAU	CC	0.810	1968
10	NEW MADRID	E	13.300	1935
10	NEW MADRID	E	14.350	1935
10	ST FRANCOIS	K	1.660	1935
10	ST FRANCOIS	K	4.260	1935
10	ST GENEVIEVE	Y	0.750	1952
10	ST GENEVIEVE	Y	1.220	1952
10	WAYNE	143	3.200	1964
10	WAYNE	143	3.270	1964
10	WAYNE	34	35.070	1927
10	WAYNE	34	35.130	1927

TABLE 2 (Continued)

SUMMARY OF FIELD TEST PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
1	ANDREW	E	1.340	1976
1	ANDREW	E	2.080	1976
1	ANDREW	I-29	14.730	1964
1	ANDREW	I-29	15.150	1964
1	ATCHISON	59	16.900	1927
1	ATCHISON	59	17.100	1927
1	GENTRY	136	10.700	1957
1	GENTRY	136	16.400	1938
1	GENTRY	136	17.100	1938
1	GENTRY	136	9.530	1957
1	HOLT	I-29	24.690	1971
2	ADAIR	63	4.910	1942
2	ADAIR	63	7.210	1942
2	LIVINGSTON	139	0.580	1947
2	LIVINGSTON	139	2.030	1947
2	MERCER	136	8.140	1973
2	MERCER	136	8.330	1973
2	MERCER	65	15.730	1941
2	MERCER	65	15.830	1941
2	SALINE	OLD40	0.850	1929
2	SALINE	OLD40	2.550	1929
2	SALINE	OLD40	3.620	1929
3	KNOX	15	29.360	1937
3	KNOX	15	29.560	1937
3	LEWIS	16	11.720	1938
3	LEWIS	16	12.280	1938
3	LEWIS	61	20.180	1977
3	LEWIS	61	6.510	1977
3	MARION	24	1.320	1935
3	MARION	24	1.940	1935
3	MARION	61	2.100	1971
3	PIKE	54	21.800	1968
3	PIKE	54	23.160	1968
3	RALLS	19	7.190	1937
3	RALLS	19	8.420	1938
4	CASS	58	13.700	1936
4	CASS	58	16.400	1936
4	HENRY	K	4.000	1936
4	HENRY	K	4.900	1936
4	JOHNSON	13	0.130	1925
4	JOHNSON	13	6.990	1925
4	JOHNSON	50	11.060	1967
4	JOHNSON	50	11.240	1967

TABLE 2 (Continued)

SUMMARY OF FIELD TEST PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
4	LAFAYETTE	13	22.900	1925
4	LAFAYETTE	13	23.300	1925
4	LAFAYETTE	23	8.000	1934
4	LAFAYETTE	23	8.330	1934
4	LAFAYETTE	I-70	16.400	1962
4	LAFAYETTE	I-70	17.440	1962
4	RAY	13	1.600	1943
5	BOONE	I-70	3.140	1959
5	BOONE	I-70	3.580	1959
5	BOONE	M	0.860	1935
5	BOONE	M	1.860	1935
5	COLE	50-63	7.600	1977
5	COLE	50-63	8.340	1977
5	MARIES	T	6.320	1937
5	MARIES	T	6.820	1937
5	MILLER	54	20.181	1976
5	MILLER	54	20.331	1976
6	FRANKLIN	47	2.850	1962
6	FRANKLIN	47	3.740	1962
6	JEFFERSON	61	27.300	1939
6	JEFFERSON	61	27.700	1939
6	ST. CHARLES	D	6.220	1936
6	ST. CHARLES	D	6.620	1936
7	BARRY	37	0.592	1965
7	BARRY	37	1.354	1965
7	BATES	18	0.650	1936
7	BATES	18	0.730	1936
7	BATES	F	0.992	1953
7	BATES	F	3.081	1953
7	CEDAR	97	3.377	1936
7	CEDAR	97	5.208	1936
7	MCDONALD	90	2.395	1950
7	MCDONALD	90	2.937	1950
7	ST. CLAIR	E	3.400	1935
7	ST. CLAIR	E	3.510	1935
7	ST. CLAIR	E	3.650	1935
7	ST. CLAIR	E	3.900	1935
8	CHRISTIAN	60	1.210	1953
8	CHRISTIAN	60	1.460	1953
8	GREENE	CC	5.350	1948
8	GREENE	CC	7.300	1948
8	HICKORY	54	25.380	1933
8	HICKORY	54	26.040	1933

TABLE 2 (Continued)

SUMMARY OF FIELD TEST PIPE LOCATIONS FOR CSP AND RCP

PART B - RCP

DISTRICT	COUNTY	ROUTE	LOG MILE	DATE INSTALLED
8	POLK	13	17.860	1959
8	POLK	13	9.480	1959
8	POLK	13	9.640	1959
8	STONE	M	0.640	1947
8	STONE	RB	0.200	1971
8	STONE	RB	0.260	1971
9	CARTER	60	40.900	1955
9	CARTER	60	41.010	1955
9	CRAWFORD	19	27.000	1934
9	CRAWFORD	19	27.100	1934
9	DENT	B	5.500	1936
9	DENT	B	6.050	1936
9	HOWELL	63	19.450	1963
9	HOWELL	63	19.850	1963
9	REYNOLDS	21	17.950	1970
9	REYNOLDS	21	18.750	1970
9	RIPLEY	160	21.380	1966
9	RIPLEY	160	21.940	1966
9	TEXAS	17	42.670	1933
9	TEXAS	17	43.870	1933
10	BOLLINGER	72	1.520	1926
10	BOLLINGER	72	16.850	1925
10	BUTLER	67	12.180	1936
10	BUTLER	67	13.330	1936
10	CAPE GIR.	34	0.780	1940
10	CAPE GIR.	34	0.840	1940
10	MISSISSIPPI	60	5.200	1942
10	MISSISSIPPI	80	11.750	1940
10	MISSISSIPPI	J	2.920	1926
10	MISSISSIPPI	J	3.120	1926
10	ST GENEVIEVE	61	0.500	1940
10	ST GENEVIEVE	61	0.700	1940

TABLE 3
SAMPLE OF
SAS DATABASE FOR CSP
(Survey Data)

OBS	INS	DATE	CO	CONUM	DIS	RT	PRO	AB	LM	LMB	DTIN	S64	PI	BRAND	SLOPE
1	CDM JWH	19890201	BOLLINGER	9	10	F	SEC 1		0.120	RT N	1938	Y		WHEELING	2
2	CDM JWH	19890201	BOLLINGER	9	10	F	SEC 1		0.540	RT N	1938	Y		WHEELING	10
3	CDM JWH	19890201	BOLLINGER	9	10	F	SEC 1		0.950	RT N	1938	Y		WHEELING	9
4	CDM JWH	19890201	BOLLINGER	9	10	F	SEC 1		1.220	RT N	1938	Y		WHEELING	5
5	CDM JTS	19890327	BOLLINGER	9	10	Y	Y-S-944 ¢1|		1.623	RT. 34	1953				0
6	CDM JTS	19890327	BOLLINGER	9	10	Y	Y-S-944 ¢1|		0.417	RT. 34	1953			WHEELING	3
7	CDM JTS	19890327	BOLLINGER	9	10	Y	Y-S-944 ¢1|		0.279	RT.34	1953			WHEELING	7
8	CDM JTS	19890327	BOLLINGER	9	10	Y	Y-S-944 ¢1|		0.174	RT.34	1953			WHEELING	2
9	CDM JTS	19890327	BOLLINGER	9	10	Y	Y-S-944 ¢1|		0.076	RT.34	1953			WHEELING	4
10	CDM JTS	19890328	BOLLINGER	9	10	W	W-S-1879 ¢2|		3.116	RT. 51	1961			UNITED STATES STEEL	2
11	CDM JTS	19890328	BOLLINGER	9	10	W	W-S-1879 ¢2|		2.827	RT. 51	1961			UNITED STATES STEEL	8
12	CDM JTS	19890328	BOLLINGER	9	10	W	W-S-1879 ¢2|		0.318	RT. 51	1961			UNITED STATES STEEL	4
13	CDM JTS	19890328	BOLLINGER	9	10	W	W-S-1879 ¢2|		0.182	RT. 51	1961			UNITED STATES STEEL	8
14	CDM JTS	19890328	BOLLINGER	9	10	W	W-S-1879 ¢2|		0.014	RT.51	1961			UNITED STATES STEEL	1
15	CDM JTS	19890328	BOLLINGER	9	10	E	SE-2		3.612	WAYNE CO LINE	1941			ARMCO	28
16	CDM JTS	19890328	BOLLINGER	9	10	E	SE-2		3.572	WAYNE CO LINE	1941			ARMCO	25
17	CDM JTS	19890328	BOLLINGER	9	10	E	SE-2		3.476	WAYNE CO LINE	1941			ARMCO	5
18	CDM JTS	19890328	BOLLINGER	9	10	E	SE-S-704 ¢2|A		2.547	WAYNE CO LINE	1948				11
19	CDM JTS	19890328	BOLLINGER	9	10	E	SE-S-704 ¢2|A		1.950	WAYNE CO LINE	1948				1
20	CDM JTS	19890328	BOLLINGER	9	10	51	51-A-1A		35.900	PERRY CO LINE	1929				4

OBS	DIA	LGHT	LGHS	EFFR	EFFB	EFFN	GAGE	CORRPAT	CORRS	CORRC	REP	LIN	LINTYP	ABST	ABSD	ABGR	FSC	FSI	DRIFT	WATCR	WATLV	WATFR	WATMI	WATVP	WATRE	WATOT	WATEX	ENDCH	ENDSP	ENDRR	ENDFL	ENDNO	ENDOT
1	36	40	0				12	122 1/2		Y	.			Y	Y	Y		Y				Y										Y	
2	30	44	0	Y			14	142 1/2		Y	.			Y	Y	Y		Y						Y		Y	SEWAGE FROM HOUSE					Y	
3	24	40	0	Y			14	142 1/2		Y	.			Y	Y	Y		Y			Y			Y								Y	
4	24	38	0	Y			14	142 1/2		Y	.			Y	Y	Y		Y						Y								Y	
5	30	32	0	Y			12	122 3/4		Y	.			Y	Y	Y		Y						Y								Y	
6	36	36	0			Y	12	122 3/4		Y	.	T		Y	Y	Y		Y				Y										Y	
7	36	38	0			Y	12	122 3/4		Y	.	T		Y	Y	Y		Y				Y										Y	
8	36	34	0			Y	12	122 3/4		Y	.			Y	Y	Y		Y				Y										Y	
9	36	52	0			Y	12	122 3/4		Y	.			Y	Y	Y		Y				Y										Y	
10	24	40	0	Y			14	142 3/4		Y	.			Y				Y		Y												Y	
11	24	38	0	Y			14	142 3/4		Y	.	T		Y	Y			Y		Y												Y	
12	24	36	0	Y			14	142 3/4		Y	.	T		Y	Y			Y				Y										Y	
13	24	40	0	Y			14	142 3/4		Y	.			Y	Y	Y		Y			Y			Y								Y	
14	24	36	0	Y			14	142 3/4		Y	.			Y	Y	Y		Y						Y								Y	
15	18	70	0	Y			16	162 3/4		Y	.			Y				Y				Y										Y	
16	18	62	0	Y			16	162 3/4		Y	.			Y				Y				Y										Y	
17	30	48	0	Y			14	142 3/4		Y	.			Y				Y				Y										Y	
18	24	34	0	Y			14	142 3/4		Y	.			Y				Y				Y										Y	
19	24	30	0	Y			14	142 3/4		Y	.			Y				Y				Y				Y	SEWAGE					Y	
20	24	38	0			Y	0	02 3/4		Y	.			Y				Y						Y				Y					Y

TABLE 3 (Continued)

SAMPLE OF SAS DATABASE FOR CSP

(Survey Data)

OBS	ENDEX	CEUM	CEMS	CEPR	CESP	CESC	CECP	CEOT	CEEX	DCI	DCO	WATO	WATI	FILI	FILO	DURAT
1										2	3					0
2										3	8	Y			Y	0
3										2	5					0
4										2	3					1
5										1	1					0
6										2	2					0
7										1	3					5
8										1	1					4
9										1	3				Y	1
10										1	3	Y	Y			2
11										1	3					7
12										2	3					0
13										3	5	Y			Y	0
14										3	2	Y	Y			0
15										1	20					2
16										1	14					1
17										1	2					1
18										1	4					4
19										2	2			Y		0
20	32"X39"WINGWALL									2	2					0

OBS	DR8A	DR8B	DR7A	DR7B	DR7C	DR7D	DR7E	DR6A	DR6B	DR6C	DR6D	DR5A	DR5B	DR5C	DR5D	DR5E	DR4A	DR4B	DR4C	DR4D	DR3A	DR3B	DR3C	DR3D	DR3E	DR2A	DR2B	DR2C	DR1A
1																													
2																													
3																													
4																													Y
5																													
6																													
7												Y																	
8																			Y										
9																													Y
10																											Y		
11			Y																										
12																													
13																													
14																													
15																										Y			
16																													Y
17																													
18																		Y											
19																													
20																													

OBS	DR1B	DR1C	DR0A	DR0B	CMPSTR	CMPJC	JC7A	JC7B	JC7C	JC6A	JC6B	JC6C	JC6D	JC5A	JC5B	JC5C	JC5D	JC5E	JC4A	JC4B	JC4C	JC4D	JC4E	JC4F	JC3A	JC3B	JC3C	JC3D	JC3E	JC2A	JC2B	JC2C	JC1A	JC1B
1					4	8																												
2			Y		4	8																												
3			Y		5	8																												
4					8	8																												
5			Y		8	8																												
6			Y		5	8																												
7					6	9																												
8					6	9																												
9					4	9																												
10					7	8																												
11					7	9																												
12			Y		8	8																												
13			Y		8	8																												
14			Y		6	8																												
15					7	8																												
16					7	8																												
17	Y				7	8																												
18					7	8																												
19			Y		7	8																												
20			Y		3	8																												

OBS	CMPAL	AL7A	AL7B	AL6A	AL6B	AL5A	AL5B	AL5C	AL4A	AL4B	AL4C	AL3A	AL3B	AL2A	AL2B	AL1A	AL1B	CECR
1	4									Y								
2	4									Y								
3	5						Y											
4	8																	
5	8																	
6	5						Y											
7	6				Y													
8	6				Y													
9	4									Y								
10	7		Y															
11	7		Y															
12	8																	
13	8																	
14	6				Y													
15	7		Y															
16	7		Y															
17	7		Y															
18	7		Y															
19	7		Y															
20	3											Y						

TABLE 4
SAMPLE OF
SAS DATABASE FOR RCP
(Survey Data)

OBS	INS	DATE	CO	CONUM	DIS	RT	PRO	AB	LM	LMB	DTIN	S64	PI	BRAND	SLOPE	DIA	LGHT
1	CBL	19890320	ANDREW	2	1	48	SEC. 3		9.70	RTE. 71	1933				5	24	88
2	CBL	19890320	ANDREW	2	1	48	SEC. 3		11.11	RTE. 71	1933				5	24	48
3	CBL	19890320	ANDREW	2	1	48	SEC. 3		11.69	RTE. 71	1933				4	24	40
4	CBL	19890320	ANDREW	2	1	48	SEC. 3		12.00	RTE. 71	1933				3	24	40
5	CBL	19890320	ANDREW	2	1	48	SEC. 3		12.06	RTE. 71	1933				4	24	40
6	CBL	19890201	ANDREW	2	1	E	RS-165(3)		0.23	RTE. 71	1976				1	30	121
7	CBL	19890313	ANDREW	2	1	E	RS-165(3)		0.64	RTE. 71	1976			HYDRO CONDUIT	1	42	135
8	CBL	19890313	ANDREW	2	1	E	RS-165(3)		1.20	RTE. 71	1976				1	36	85
9	CBL	19890313	ANDREW	2	1	E	RS-165(3)		1.34	RTE. 71	1976	8-26-74			2	36	140
10	CBL	19890313	ANDREW	2	1	E	RS-165(3)		2.08	RTE. 71	1976	8-24-74		HYDRO CONDUIT	2	36	85
11	CBL	19890315	ANDREW	2	1	I-29	I-29-2(9)		12.87	ANDREW CO. LINE	1964				3	30	172

OBS	LGHS	REP	LIN	LINTYP	ABST	ABSD	ABGR	FSC	FSI	DRIFT	WATCR	WATLV	WATFR	WATMI	WATVP	WATRE	WATOT	WATEX	ENDCH	ENDSP	ENDRR	ENDFL	ENDNO	ENDOT	ENDEX	CEUM	CEMS	CEPI	CESP	CESC	CECR	CEOT	CEEX
1	4	.			Y				Y		Y								Y														
2	4	.			Y				Y		Y								Y														
3	4	.			Y				Y		Y								Y														
4	4	.			Y				Y		Y								Y														
5	4	.			Y				Y		Y								Y														
6	8	.			Y				Y							Y						Y					Y	Y					
7	8	.			Y				Y		Y											Y				Y	Y	Y					
8	8	.			Y				Y		Y											Y											
9	8	.	T		Y				Y		Y											Y				Y	Y	Y					
10	8	.	T		Y				Y				Y									Y						Y					
11	4	.			Y				Y							Y			Y														

OBS	DCI	DCO	FWATO	FWATI	DUILLI	DUILLO	DURRAT	DRSFT	DRWAF	RCURXL	RURSP	PRAT	CPCC	CC7A	CC7B	CC6A	CC6B	CC5A	CC5B	CC4A	CC4B	CC4C	CC3A	CC3B	CC3C
1	9	12					8	8	9	9	9	8	9												
2	6	8					8	8	9	9	9	9	9												
3	2	3					8	8	9	9	9	8	9												
4	3	4					9	9	9	9	9	8	9												
5	2	3					8	8	9	9	9	8	9												
6	12	16	Y			Y	8	8	9	9	9	7	9												
7	14	16	Y			Y	8	8	9	9	9	4	9												
8	2	3					9	9	9	9	9	9	9												
9	16	18					8	8	9	9	8	6	9												
10	15	20					6	8	9	9	6	6	9												
11	8	15					8	8	9	9	9	9	9												

OBS	CC3D	CC2A	CC2B	CC2C	CC1A	CC1B	RCPJC	JC7A	JC7B	JC6A	JC6B	JC6C	JC6D	JC5A	JC5B	JC5C	JC5D	JC5E	JC5F	JC4A	JC4B	JC4C	JC4D	JC4E	JC4F	JC3A	JC3B	JC3C	JC3D	JC3E
1							8																							
2							9																							
3							8																							
4							8																							
5							8																							
6							8																							
7							4						Y							Y		Y								
8							9																							
9							6			Y			Y																	
10							6																						Y	
11							9																							

OBS	JC2A	JC2B	JC2C	JC2D	JC2E	JC2F	JC1A	JC1B	JC1C	RCPAL	AL7A	AL7B	AL6A	AL6B	AL5A	AL5B	AL5C	AL4A	AL4B	AL4C	AL4D	AL3A	AL3B	AL3C	AL2A	AL2B	AL2C	AL1A	AL1B
1										9																			
2										9																			
3										9																			
4										9																			
5										9																			
6										7	Y																		
7										9																			
8										9																			
9										9																			
10										8																			
11										9																			

TABLE 5

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE
(Survey Data)

PART A - CSP PC DATABASE
(Statewide Combined Data)

INS	Inspector
DATE	Date
CO	County
CONUM	County Num
DIS	District
RT	Route
PRO	Project
AB	Abandon Highway
LM	Log Mile
LMB	Log Mile Beginning
DTIN	Date Installed (Year Only)
S64	Surveyed in 64
PI	Pipe Ident.
BRAND	Brand
SLOPE	Slope (%)
DIA	Diameter of Pipe Inches
LGHT	Length Ft. Total
LGHS	Length Ft. Section
EFR	End Finished Rolled
EFB	End Finished Banded
EFN	End Finished None
GAGE	Gage
CORRPAT	Corrugation Pattern
CORRS	Corrugation Spiral
CORRC	Corrugation Circular
REP	Replaced
LIN	Liner Installed
LINTYP	Liner Type
ABSLDST	Abrasive Load Silt
ABSLDSD	Abrasive Load Sand
ABSLDGR	Abrasive Load Gravel
FSC	Flow Stream Continuous
FSI	Flow Stream Intermittent
DRIFT	Drift
WATSHCR	Watershed Type Cropland
WATSHLV	Watershed Type Livestock
WATSHFR	Watershed Type Forest
WATSHMI	Watershed Type Mining
WATSHVP	Watershed Type Veg/Pas
WATSHRE	Watershed Type Residential
WATSHOT	Watershed Type Other
WATSHOTEX	Watershed Other Explanation
ENDCOHE	End Protection Concrete Headwall
ENDSLPR	End Protection Concrete Slope Protection
ENDRIP	End Protection Riprap

TABLE 5 (Continued)

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE (Survey Data)

PART A - CSP PC DATABASE (Continued)
(Statewide Combined Data)

ENDFLAR	End Protection Metal Flared
NONE	No End Protection
ENDOT	End Protection Other
ENDOTEX	End Protection Other Explanation
CEPTUM	Condition End Protection Undermining
CEPTMS	Condition End Protection Movement/Settlement
CEPTPR	Condition End Protection Rusting
CEPTSP	Condition End Protection Perforation
CEPTCP	Condition End Protection Crushed
CEPTCP	Condition End Protection Piping
CEPTOT	Condition End Protection Other
CEOTPTEX	Condition End Protection Other Explanation
DEPCOVI	Depth of Cover Inlet
DEPCOVO	Depth of Cover Outlet
WATERO	Water Stand in Pipe Outlet
WATERI	Water Stand in Pipe Inlet
FILLI	Filling Material in Pipe Inlet
FILLO	Filling Material in Pipe Outlet
CMPDURRT*	CMP Durability Rating
CMPDURRTC*	CMP Durability Rating Comments
CMPSTRRAT*	CMP Structural Rating
CMPSTRJS*	CMP Structural Rating Joints and Seams
CMPSTRJSC*	CMP Structural Rating Joints and Seams Comments
CMPSTRAL*	CMP Structural Rating Alignment
CMPSTRALC*	CMP Structural Rating Alignment Comments

*CMP understood in this report to be CSP.

TABLE 5 (Continued)

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE (Survey Data)

PART A - RCP PC DATABASE
(Statewide Combined Data)

INS	Inspector
DATE	Date
CO	County
CONUM	County Num
DIS	District
RT	Route
PRO	Project
AB	Abandon Highway
LM	Log Mile
LMB	Log Mile Beginning
DTIN	Date Installed (Year Only)
S64	Surveyed in 64
PI	Pipe Ident.
BRAND	Brand
SLOPE	Slope (%)
DIA	Diameter of Pipe Inches
LGHT	Length Ft. Total
LGHS	Length Ft. Section
REP	Replaced
LIN	Liner Installed
LINTYP	Liner Type
ABSLDST	Abrasive Load Silt
ABSLDSD	Abrasive Load Sand
ABSLDGR	Abrasive Load Gravel
FSC	Flow Stream Continuous
FSI	Flow Stream Intermittent
DRIFT	Drift
WATSHCR	Watershed Type Cropland
WATSHLV	Watershed Type Livestock
WATSHFR	Watershed Type Forest
WATSHMI	Watershed Type Mining
WATSHVP	Watershed Type Veg/Pas
WATSHRE	Watershed Type Residential
WATSHOT	Watershed Type Other
WATSHOTEX	Watershed Other Explanation
ENDCOHE	End Protection Concrete Headwall
ENDSLPR	End Protection Slope Protection
ENDRIP	End Protection Riprap
ENDFLAR	End Protection Precast Flared
NONE	No End Protection
ENDOT	End Protection Other
ENDOTEX	End Protection Other Explanation
CEPTUM	Condition End Protection Undermining
CEPTMS	Condition End Protection Movement/Settlement
CEPTPR	Condition End Protection Piping

TABLE 5 (Continued)

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE
(Survey Data)

PART A - RCP PC DATABASE (Continued)
(Statewide Combined Data)

CEPTSP	Condition End Protection Scaling
CEPTSC	Condition End Protection Spalling
CEPTCP	Condition End Protection Cracking
CEPTOT	Condition End Protection Other
CEPTOTEX	Condition End Protection Other Explanation
DEPCOVI	Depth of Cover Inlet
DEPCOVO	Depth of Cover Outlet
WATERO	Water Stand in Pipe Outlet
WATERI	Water Stand in Pipe Inlet
FILLI	Filling Material in Pipe Inlet
FILLO	Filling Material in Pipe Outlet
DURMATRAT	Durability (Material) Rating
DURSFT	Durability (Material) Rating Softening
DURWAF	Durability (Material) Rating Weathering Above Flow Line
DUREXL	Durability (Material) Rating Erosive Losses
DURSPA	Durability (Material) Rating Spalling
RCPSTRRAT	RCP Structural Rating
RCPSTRCC	RCP Structural Rating Cracks and Conditions
RCPSTRCCC	RCP Structural Rating Cracks and Conditions Comments
RCPSTRJC	RCP Structural Rating Joint Condition
RCPSTRJCC	RCP Structural Rating Joint Condition Comments
RCPSTRAL	RCP Structural Rating Alignment
RCPSTRALC	RCP Structural Rating Alignment Comments

TABLE 5 (Continued)

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE
(Survey Data)

PART B - CSP SAS DATABASE

INS	Inspector
DATE	Date
CO	County
CONUM	County Num
DIS	District
RT	Route
PRO	Project
AB	Abandon Highway
LM	Log Mile
LMB	Log Mile Beginning
DTIN	Date Installed (Year Only)
S64	Surveyed in 64
PI	Pipe Ident.
BRAND	Brand
SLOPE	Slope (%)
DIA	Diameter of Pipe Inches
LGHT	Length Ft. Total
LGHS	Length Ft. Section
EFR	End Finished Rolled
EFB	End Finished Banded
EFN	End Finished None
GAGE	Gage
CORRPAT	Corrugation Pattern
CORRS	Corrugation Spiral
CORRC	Corrugation Circular
REP	Replaced
LIN	Liner Installed
LINTYP	Liner Type
ABST	Abrasive Load Silt
ABSD	Abrasive Load Sand
ABGR	Abrasive Load Gravel
FSC	Flow Stream Continuous
FSI	Flow Stream Intermittent
DRIFT	Drift
WATCR	Watershed Type Cropland
WATLV	Watershed Type Livestock
WATFR	Watershed Type Forest
WATMI	Watershed Type Mining
WATVP	Watershed Type Veg/Pas
WATRE	Watershed Type Residential
WATOT	Watershed Type Other
WATEX	Watershed Other Explanation
ENDCH	End Protection Concrete Headwall
ENDSP	End Protection Concrete Slope Protection
ENDRR	End Protection Riprap
ENDFL	End Protection Metal Flared

TABLE 5 (Continued)

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE (Survey Data)

PART B - CSP SAS DATABASE (Continued)

ENDNO	No End Protection
ENDOT	End Protection Other
ENDEX	End Protection Other Explanation
CEPUM	Condition End Protection Undermining
CEMS	Condition End Protection Movement/Settlement
CEPR	Condition End Protection Rusting
CESP	Condition End Protection Perforation
CESC	Condition End Protection Crushed
CECP	Condition End Protection Piping
CEOT	Condition End Protection Other
CEEX	Condition End Protection Other Explanation
DCI	Depth of Cover Inlet
DCO	Depth of Cover Outlet
WATO	Water Stand in Pipe Outlet
WATI	Water Stand in Pipe Inlet
FILLI	Filling Material in Pipe Inlet
FILLO	Filling Material in Pipe Outlet
DURRAT	CMP Durability Rating
CMPDURRTC*	CMP Durability Rating Comments (See Attached Rating Sheet)
CMPSTR*	CMP Structural Rating
CMPJC*	CMP Structural Rating Joints and Seams
CMPSTRJSC*	CMP Structural Rating Joints and Seams Comments (See Attached Rating Sheet)
CMPAL*	CMP Structural Rating Alignment
CMPSTRALC*	CMP Structural Rating Alignment Comments (See Attached Rating Sheet)

*CMP understood in this report to be CSP.

TABLE 5 (Continued)

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE
(Survey Data)

PART B - CSP SAS DATABASE (Continued)

CMP DURABILITY (MATERIAL) RATING

Durability

- 9 New condition.
- 8 A Superficial rust in spots.
  - B Slight discoloration.
- 7 A Moderate rust in spots.
  - B Slight pitting.
  - C Discoloration.
  - D Loss of base metal in pitted areas, approximately 10%.
  - E Some isolated bulges in barrel.
- 6 A Heavy rust.
  - B Pitting.
  - C Some thinning of base metal in isolated areas.
  - D Minor flattening in bottom half and/or minor bulges in top half.
- 5 A Invert mostly covered with rust.
  - B Loss of base metal under rust approximately 10%.
  - C Severe pitting.
  - D Loss of base metal in pitted area approximately 30%.
  - E Bottom half flattened significantly and/or moderate bulges in top half.
- 4 A Appreciable rust in majority of pipe.
  - B Inverts covered with rust.
  - C Loss of base metal severe enough that deflection or penetration will occur when struck with hammer.
  - D Significant distortion at isolated locations in top half, extreme flattening.
- 3 A Corroded or abraded nearly through.
  - B Extensive heavy rust.
  - C Deep pitting with 60 to 90% loss of base metal.
  - D Metal may be punctured easily with light blow of hammer.
  - E Distortion throughout pipe, lower third kinked, ponding water.
- 2 A Perforation in scattered locations.
  - B Invert with minor perforation not causing significant exfiltration.
  - C Extreme deflection, flattening of crown.
- 1 A Perforation extensive in inverts and/or extensive perforation in pipe due to corrosion.
  - B Exfiltration causing erosion of fill material under or around pipe.
  - C Partially collapsed with crown in reverse curve.
- 0 A Complete invert rusted out and/or bottom of pipe rusted out.
  - B Failure, collapsed pipe.

CMP STRUCTURAL RATING

Joint and Seam Condition

- 9 All joints and seams tight.
- 8 One or more joints loosened less than 1/4 width of band.
- 7 A One or more joints loosened 1/8 to 1/4 width of band.
  - B Slight faulting at one or more joints due to band loosening.
  - C Slight movement of seams.
- 6 A One joint loosened greater than 1/4 width of band.
  - B Minor opening of pipe seams.
  - C Minor cracking of welds at seams or around rivets.
  - D Slight infiltration, exfiltration.
- 5 A Two or more joints loosened greater than 1/4 width of band.
  - B Faulting less than 1" on one or more joints due to band loosening.
  - C Moderate opening of pipe seams.
  - D Moderate cracking of welds at seams or around rivets.
  - E Minor infiltration, exfiltration.
- 4 A One joint open exposing one edge of band and backfill material.
  - B Faulting 1 to 2" of one or more joints due to band loosening.
  - C Appreciable opening of pipe seams.
  - D Appreciable cracking of welds at seams or around rivets.
  - E Moderate infiltration, exfiltration.
  - F Minor ponding of water or soil due to joint failure.
- 3 A Two or more joints open exposing one edge of band and backfill material.
  - B Faulting of one or more joints greater than 2".
  - C Pipe seams open exposing backfill.
  - D Appreciable infiltration, exfiltration.
  - E Moderate ponding of water or soil due to joint failure.
- 2 A Severe infiltration, exfiltration.
  - B Appreciable water or soil ponding.
  - C Severe seam failure.
- 1 A Severe faulting of all joints.
  - B Pipe partially filled causing improper flow.
- 0 Failure of pipe due to joint or seam failure.

Alignment

- 9 Straight or smooth, new.
- 8 Slight deflection of pipe alignment, local areas, less than 1/4" in 10' length.
- 7 A Misalignment of joints 1/4 to 1/2" due to differential movement.
  - B Minor deflection of pipe alignment 1/4 to 1/2" in 10' length.
- 6 A Misalignment of joints 1/2 to 1" due to differential movement.
  - B Moderate deflection of pipe alignment without ponding water, 1/2 to 3/4" per 10' length.
- 5 A Misalignment of joints 1" to 2" due to differential movement.
  - B Significant deflection of pipe alignment, 3/4 to 1" per 10' length.
  - C Minor ponding of water or soil.
- 4 A Misalignment of joints greater than 2" due to differential movement.
  - B Appreciable deflection of pipe alignment, 1" to 2" per 10' length.
  - C Moderate ponding of water or soil.
- 3 A Major deflection of pipe alignment, 2 to 4" per 10' length.
  - B Significant ponding of water or soil.
- 2 A Advanced deflection of pipe alignment, 4 to 6" per 10' length.
  - B Advanced ponding of water or soil causing some flow constrictions.
- 1 A Alignment severe enough to impede proper flow, greater than 6" per 10' length.
  - B Pipe partially filled from ponding of water or soil.
- 0 Failure of pipe due to alignment failure causing no flow.

TABLE 5 (Continued)

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE (Survey Data)

PART B - RCP SAS DATABASE

INS	Inspector
DATE	Date
CO	County
CONUM	County Num
DIS	District
RT	Route
PRO	Project
AB	Abandon Highway
LM	Log Mile
LMB	Log Mile Beginning
DTIN	Date Installed (Year Only)
S64	Surveyed in 64
PI	Pipe Ident.
BRAND	Brand
SLOPE	Slope (%)
DIA	Diameter of Pipe Inches
LGHT	Length Ft. Total
LGHS	Length Ft. Section
REP	Replaced
LIN	Liner Installed
LINTYP	Liner Type
ABST	Abrasive Load Silt
ABSD	Abrasive Load Sand
ABGR	Abrasive Load Gravel
FSC	Flow Stream Continuous
FSI	Flow Stream Intermittent
DRIFT	Drift
WATCR	Watershed Type Cropland
WATLV	Watershed Type Livestock
WATFR	Watershed Type Forest
WATMI	Watershed Type Mining
WATVP	Watershed Type Veg/Pas
WATRE	Watershed Type Residential
WATOT	Watershed Type Other
WATEX	Watershed Other Explanation
ENDCH	End Protection Concrete Headwall
ENDSP	End Protection Slope Protection
ENDRR	End Protection Riprap
ENDFL	End Protection Precast Flared
ENDNO	No End Protection
ENDOT	End Protection Other
ENTEX	End Protection Other Explanation
CEPUM	Condition End Protection Undermining
CEMS	Condition End Protection Movement/Settlement
CEPI	Condition End Protection Piping
CESP	Condition End Protection Scaling

TABLE 5 (Continued)

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE (Survey Data)

PART B - RCP SAS DATABASE (Continued)

CESC	Condition End Protection Spalling
CECR	Condition End Protection Cracking
CEOT	Condition End Protection Other
CEEX	Condition End Protection Other Explanation
DCI	Depth of Cover Inlet
DCO	Depth of Cover Outlet
WATO	Water Stand in Pipe Outlet
WATI	Water Stand in Pipe Inlet
FILLI	Filling Material in Pipe Inlet
FILLO	Filling Material in Pipe Outlet
DURRAT	Durability (Material) Rating
DURSFT	Durability (Material) Rating Softening
DURWAF	Durability (Material) Rating Weathering Above Flow Line
DURXL	Durability (Material) Rating Erosive Losses
DURSP	Durability (Material) Rating Spalling
RCPRAT	RCP Structural Rating
RCPCC	RCP Structural Rating Cracks and Conditions
RCPSTRCCC	RCP Structural Rating Cracks and Conditions Comments (See attached rating sheet)
RCPJC	RCP Structural Rating Joint Condition
RCPSTRJCC	RCP Structural Rating Joint Condition Comments (See attached rating sheet)
RCPAL	RCP Structural Rating Alignment
RCPSTRALC	RCP Structural Rating Alignment Comments (See attached rating sheet)

TABLE 5 (Continued)

ABBREVIATED CODES FOR CSP AND RCP PC AND SAS DATABASE (Survey Data)

PART B - RCP SAS DATABASE (Continued)

RCP STRUCTURAL RATING

Cracks and conditions resulting from cracks

- 9 No cracking
- 8 Fine or short cracks in end sections
- 7 A Short or fine cracks in barrel sections
  - B Full coarse crack in an end section.
- 6 A One section with a full fine crack.
  - B One full coarse crack in each end section.
- 5 A Two sections with full fine cracks.
  - B One full open crack in an end section.
- 4 A One or two sections with full coarse cracks.
  - B Three or more sections with full fine cracks.
  - C One full open crack in both end sections plus other cracks coarse or fine.
- 3 A Two or more sections with two full coarse cracks.
  - B One or more section with three or four full coarse cracks.
  - C One or more sections with one full open plus one full coarse crack.
  - D One or both end sections broken into four or more pieces by open cracks.
- 2 A One or more sections with three or four full cracks at least two of which are open, separating pipe into two or more pieces, still in place.
  - B Slight shortening of vertical diameter.
  - C Faulting of cracks in any section.
- 1 A One or more sections broken into four or more separate pieces by open cracks.
  - B Pieces of sections loose or missing allowing undercutting or infiltration of fill.
- 0 Culvert in need of immediate replacement.

Joint Condition

- 9 All joints tight
- 8 One or more joints loosened less than 1/2 depth of bell and spigot.
- 7 A One intermediate joint loosened greater than 1/2 depth of bell and spigot.
  - B Both end joints loosened less than 1/2 depth of bell and spigot.
- 6 A Two intermediate joints loosened greater than 1/2 depth of bell and spigot.
  - B One end joint loosened greater than 1/2 depth of bell and spigot.
  - C Slight cracking of bells or spigots.
  - D Minor infiltration, exfiltration.
- 5 A Three intermediate joints loosened greater than 1/2 depth of bell and spigot.
  - B Both end joints loosened greater than 1/2 depth of bell and spigot.
  - C One end joint open.
  - D Minor cracking of bells or spigots.
  - E Moderate infiltration, exfiltration.
  - F Faulting of one or two joints less than 1".
- 4 A Four or more intermediate joints loosened greater than 1/2 depth of bell and spigot.
  - B Both end joints open exposing backfill.
  - C One end joint faulted less than 2".
  - D Moderate cracking of bells or spigots.
  - E Appreciable infiltration, exfiltration.
  - F Faulting of one or two intermediate joints greater than 1".
- 3 A One intermediate joint open exposing backfill.
  - B Both end joints deflected over 2".
  - C Significant cracking of bells or spigots.
  - D Major infiltration, exfiltration.
  - E Faulting of three or more intermediate joints greater than 1".
- 2 A Two or more intermediate joints open exposing backfill.
  - B End sections separated and dropped.
  - C Water ponding because of dislocation at joints.
  - D Severe cracking of bells or spigots.
  - E Advanced infiltration, exfiltration.
  - F Faulting of one or more intermediate joints greater than 2".
- 1 A Deflection of intermediate joints causing severe ponding of water or soils.
  - B Pipe partially filled causing significant flow problems.
  - C Several sections dropped at ends of pipe.
- 0 Failure of pipe due to joint failures causing no flow.

Alignment

- 9 Straight or smooth, new.
- 8 Slight deflection of pipe alignment, local areas, less than 1/4" in 10' length.
- 7 A Misalignment of joints 1/4 to 1/2" due to differential movement.
  - B Minor deflection of pipe alignment 1/4 to 1/2" in 10' length.
- 6 A Misalignment of joints 1/2 to 1" due to differential movement.
  - B Moderate deflection of pipe alignment without ponding water, 1/2 to 3/4" per 10' length.
- 5 A Misalignment of joints 1" to 2" due to differential movement.
  - B Significant deflection of pipe alignment, 3/4 to 1" per 10' length.
  - C Minor ponding of water or soil.
- 4 A Misalignment of joints greater than 2" due to differential movement.
  - B Appreciable deflection of pipe alignment, 1" to 2" per 10' length.
  - C Moderate ponding of water or soil.
  - D One end section open and slightly dropped.
- 3 A Major deflection of pipe alignment, 2 to 4" per 10' length.
  - B Significant ponding of water or soil.
  - C Both end sections open and slightly dropped.
- 2 A Advanced deflection of pipe alignment, 4 to 6" per 10' length.
  - B Advanced ponding of water or soil causing some flow constrictions.
  - C One or both end sections out of position.
- 1 A Alignment severe enough to impede proper flow, greater than 6" per 10' length.
  - B Pipe partially filled from ponding of water or soil.
- 0 Failure of pipe due to alignment failure causing no flow.

TABLE 6

SAMPLE OF SAS DATABASE FOR CSP

(Field and Laboratory Tests)

OBS	CO	PT	LM	DTIN	AGE	DUR	STR	MUS	RE4	SPR	SING	SPV	V2P	L12	L9	L3	L6	SB	PH	CHL	HARD	COND
1	ANDREW	Z	1.33	1950	39	4	9	22.4	1953	82	205	0.626	0.123	0.116	0.115	0.117	0.000	2200	6.5	20	128	0.343
2	ANDREW	Z	1.91	1950	39	0	9	23.1	1761	220	215	0.579	0.126	0.086	0.084	0.085	0.000	1800	7.3	34	176	0.490
3	ATCHISON	J	1.46	1950	39	4	8	36.5	1264	55	170	0.566	0.108	0.105	0.106	0.106	0.110	2700	7.1	7	178	0.325
4	ATCHISON	J	3.27	1950	39	7	9	21.7	2412	100	285	0.586	0.114	0.070	0.075	0.077	0.075	1800	7.4	18	216	0.550
5	HOLT	U	4.00	1961	28	8	9	27.9	3140	185	250	0.554	0.085	0.146	0.144	0.147	0.148	1400	7.3	11	248	0.735
6	HOLT	U	0.04	1961	28	4	9	22.8	2374	100	255	0.610	0.100	0.076	0.078	0.076	0.074	2200	7.1	8	174	0.429
7	ANDREW	H	11.22	1947	42	5	9	19.6	3408	120	290	0.601	0.097	0.112	0.113	0.109	0.000	1900	7.5	12	228	0.618
8	ANDREW	H	11.55	1947	42	8	8	18.8	2566	140	280	0.593	0.084	0.084	0.086	0.088	0.087	2100	7.3	9	90	0.283
9	GENTRY	BB	0.44	1961	28	8	9	23.4	1570	84	440	0.734	0.129	0.067	0.075	0.072	0.080	2200	7.1	11	142	0.410
10	GENTRY	BB	1.78	1961	28	4	9	24.2	1800	110	340	0.674	0.135	0.068	0.073	0.073	0.088	2000	7.1	12	210	0.559
11	GENTRY	Z	3.58	1941	48	0	8	15.9	2221	150	330	0.239	0.112	0.081	0.078	0.076	0.000	1200	7.6	67	328	0.930
12	GENTRY	Z	3.12	1941	48	3	4	22.9	2183	100	210	0.560	0.108	0.054	0.055	0.056	0.071	1600	7.5	16	270	0.710
13	ADAIR	N	1.03	1934	55	1	8	22.4	2106	70	220	0.532	0.135	0.062	0.068	0.066	0.000	1500	7.1	15	150	0.339
14	ADAIR	N	1.07	1934	55	7	8	26.0	1838	160	200	0.299	0.114	0.063	0.062	0.063	0.087	1300	7.1	16	180	0.390
15	HOWARD	SK	2.53	1938	51	0	8	58.2	1417	90	380	0.550	0.096	0.117	0.121	0.122	0.000	3200	7.3	9	250	0.310
16	HOWARD	SK	2.68	1938	51	4	7	57.3	1761	140	650	0.702	0.109	0.087	0.087	0.071	0.087	2000	7.3	4	360	0.320
17	HOWARD	SA	4.33	1947	42	3	9	51.2	2566	87	480	0.652	0.092	0.082	0.092	0.091	0.091	3700	6.7	3	230	0.239
18	HOWARD	SA	4.39	1947	42	0	8	62.3	2298	39	240	0.566	0.096	0.069	0.070	0.049	0.000	3400	6.9	4	240	0.220
19	HOWARD	DD	0.45	1963	26	7	8	55.2	1149	88	300	0.667	0.106	0.086	0.089	0.088	0.089	2400	7.3	5	420	0.360
20	HOWARD	DD	0.88	1963	26	1	9	64.0	2221	70	210	0.743	0.117	0.113	0.114	0.118	0.104	3500	7.4	8	390	0.390
21	LIVINGSTON	J	2.04	1933	56	7	8	61.8	1417	110	190	0.609	0.110	0.079	0.077	0.078	0.181	1800	7.6	4	112	0.412
22	LIVINGSTON	J	2.38	1933	56	7	9	48.3	880	120	190	0.575	0.079	0.090	0.090	0.083	0.095	1400	7.5	9	164	0.369
23	MERCER	M	6.40	1936	53	7	8	41.3	2757	470	300	0.460	0.106	0.107	0.112	0.110	0.153	2000	7.7	19	510	1.015
24	MERCER	M	6.52	1936	53	0	4	44.4	2144	84	310	0.492	0.121	0.075	0.078	0.078	0.000	2800	8.1	19	270	0.594
25	MERCER	A	0.40	1949	40	8	8	22.5	1110	120	280	0.514	0.118	0.062	0.068	0.069	0.069	1200	6.5	20	324	0.476
26	MERCER	A	2.15	1949	40	0	8	24.8	1646	84	860	0.629	0.115	0.074	0.080	0.081	0.000	2400	6.4	7	234	0.374
27	RANDOLPH	AA	0.49	1962	27	7	9	58.6	1264	61	330	0.687	0.105	0.079	0.085	0.082	0.086	1800	7.0	4	480	0.340
28	RANDOLPH	AA	0.85	1962	27	7	9	56.7	919	42	300	0.651	0.122	0.079	0.085	0.082	0.084	2100	7.0	5	380	0.285
29	SALINE	YY	1.15	1957	32	7	9	61.3	1072	64	350	0.670	0.093	0.088	0.099	0.113	0.089	2100	6.9	10	510	0.372
30	SALINE	YY	2.60	1957	32	0	8	54.5	1187	53	300	0.619	0.109	0.088	0.088	0.087	0.000	1800	7.1	13	290	0.310
31	LEWIS	J	1.94	1949	40	1	2	19.1	7277	1200	1100	0.633	0.072	0.072	0.077	0.077	0.000	2700	7.6	19	256	0.525
32	LEWIS	H	1.60	1962	27	1	7	28.9	2106	150	270	0.587	0.107	0.075	0.079	0.082	0.000	2100	7.5	12	296	0.687
33	LEWIS	H	1.85	1962	27	5	8	22.5	3600	390	610	0.608	0.102	0.102	0.107	0.103	0.107	3150	7.3	15	256	0.527
34	RALLS	N	0.42	1958	31	2	6	34.6	4021	3300	490	0.101	0.074	0.105	0.102	0.102	0.000	2600	7.1	83	348	0.434
35	RALLS	N	2.38	1958	31	5	7	7.4	9958	2700	1400	0.500	0.098	0.102	0.104	0.103	0.096	5900	7.4	10	132	0.296
36	RALLS	J	7.47	1979	10	9	8	18.2	2106	250	1600	0.759	0.124	0.062	0.057	0.058	0.062	2500	7.2	14	240	0.548
37	RALLS	J	9.00	1979	10	5	4	20.2	2566	240	390	0.744	0.103	0.062	0.057	0.058	0.092	4700	7.1	18	200	0.466
38	MARION	E	5.58	1936	53	1	7	27.2	2068	105	260	0.671	0.116	0.109	0.111	0.107	0.000	1900	7.4	23	262	0.838
39	MARION	E	6.65	1936	53	4	4	24.7	2643	180	220	0.630	0.123	0.079	0.080	0.081	0.081	2300	7.6	14	164	0.367
40	CLARK	FF	0.49	1963	26	5	9	34.5	2413	102	230	0.732	0.153	0.107	0.110	0.108	0.052	2900	7.1	23	298	0.592
41	CLARK	FF	1.92	1963	26	2	7	21.8	1609	84	180	0.541	0.144	0.074	0.080	0.081	0.074	2000	7.3	33	302	0.647
42	KNOX	E	1.94	1949	40	4	4	31.9	4979	190	380	0.639	0.103	0.176	0.174	0.175	0.139	2100	7.0	12	304	0.641
43	KNOX	E	4.68	1949	40	1	5	19.9	4213	300	460	0.645	0.096	0.109	0.109	0.112	0.000	2150	7.2	30	252	0.579
44	KNOX	K	4.33	1971	18	4	8	41.4	2260	130	190	0.629	0.109	0.072	0.072	0.079	0.079	3000	7.3	11	216	0.504
45	KNOX	K	5.04	1971	18	2	6	23.9	2413	90	160	0.696	0.149	0.057	0.064	0.061	0.000	2400	7.4	13	156	0.343
46	CASS	B	6.80	1936	53	1	8	24.8	1762	190	110	0.541	0.097	0.080	0.083	0.081	0.000	1800	7.1	11	276	0.609
47	CASS	58	6.50	1937	52	5	8	22.8	1685	120	220	0.599	0.116	0.086	0.084	0.083	0.047	1500	7.6	26	206	0.784
48	CASS	D	3.85	1947	42	0	4	21.0	2758	340	240	0.517	0.104	0.077	0.079	0.080	0.000	1500	7.3	19	192	0.603
49	CASS	D	4.00	1947	42	0	8	16.0	1302	130	360	0.632	0.090	0.057	0.058	0.058	0.058	1700	7.6	23	248	0.800
50	HENRY	CC	1.64	1957	32	5	9	28.8	4213	250	700	0.558	0.101	0.145	0.146	0.145	0.082	2000	7.5	12	256	0.718
51	HENRY	CC	3.31	1957	32	1	9	43.8	1532	110	130	0.630	0.102	0.123	0.109	0.110	0.000	2000	7.3	11	224	0.702
52	LAFAYETTE	M	4.77	1948	41	5	8	16.9	1417	120	220	0.922	0.115	0.059	0.056	0.050	0.053	1700	7.0	32	286	0.756
53	LAFAYETTE	M	6.25	1948	41	1	7	18.2	2758	260	330	0.515	0.096	0.070	0.074	0.077	0.083	2000	8.7	46	754	1.392
54	LAFAYETTE	FF	12.20	1958	31	1	3	23.5	1379	140	170	0.670	0.130	0.067	0.072	0.073	0.000	2800	7.0	10	100	0.276
55	LAFAYETTE	U	3.02	1960	29	7	9	23.1	2834	220	750	0.595	0.080	0.102	0.104	0.106	0.119	2900	7.4	11	184	0.476

TABLE 7

SAMPLE OF SAS DATABASE FOR RCP

(Field and Laboratory Tests)

OBS	CO	RT	LM	DTIN	AGE	DUR	STR	MOS	RE4	SING	V2P	SD	PH	CHL	HARD	COND
1	ANDREW	E	1.340	1976	13	8	6	21.1	2030	205	0.128	1200	7.5	26	290	0.696
2	ANDREW	E	2.080	1976	13	6	6	15.3	1800	380	0.109	2100	7.4	4	200	0.467
3	ANDREW	I-29	14.730	1964	25	6	4	26.3	2758	270	0.104	1600	7.7	16	104	0.534
4	ANDREW	I-29	15.150	1964	25	8	9	15.2	996	250	0.152	1100	7.4	74	388	1.021
5	ATCHISON	59	16.900	1927	62	8	3	16.6	2949	285	0.091	2000	7.5	10	186	0.485
6	ATCHISON	59	17.100	1927	62	8	7	32.4	2413	260	0.110	1700	7.1	63	314	0.794
7	HOLT	I-29	24.690	1971	18	8	9	17.7	2719	260	0.096	1900	7.2	76	198	0.680
8	GENTRY	136	17.100	1938	51	6	8	20.1	1609	230	0.123	1600	7.5	51	184	0.623
9	GENTRY	136	16.400	1938	51	8	6	13.6	3715	310	0.112	1100	7.6	86	428	1.138
10	GENTRY	136	10.700	1957	32	8	8	28.3	2528	295	0.092	3100	7.1	11	150	0.414
11	GENTRY	136	9.530	1957	32	6	5	17.8	2604	330	0.097	2200	7.3	15	158	0.424
12	ADAIR	63	4.910	1942	47	8	2	26.1	1149	160	0.134	2400	6.2	27	300	0.543
13	ADAIR	63	7.210	1942	47	8	9	38.6	1417	280	0.141	1400	6.2	58	260	0.623
14	LIVINGSTON	139	2.030	1947	42	9	4	45.6	3524	580	0.101	2200	7.2	6	182	0.410
15	LIVINGSTON	139	0.580	1947	42	9	8	57.9	2719	400	0.098	3700	7.7	3	120	0.292
16	MERCER	65	15.830	1941	48	8	7	10.3	1953	160	0.135	2700	7.1	11	192	0.432
17	MERCER	65	15.730	1941	48	8	9	9.6	1953	210	0.126	1800	7.3	33	264	0.644
18	MERCER	136	8.140	1973	16	9	6	21.9	1915	240	0.117	2100	7.3	11	188	0.425
19	MERCER	136	8.330	1973	16	9	5	10.6	1532	180	0.138	2200	7.3	2	106	0.259
20	SALINE	OLD40	0.850	1929	60	8	7	45.3	958	280	0.095	1300	8.2	118	226	0.663
21	SALINE	OLD40	2.550	1929	60	5	7	50.1	4213	420	0.108	2900	6.1	16	196	0.455
22	SALINE	OLD40	3.620	1929	60	6	8	36.1	6511	510	0.095	3100	7.6	10	142	0.313
23	LEWIS	16	11.720	1938	51	8	4	32.4	3447	510	0.110	2400	7.1	28	272	0.716
24	LEWIS	16	12.280	1938	51	6	7	23.1	5362	560	0.123	2800	7.2	49	238	0.570
25	LEWIS	61	6.510	1977	12	9	3	28.1	1915	180	0.124	1850	7.2	11	478	0.917
26	LEWIS	61	20.180	1977	12	9	8	21.8	4596	720	0.111	1850	7.0	20	330	0.598
27	RALLS	19	8.420	1938	51	6	5	24.4	996	120	0.128	1500	7.7	98	130	0.737
28	RALLS	19	7.190	1937	52	8	7	17.3	1724	200	0.133	2400	7.6	13	176	0.462
29	MARION	24	1.320	1935	54	7	3	28.0	3715	670	0.091	3550	7.3	21	290	0.600
30	MARION	24	1.940	1935	54	7	8	27.9	1226	250	0.143	2850	7.3	17	192	0.424
31	MARION	61	2.100	1971	18	9	1	23.4	5362	870	0.119	3500	7.0	37	230	0.518
32	PIKE	54	21.800	1968	21	9	9	19.4	2949	460	0.099	2650	7.2	11	222	0.470
33	PIKE	54	23.160	1968	21	9	2	20.4	4175	890	0.162	3400	6.9	7	238	0.490
34	KNOX	15	29.560	1937	52	7	1	25.8	2106	250	0.127	2000	7.3	9	118	0.229
35	KNOX	15	29.360	1937	52	8	5	25.2	2490	340	0.120	1800	7.3	15	128	0.296
36	CASS	58	13.700	1936	53	8	1	18.8	1685	460	0.099	1800	7.6	17	260	0.706
37	CASS	58	16.400	1936	53	8	6	12.6	958	82	0.114	1700	7.2	12	258	0.698
38	HENRY	K	4.000	1936	53	6	4	33.9	4979	110	0.093	1800	7.5	60	398	1.067
39	HENRY	K	4.900	1936	53	8	7	29.1	2221	100	0.120	2400	7.4	11	254	0.666
40	JOHNSON	13	0.130	1925	64	7	5	23.8	843	90	0.160	1900	7.6	75	208	0.641
41	JOHNSON	13	6.990	1925	64	7	7	39.3	1072	150	0.174	1900	7.4	38	264	0.754
42	JOHNSON	50	11.060	1967	22	9	6	45.6	881	140	0.119	1800	7.3	18	306	0.770
43	JOHNSON	50	11.240	1967	22	3	2	47.0	1341	100	0.130	2600	6.2	11	248	0.420
44	LAFAYETTE	13	22.900	1925	64	7	4	25.8	1149	260	0.149	1200	7.5	26	290	0.696
45	LAFAYETTE	13	23.300	1925	64	8	1	22.0	919	190	0.112	1800	7.2	42	220	0.762
46	LAFAYETTE	23	8.000	1934	55	4	6	27.4	1762	240	0.112	1800	7.4	37	244	0.584
47	LAFAYETTE	23	8.330	1934	55	8	1	32.6	2106	170	0.116	1700	7.4	26	260	0.671
48	LAFAYETTE	I-70	16.400	1962	27	8	4	33.7	843	80	0.137	1100	7.2	140	200	1.019
49	LAFAYETTE	I-70	17.440	1962	27	6	5	17.7	1072	100	0.161	1600	7.0	38	178	0.581
50	RAY	13	1.600	1943	46	8	7	23.1	1570	120	0.120	1600	6.7	14	200	0.511
51	COLE	50-63	7.600	1977	12	9	8	26.2	5745	280	0.137	1900	6.3	55	146	0.416
52	COLE	50-63	8.340	1977	12	9	2	24.5	2987	230	0.151	590	5.5	632	526	1.409
53	MILLER	54	20.331	1976	13	9	5	23.6	11873	1200	0.123	2000	5.8	27	216	0.418
54	MILLER	54	20.181	1976	13	9	8	27.4	8809	430	0.129	2200	6.1	26	116	0.280
55	BOONE	M	0.860	1935	54	9	2	25.0	2528	580	0.147	1700	7.0	105	240	0.672

TABLE 8

ABBREVIATED CODES FOR SAS DATABASE
(Field and Laboratory Tests)

PART A - CSP DATABASE

CO	County
RT	Route
LM	Logmile
DTIN	Date Installed
AGE	Age
DUR	Durability Rating (Material)
STR	Structural Rating
MOS	Moisture Content
RE4	4-Pin Resistance (ohms)
SPR	Soil-Pipe Resistance (ohms)
SING	Single Probe Resistance (ohms)
SPV	Soil-Pipe Voltage (volts)
V2P	2 Pin Voltage (volts)
L12	Pipe Thickness at 12:00 Position (inches)
L9	Pipe Thickness at 9:00 Position (inches)
L3	Pipe Thickness at 3:00 Position (inches)
L6	Pipe Thickness at 6:00 Position (inches)
SB	Soil Box Resistance (ohms)
PH	pH
CHL	Chloride Content (ppm)
HARD	Total Hardness ($CaCo_3$ mg/L)
COND	Conductance (Micro MHos)

PART B - RCP DATABASE

CO	County
RT	Route
LM	Logmile
DTIN	Date Installed
AGE	Age
DUR	Durability Rating (Material)
STR	Structural Rating
MOS	Moisture Content
RE4	4-Pin Resistance (ohms)
SING	Single Probe Resistance (ohms)
V2P	2 Pin Voltage Probe (Volts)
SB	Soil Box Resistance (minimum resistance) (ohms)
PH	pH
CHL	Chloride Content (ppm)
HARD	Total Hardness ($CaCO_3$ MG/L)
COND	Conductance (micro MHos)

TABLE 9

STATISTICAL SET-UP FOR
ALL SURVEY DATA ANALYZED BY PHYSICAL PLACEMENT

Combined District Data (CSP)

Dependent Variables	Independent Variables
Durability Rating (Material)	Age
Structural Rating	Slope
Structural Rating (Joint and Seam Condition)	Depth of Cover (Inlet)
Structural Rating (Alignment)	Depth of Cover (Outlet)

Combined District Data (RCP)

Dependent Variables	Independent Variables
Durability Rating (Material)	Age
Durability Rating (Softening)	Slope
Durability Rating (Weathering Above Flow Line)	Depth of Cover (Inlet)
Durability Rating (Erosive Losses)	Depth of Cover (Outlet)
Durability Rating (Spalling)	
Structural Rating	
Structural Rating (Cracks)	
Structural Rating (Joint Condition)	
Structural Rating (Alignment)	

Individual District Data (CSP)

Dependent Variables	Independent Variables
Durability Rating (Material)	Age
Structural Rating	Slope
Structural Rating (Joint and Seam Condition)	Depth of Cover (Inlet)
Structural Rating (Alignment)	Depth of Cover (Outlet)

Individual District Data (RCP)

Dependent Variables	Independent Variables
Durability Rating (Material)	Age
Durability Rating (Softening)	Slope
Durability Rating (Weathering Above Flow Line)	Depth of Cover (Inlet)
Durability Rating (Erosive Losses)	Depth of Cover (Outlet)
Durability Rating (Spalling)	
Structural Rating	
Structural Rating (Cracks)	
Structural Rating (Joint Condition)	
Structural Rating (Alignment)	

TABLE 10

STATISTICAL SET-UP FOR
ALL SURVEY DATA ANALYZED BY GEOLOGICAL AREA FOR CSP AND RCP

Analyses were conducted using data stratified as follows:

Forest Industry:

1. Normal Yield
2. High Yield

Surficial Materials:

1. Clay, silt, sand and gravel mix
2. Silt, clay
3. Chert, clay, and colluvium
4. Alluvial sand

Shale, Clay, and Silica Sand:

1. Thin shale
2. Clays

Minerals:

1. Lead Zinc Mining
2. Barite
3. Coal Mining
    a. Normal Yield
    b. High Yield

Ground Water Yields From Bedrock:

1. Saline water low yields
2. Drawdown (gal/min/ft)
    a. 20-40
    b. 10-20
    c. 2-10
    d. <2

Water Quality in Bedrock:

1. Sodium Sulfate
    a. > 10,000
    b. 1,000 - 10,000
    c. 200 - 1,000
2. Sodium Bicarbonate

TABLE 10 (Continued)

STATISTICAL SET-UP FOR
ALL SURVEY DATA ANALYZED BY GEOLOGICAL AREA FOR CSP AND RCP

Variables included in each of the above groups:

CSP:

Dependent Variables	Independent Variables
Durability Rating (Material)	Age
Structural Rating	Slope
Structural Rating (Joint and Seam Condition)	Depth of Cover (Inlet)
Structural Rating (Alignment)	Depth of Cover (Outlet)

RCP:

Dependent Variables	Independent Variables
Durability Rating (Material)	Age
Durability Rating (Softening)	Slope
Durability Rating (Weathering Above Flow Line)	Depth of Cover (Inlet)
Durability Rating (Erosive Losses)	Depth of Cover (Outlet)
Durability Rating (Spalling)	
Structural Rating	
Structural Rating (Cracks)	
Structural Rating (Joint Condition)	
Structural Rating (Alignment)	

TABLE 11

STATISTICAL SET-UP FOR
ALL SURVEY DATA STRATIFIED BY WATERSHED AREAS

Analyses were conducted using data stratified into seven watershed areas as follows:

1. Cropland
2. Livestock
3. Forest
4. Mining
5. Vegetation/Pasture
6. Residential
7. Other

Variables included in each of the above groups:

CSP:

Dependent Variables	Independent Variables
Durability Rating	Age
Structural Rating	
Structural Rating (Joint Condition)	
Structural Rating (Alignment)	

RCP:

Dependent Variables	Independent Variables
Durability Rating	Age
Durability Rating (Softening)	
Durability Rating (Weathering Above Flow Line)	
Durability Rating (Erosive Losses)	
Durability Rating (Spalling)	
Structural Rating	
Structural Rating (Cracks)	
Structural Rating (Joint Condition)	
Structural Rating (Alignment)	

TABLE 12

STATISTICAL SET-UP FOR
<u>FIELD AND LABORATORY TESTS FOR CSP AND RCP</u>

Regressions were conducted using data from laboratory and field testing conducted by research office personnel. Data were stratified into four groups for testing as follows:

1. Field tests associated with CSP
2. Laboratory tests associated with CSP
3. Field tests associated with RCP
4. Laboratory tests associated with RCP

Variables included in each of the above groups:

1. **Field Tests (CSP)**

Dependent Variables	Independent Variables
Structural Rating	Voltage (2-Pin)
Durability Rating	Resistance (Single Probe)
	Resistance (4-Pin)
	Resistance (Soil Pipe)
	Moisture
	Voltage (Single Probe)
	Thickness at 12 Position
	Thickness at 9 Position
	Thickness at 6 Position
	Thickness at 3 Position
	Age

2. **Field Tests (RCP)**

Dependent Variables	Independent Variables
Structural Rating	Resistance (Single Probe)
Durability Rating	Voltage (2-Pin)
	Resistance (4-Pin)
	Moisture
	Age

3. **Laboratory Tests (CSP and RCP)**

Dependent Variables	Independent Variables
Structural Rating	Soil Box (minimum resistance)
Durability Rating	pH
	Chloride Content
	Total Water Hardness
	Conductance
	Age

TABLE 13

RESULTS OF STATISTICAL ANALYSIS BY COMBINED DISTRICTS FOR CSP
(N=2255)

Dependent Variables	Independent Variables	R^2
Durability Rating (Material)	Age	0.06
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00

TABLE 14

RESULTS OF STATISTICAL ANALYSIS BY
COMBINED DISTRICTS FOR RCP
(N=1642)

Dependent Variables	Independent Variables	R^2
Durability Rating (Material)	Age	0.14
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Softening)	Age	0.04
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Weathering Above Flow Line)	Age	0.07
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Durability Rating (Erosive Losses)	Age	0.12
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Durability Rating (Spalling)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.08
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.08
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.11
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01

TABLE 15

RESULTS OF STATISTICAL ANALYSIS BY
INDIVIDUAL DISTRICT FOR CSP

Dependent Variable	Independent Variable	R^2 Values by Districts									
		1	2	3	4	5	6	7	8	9	10
Durability Rating (Material)	Age	0.26	0.01	0.38	0.42	0.30	0.04	0.18	0.08	0.04	0.13
	Slope	0.02	0.01	0.00	0.00	0.00	0.00	0.08	0.05	0.01	0.00
	Depth of Cover Inlet	0.03	0.01	0.09	0.00	0.03	0.00	0.04	0.02	0.02	0.07
	Depth of Cover Outlet	0.01	0.01	0.08	0.00	0.03	0.00	0.07	0.02	0.04	0.02
Structural Rating	Age	0.04	0.01	0.09	0.05	0.02	0.06	0.18	0.05	0.00	0.06
	Slope	0.02	0.03	0.00	0.02	0.00	0.19	0.01	0.00	0.00	0.05
	Depth of Cover Inlet	0.00	0.03	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00
	Depth of Cover Outlet	0.00	0.05	0.00	0.03	0.00	0.17	0.02	0.00	0.00	0.04
Structural Rating (Joints and Seams)	Age	0.01	0.06	0.08	0.04	0.01	0.12	0.13	0.01	0.01	0.02
	Slope	0.00	0.10	0.01	0.02	0.00	0.23	0.00	0.00	0.00	0.01
	Depth of Cover Inlet	0.01	0.00	0.00	0.01	0.01	0.00	0.02	0.00	0.00	0.00
	Depth of Cover Outlet	0.01	0.00	0.00	0.03	0.00	0.05	0.01	0.00	0.00	0.00
Structural Rating (Alignment)	Age	0.04	0.00	0.08	0.07	0.03	0.03	0.12	0.06	0.00	0.07
	Slope	0.03	0.04	0.01	0.03	0.00	0.31	0.02	0.00	0.00	0.07
	Depth of Cover Inlet	0.00	0.03	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
	Depth of Cover Outlet	0.00	0.07	0.00	0.03	0.00	0.14	0.01	0.00	0.00	0.04
Observations (N)		(231)	(249)	(297)	(162)	(263)	(73)	(201)	(275)	(294)	(210)

TABLE 16

RESULTS OF STATISTICAL ANALYSIS BY
INDIVIDUAL DISTRICT FOR RCP

Dependent Variable	Independent Variable	R^2 Values by Districts 1	2	3	4	5	6	7	8	9	10
Durability Rating (Material)	Age	0.02	0.26	0.37	0.19	0.21	0.00	0.16	0.10	0.15	0.17
	Slope	0.01	0.03	0.01	0.01	0.03	0.00	0.02	0.00	0.00	0.01
	Depth of Cover Inlet	0.00	0.03	0.05	0.01	0.05	0.05	0.01	0.01	0.00	0.00
	Depth of Cover Outlet	0.00	0.04	0.07	0.00	0.04	0.06	0.01	0.01	0.00	0.00
Durability Rating (Softening)	Age	0.01	0.08	0.00	0.26	0.03	0.02	0.17	0.02	0.18	0.01
	Slope	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.00	0.00	0.03
	Depth of Cover Inlet	0.00	0.00	0.00	0.01	0.01	0.03	0.00	0.00	0.01	0.00
	Depth of Cover Outlet	0.00	0.01	0.00	0.01	0.01	0.05	0.01	0.00	0.00	0.00
Durability Rating (Weathering Above Flow Line)	Age	0.11	0.04	0.03	0.29	0.06	0.00	0.08	0.06	0.20	0.07
	Slope	0.00	0.00	0.01	0.01	0.05	0.00	0.01	0.01	0.02	0.00
	Depth of Cover Inlet	0.04	0.00	0.00	0.01	0.01	0.07	0.01	0.01	0.02	0.01
	Depth of Cover Outlet	0.04	0.01	0.01	0.01	0.01	0.08	0.01	0.02	0.03	0.02
Durability Rating (Erosive Losses)	Age	0.06	0.18	0.36	0.18	0.29	0.01	0.07	0.09	0.15	0.17
	Slope	0.02	0.04	0.01	0.01	0.04	0.00	0.00	0.00	0.00	0.01
	Depth of Cover Inlet	0.04	0.04	0.05	0.02	0.06	0.09	0.00	0.01	0.00	0.00
	Depth of Cover Outlet	0.04	0.04	0.07	0.02	0.05	0.10	0.02	0.01	0.01	0.00
Durability Rating (Spalling)	Age	0.01	0.05	0.04	0.14	0.04	0.01	0.14	0.03	0.07	0.02
	Slope	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.00	0.00
	Depth of Cover Inlet	0.00	0.02	0.00	0.00	0.01	0.10	0.03	0.00	0.04	0.01
	Depth of Cover Outlet	0.00	0.03	0.01	0.00	0.01	0.10	0.04	0.01	0.01	0.01
Structural Rating	Age	0.05	0.03	0.15	0.10	0.19	0.04	0.22	0.04	0.11	0.25
	Slope	0.02	0.01	0.04	0.07	0.00	0.00	0.00	0.04	0.01	0.12
	Depth of Cover Inlet	0.01	0.03	0.00	0.00	0.10	0.01	0.03	0.00	0.04	0.00
	Depth of Cover Outlet	0.00	0.05	0.00	0.01	0.11	0.01	0.04	0.00	0.02	0.03

TABLE 16 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY
INDIVIDUAL DISTRICT FOR RCP

		R^2 Values by Districts									
Dependent Variable	Independent Variable	1	2	3	4	5	6	7	8	9	10
Structural Rating (Cracks)	Age	0.02	0.01	0.01	0.00	0.01	0.19	0.24	0.07	0.02	0.02
	Slope	0.00	0.01	0.01	0.00	0.00	0.55	0.01	0.01	0.00	0.01
	Depth of Cover Inlet	0.00	0.00	0.01	0.04	0.01	0.00	0.04	0.01	0.00	0.00
	Depth of Cover Outlet	0.01	0.00	0.00	0.06	0.03	0.00	0.03	0.00	0.00	0.00
Structural Rating (Joint Condition)	Age	0.04	0.03	0.21	0.16	0.21	0.02	0.09	0.00	0.14	0.22
	Slope	0.02	0.01	0.07	0.07	0.00	0.00	0.00	0.03	0.00	0.14
	Depth of Cover Inlet	0.02	0.03	0.00	0.01	0.10	0.03	0.01	0.00	0.04	0.00
	Depth of Cover Outlet	0.00	0.04	0.00	0.00	0.12	0.03	0.03	0.00	0.03	0.03
Structural Rating (Alignment)	Age	0.10	0.01	0.30	0.26	0.16	0.01	0.09	0.09	0.06	0.21
	Slope	0.01	0.00	0.02	0.14	0.01	0.00	0.00	0.01	0.00	0.10
	Depth of Cover Inlet	0.04	0.00	0.08	0.03	0.05	0.02	0.01	0.02	0.02	0.01
	Depth of Cover Outlet	0.03	0.00	0.07	0.01	0.05	0.01	0.04	0.00	0.01	0.04
Observations (N)		(192)	(156)	(188)	(166)	(157)	(103)	(166)	(176)	(190)	(148)

TABLE 17

CORRELATION OF DURABILITY AND STRUCTURAL RATINGS USING ALL SURVEY DATA FOR CSP AND RCP

CSP: Durability Rating
(N=2255)

Durability of CSP was rated on penetration of corrosion

RCP: Durability Rating
(N=1642)

	R
Durability Rating (Material) Vs. Softening	0.59
Durability Rating (Material) Vs. Weathering Above Flow Line	0.52
Durability Rating (Material) Vs. Erosive Losses	0.85
Durability Rating (Material) Vs. Spalling	0.58

CSP: Structural Rating
(N=2255)

Structural Rating Vs. Joint and Seam Condition	0.66
Structural Rating Vs. Alignment	0.94

RCP: Structural Rating
(N=1642)

Structural Rating Vs. Cracks and Condition	0.47
Structural Rating Vs. Joint Condition	0.90
Structural Rating Vs. Alignment	0.76

TABLE 18

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
	(Forest Industry: Normal Yield) (N=985)	
Durability Rating (Material)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.00
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
	(Forest Industry: High Yield) (N=225)	
Durability Rating (Material)	Age	0.20
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating	Age	0.06
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.11
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.06
	Slope	0.00
	Depth of Cover Inlet	0.53
	Depth of Cover Outlet	0.17

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
(Surficial Material: Clay, Silt, and Sand and Gravel Mix) (N=813)		
Durability Rating (Material)	Age	0.16
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.03
	Slope	0.02
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Joints and Seams)	Age	0.03
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.02
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
(Surficial Material: Silt, Clay) (N=121)		
Durability Rating (Material)	Age	0.24
	Slope	0.02
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.06
	Slope	0.02
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.02
Structural Rating (Joints and Seams)	Age	0.00
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.09
	Slope	0.02
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
(Surficial Material: Chert, Clay, and Colluvium) (N=1069)		
Durability Rating (Material)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating	Age	0.01
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.01
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
(Surficial Material: Alluvial Sand) (N=61)		
Durability Rating (Material)	Age	0.13
	Slope	0.02
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.04
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.03
Structural Rating (Alignment)	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
(Shale, Clay, and Silica Sand: Thin Shale) (N=712)		
Durability Rating (Material)	Age	0.15
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.03
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Alignment)	Age	0.03
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
(Shale, Clay, and Silica Sand: Clays) (N=140)		
Durability Rating (Material)	Age	0.44
	Slope	0.01
	Depth of Cover Inlet	0.09
	Depth of Cover Outlet	0.08
Structural Rating	Age	0.07
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.09
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.06
	Slope	0.03
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
(Minerals: Lead-Zinc Mining) (N=115)		
Durability Rating (Material)	Age	0.36
	Slope	0.00
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.05
Structural Rating	Age	0.07
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.12
	Slope	0.02
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03
Structural Rating (Alignment)	Age	0.07
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
(Minerals: Barite) (N=87)		
Durability Rating (Material)	Age	0.12
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.04
Structural Rating	Age	0.03
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
	(Coal Mining: Normal Yield) (N=853)	
Durability Rating (Material)	Age	0.16
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.04
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.02
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
Structural Rating (Alignment)	Age	0.04
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
	(Coal Mining: High Yield) (N=108)	
Durability Rating (Material)	Age	0.08
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating	Age	0.05
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Joints and Seams)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.05
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
(Ground Water From Bedrock: Saline Water Low Yields) (N=191)		
Durability Rating (Material)	Age	0.35
	Slope	0.02
	Depth of Cover Inlet	0.11
	Depth of Cover Outlet	0.11
Structural Rating	Age	0.10
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.10
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.08
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
(Ground Water From Bedrock: 20-40 Gal. Drawdown) (N=67)		
Durability Rating (Material)	Age	0.29
	Slope	0.00
	Depth of Cover Inlet	0.09
	Depth of Cover Outlet	0.09
Structural Rating	Age	0.12
	Slope	0.00
	Depth of Cover Inlet	0.10
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.05
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Alignment)	Age	0.14
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
(Ground Water From Bedrock: 10-20 Gal. Drawdown) (N=36)		
Durability Rating (Material)	Age	0.02
	Slope	0.08
	Depth of Cover Inlet	0.05
	Depth of Cover Outlet	0.10
Structural Rating	Age	0.01
	Slope	0.07
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.03
Structural Rating (Joints and Seams)	Age	0.02
	Slope	0.04
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.09
	Slope	0.14
	Depth of Cover Inlet	0.07
	Depth of Cover Outlet	0.12
(Ground Water From Bedrock: 2-10 Gal. Drawdown) (N=590)		
Durability Rating (Material)	Age	0.03
	Slope	0.01
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.02
Structural Rating	Age	0.00
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Alignment)	Age	0.00
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
(Ground Water From Bedrock: <2 Gal. Drawdown) (N=321)		
Durability Rating (Material)	Age	0.16
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating	Age	0.05
	Slope	0.04
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.02
Structural Rating (Joints and Seams)	Age	0.05
	Slope	0.04
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
Structural Rating (Alignment)	Age	0.05
	Slope	0.04
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.02
(Water Quality in Bedrock: Sodium Sulfate >10,000) (N=97)		
Durability Rating (Material)	Age	0.45
	Slope	0.03
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.10
	Slope	0.03
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.06
Structural Rating (Joints and Seams)	Age	0.08
	Slope	0.04
	Depth of Cover Inlet	0.05
	Depth of Cover Outlet	0.06
Structural Rating (Alignment)	Age	0.07
	Slope	0.08
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.12

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
(Water Quality in Bedrock: Sodium Sulfate 1,000-10,000) (N=711)		
Durability Rating (Material)	Age	0.13
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.02
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.02
	Slope	0.02
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Alignment)	Age	0.02
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
(Water Quality in Bedrock: Sodium Sulfate 200-1,000) (N=1075)		
Durability Rating (Material)	Age	0.16
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating	Age	0.06
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.06
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00

TABLE 18 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR CSP

Dependent Variables	Independent Variables	R^2
(Water Quality in Bedrock: Sodium Bicarbonate) (N=73)		
Durability Rating (Material)	Age	0.10
	Slope	0.03
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joints and Seams)	Age	0.03
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.02
Structural Rating (Alignment)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00

TABLE 19

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
	(Forest Industry: Normal Yield) (N=651)	
Durability Rating (Material)	Age	0.14
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Softening)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Durability Rating (Weathering Above Flow Line)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03
Durability Rating (Erosive Losses)	Age	0.14
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Spalling)	Age	0.03
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.10
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Cracks)	Age	0.03
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.10
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Alignment)	Age	0.09
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
	(Forest Industry: High Yield) (N=152)	
Durability Rating (Material)	Age	0.14
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Durability Rating (Softening)	Age	0.16
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Durability Rating (Weathering Above Flow Line)	Age	0.18
	Slope	0.04
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03
Durability Rating (Erosive Losses)	Age	0.14
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
Durability Rating (Spalling)	Age	0.24
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.13
	Slope	0.04
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.16
	Slope	0.05
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating (Alignment)	Age	0.12
	Slope	0.03
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Surficial Material: Clay, Silt, and Sand and Gravel) (N=565)		
Durability Rating (Material)	Age	0.19
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03
Durability Rating (Softening)	Age	0.03
	Slope	0.03
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Durability Rating (Weathering Above Flow Line)	Age	0.06
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Erosive Losses)	Age	0.13
	Slope	0.03
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.04
Durability Rating (Spalling)	Age	0.03
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.08
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.10
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.12
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
	(Surficial Material: Silt, Clay) (N=107)	
Durability Rating (Material)	Age	0.28
	Slope	0.03
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.02
Durability Rating (Softening)	Age	0.42
	Slope	0.07
	Depth of Cover Inlet	0.05
	Depth of Cover Outlet	0.05
Durability Rating (Weathering Above Flow Line)	Age	0.40
	Slope	0.02
	Depth of Cover Inlet	0.05
	Depth of Cover Outlet	0.06
Durability Rating (Erosive Losses)	Age	0.26
	Slope	0.05
	Depth of Cover Inlet	0.06
	Depth of Cover Outlet	0.05
Durability Rating (Spalling)	Age	0.19
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.23
	Slope	0.03
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Cracks)	Age	0.04
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
Structural Rating (Joint Condition)	Age	0.24
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.33
	Slope	0.03
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.04

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Surficial Material: Chert, Clay and Colluvium) (N=721)		
Durability Rating (Material)	Age	0.10
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Softening)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Weathering Above Flow Line)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.03
Durability Rating (Erosive Losses)	Age	0.10
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Spalling)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.08
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating (Cracks)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Joint Condition)	Age	0.07
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating (Alignment)	Age	0.07
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
	(Surficial Material: Alluvial Sand) (N=53)	
Durability Rating (Material)	Age	0.29
	Slope	0.07
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.04
Durability Rating (Softening)	Age	0.02
	Slope	0.06
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03
Durability Rating (Weathering Above Flow Line)	Age	0.17
	Slope	0.04
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.04
Durability Rating (Erosive Losses)	Age	0.28
	Slope	0.07
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.04
Durability Rating (Spalling)	Age	0.05
	Slope	0.06
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03
Structural Rating	Age	0.30
	Slope	0.08
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.03
Structural Rating (Cracks)	Age	0.05
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.30
	Slope	0.10
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.05
Structural Rating (Alignment)	Age	0.24
	Slope	0.14
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.05

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Shale, Clay, and Silica Sand: Thin Shale) (N=565)		
Durability Rating (Material)	Age	0.15
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Softening)	Age	0.13
	Slope	0.06
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Weathering Above Flow Line)	Age	0.16
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Erosive Losses)	Age	0.11
	Slope	0.01
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.03
Durability Rating (Spalling)	Age	0.06
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.07
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.00
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.10
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.14
	Slope	0.02
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Shale, Clay, and Silica Sand: Clays) (N=67)		
Durability Rating (Material)	Age	0.31
	Slope	0.00
	Depth of Cover Inlet	0.12
	Depth of Cover Outlet	0.14
Durability Rating (Softening)	Age	0.04
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Weathering Above Flow Line)	Age	0.28
	Slope	0.04
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.06
Durability Rating (Erosive Losses)	Age	0.48
	Slope	0.01
	Depth of Cover Inlet	0.20
	Depth of Cover Outlet	0.24
Durability Rating (Spalling)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.19
	Slope	0.08
	Depth of Cover Inlet	0.11
	Depth of Cover Outlet	0.09
Structural Rating (Cracks)	Age	0.02
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating (Joint Condition)	Age	0.19
	Slope	0.12
	Depth of Cover Inlet	0.08
	Depth of Cover Outlet	0.06
Structural Rating (Alignment)	Age	0.19
	Slope	0.11
	Depth of Cover Inlet	0.10
	Depth of Cover Outlet	0.06

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
	(Minerals: Lead-Zinc Mining) (N=88)	
Durability Rating (Material)	Age	0.09
	Slope	0.03
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Softening)	Age	0.05
	Slope	0.07
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.12
Durability Rating (Weathering Above Flow Line)	Age	0.00
	Slope	0.09
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.07
Durability Rating (Erosive Losses)	Age	0.02
	Slope	0.04
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Durability Rating (Spalling)	Age	0.06
	Slope	0.12
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.05
Structural Rating	Age	0.11
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.05
Structural Rating (Cracks)	Age	0.20
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.04
Structural Rating (Joint Condition)	Age	0.08
	Slope	0.02
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.07
Structural Rating (Alignment)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.02

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
	(Minerals: Barite) (N=69)	
Durability Rating (Material)	Age	0.38
	Slope	0.11
	Depth of Cover Inlet	0.19
	Depth of Cover Outlet	0.14
Durability Rating (Softening)	Age	0.12
	Slope	0.01
	Depth of Cover Inlet	0.07
	Depth of Cover Outlet	0.07
Durability Rating (Weathering Above Flow Line)	Age	0.12
	Slope	0.07
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.00
Durability Rating (Erosive Losses)	Age	0.38
	Slope	0.11
	Depth of Cover Inlet	0.19
	Depth of Cover Outlet	0.14
Durability Rating (Spalling)	Age	0.07
	Slope	0.02
	Depth of Cover Inlet	0.11
	Depth of Cover Outlet	0.11
Structural Rating	Age	0.10
	Slope	0.01
	Depth of Cover Inlet	0.07
	Depth of Cover Outlet	0.09
Structural Rating (Cracks)	Age	0.00
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.12
	Slope	0.02
	Depth of Cover Inlet	0.07
	Depth of Cover Outlet	0.11
Structural Rating (Alignment)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.05

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
	(Coal Mining: Normal Yield) (N=651)	
Durability Rating (Material)	Age	0.13
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Softening)	Age	0.11
	Slope	0.04
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Durability Rating (Weathering Above Flow Line)	Age	0.15
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Erosive Losses)	Age	0.09
	Slope	0.01
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.03
Durability Rating (Spalling)	Age	0.05
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.08
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.09
	Slope	0.03
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.15
	Slope	0.03
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.02

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
	(Coal Mining: High Yield) (N=76)	
Durability Rating (Material)	Age	0.28
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Durability Rating (Softening)	Age	0.11
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Durability Rating (Weathering Above Flow Line)	Age	0.11
	Slope	0.02
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03
Durability Rating (Erosive Losses)	Age	0.20
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Durability Rating (Spalling)	Age	0.10
	Slope	0.01
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.04
Structural Rating	Age	0.19
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating (Cracks)	Age	0.08
	Slope	0.02
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.04
Structural Rating (Joint Condition)	Age	0.13
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.14
	Slope	0.03
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Ground Water From Bedrock: Saline Water Low Yield) (N=129)		
Durability Rating (Material)	Age	0.62
	Slope	0.00
	Depth of Cover Inlet	0.06
	Depth of Cover Outlet	0.07
Durability Rating (Softening)	Age	0.00
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Durability Rating (Weathering Above Flow Line)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Durability Rating (Erosive Losses)	Age	0.61
	Slope	0.00
	Depth of Cover Inlet	0.06
	Depth of Cover Outlet	0.07
Durability Rating (Spalling)	Age	0.11
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.34
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.11
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
Structural Rating (Joint Condition)	Age	0.35
	Slope	0.05
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.54
	Slope	0.00
	Depth of Cover Inlet	0.08
	Depth of Cover Outlet	0.09

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Ground Water From Bedrock: 20-40 Gal. Drawdown) (N=55)		
Durability Rating (Material)	Age	0.18
	Slope	0.09
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Durability Rating (Softening)	Age	0.05
	Slope	0.03
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00
Durability Rating (Weathering Above Flow Line)	Age	0.32
	Slope	0.03
	Depth of Cover Inlet	0.10
	Depth of Cover Outlet	0.03
Durability Rating (Erosive Losses)	Age	0.15
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
Durability Rating (Spalling)	Age	0.21
	Slope	0.02
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.31
	Slope	0.01
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.01
Structural Rating (Cracks)	Age	0.04
	Slope	0.01
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.01
Structural Rating (Joint Condition)	Age	0.36
	Slope	0.01
	Depth of Cover Inlet	0.07
	Depth of Cover Outlet	0.03
Structural Rating (Alignment)	Age	0.30
	Slope	0.00
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.01

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Ground Water From Bedrock: 10-20 Gal. Drawdown) (N=40)		
Durability Rating (Material)	Age	0.16
	Slope	0.06
	Depth of Cover Inlet	0.14
	Depth of Cover Outlet	0.11
Durability Rating (Softening)	Age	0.17
	Slope	0.09
	Depth of Cover Inlet	0.06
	Depth of Cover Outlet	0.03
Durability Rating (Weathering Above Flow Line)	Age	0.26
	Slope	0.01
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.02
Durability Rating (Erosive Losses)	Age	0.16
	Slope	0.06
	Depth of Cover Inlet	0.14
	Depth of Cover Outlet	0.11
Durability Rating (Spalling)	Age	0.07
	Slope	0.17
	Depth of Cover Inlet	0.10
	Depth of Cover Outlet	0.07
Structural Rating	Age	0.12
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.00
	Slope	0.00
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.03
Structural Rating (Joint Condition)	Age	0.17
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.04
	Slope	0.14
	Depth of Cover Inlet	0.06
	Depth of Cover Outlet	0.05

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Ground Water From Bedrock: 2-10 Gal. Drawdown) (N=388)		
Durability Rating (Material)	Age	0.16
	Slope	0.02
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.05
Durability Rating (Softening)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03
Durability Rating (Weathering Above Flow Line)	Age	0.07
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.04
Durability Rating (Erosive Losses)	Age	0.19
	Slope	0.03
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.04
Durability Rating (Spalling)	Age	0.06
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.03
Structural Rating	Age	0.09
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating (Cracks)	Age	0.06
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating (Joint Condition)	Age	0.07
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating (Alignment)	Age	0.06
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Ground Water From Bedrock: <2 Drawdown) (N=244)		
Durability Rating (Material)	Age	0.07
	Slope	0.01
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.04
Durability Rating (Softening)	Age	0.00
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.04
Durability Rating (Weathering Above Flow Line)	Age	0.00
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.05
Durability Rating (Erosive Losses)	Age	0.06
	Slope	0.01
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.04
Durability Rating (Spalling)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.04
Structural Rating	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.00
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.02
Structural Rating (Alignment)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.02

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY
GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Water Quality in Bedrock: Sodium Sulfate >10,000) (N=89)		
Durability Rating (Material)	Age	0.16
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Softening)	Age	0.08
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Durability Rating (Weathering Above Flow Line)	Age	0.09
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
Durability Rating (Erosive Losses)	Age	0.11
	Slope	0.02
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.03
Durability Rating (Spalling)	Age	0.10
	Slope	0.02
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating	Age	0.04
	Slope	0.14
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.01
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.04
Structural Rating (Joint Condition)	Age	0.12
	Slope	0.16
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.13
	Slope	0.27
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.00

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Water Quality in Bedrock: Sodium Sulfate 1,000-10,000) (N=529)		
Durability Rating (Material)	Age	0.21
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Durability Rating (Softening)	Age	0.08
	Slope	0.04
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Weathering Above Flow Line)	Age	0.11
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Durability Rating (Erosive Losses)	Age	0.17
	Slope	0.02
	Depth of Cover Inlet	0.04
	Depth of Cover Outlet	0.04
Durability Rating (Spalling)	Age	0.05
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.11
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Cracks)	Age	0.03
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
Structural Rating (Joint Condition)	Age	0.13
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Alignment)	Age	0.16
	Slope	0.00
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.03

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Water Quality in Bedrock: Sodium Sulfate 200-1,000) (N=700)		
Durability Rating (Material)	Age	0.09
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Softening)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.01
Durability Rating (Weathering Above Flow Line)	Age	0.04
	Slope	0.00
	Depth of Cover Inlet	0.03
	Depth of Cover Outlet	0.03
Durability Rating (Erosive Losses)	Age	0.10
	Slope	0.01
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.02
Durability Rating (Spalling)	Age	0.02
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating	Age	0.08
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01
Structural Rating (Cracks)	Age	0.01
	Slope	0.00
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.01
Structural Rating (Joint Condition)	Age	0.08
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Structural Rating (Alignment)	Age	0.08
	Slope	0.01
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.01

TABLE 19 (Continued)

RESULTS OF STATISTICAL ANALYSIS BY GEOLOGICAL AREA FOR RCP

Dependent Variables	Independent Variables	R^2
(Water Quality in Bedrock: Sodium Bicarbonate) (N=66)		
Durability Rating (Material)	Age	0.24
	Slope	0.03
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Durability Rating (Softening)	Age	0.02
	Slope	0.04
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.02
Durability Rating (Weathering Above Flow Line)	Age	0.16
	Slope	0.00
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Durability Rating (Erosive Losses)	Age	0.24
	Slope	0.03
	Depth of Cover Inlet	0.02
	Depth of Cover Outlet	0.02
Durability Rating (Spalling)	Age	0.04
	Slope	0.04
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.02
Structural Rating	Age	0.30
	Slope	0.07
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.03
Structural Rating (Cracks)	Age	0.05
	Slope	0.01
	Depth of Cover Inlet	0.00
	Depth of Cover Outlet	0.00
Structural Rating (Joint Condition)	Age	0.28
	Slope	0.06
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.04
Structural Rating (Alignment)	Age	0.24
	Slope	0.11
	Depth of Cover Inlet	0.01
	Depth of Cover Outlet	0.06

TABLE 20

RESULTS OF STATISTICAL ANALYSIS OF
ALL SURVEY DATA STRATIFIED BY WATERSHED AREAS FOR CSP

		R^2 Values By						
Dependent Variable	Independent Variable	Cropland	Livestock	Forest	Mining	Vegetation/ Pasture	Residential	Other
Durability Rating (Material)	Age	0.22	0.11	0.13	0.40	0.16	0.30	0.00
Structural Rating	Age	0.05	0.07	0.06	0.06	0.04	0.13	0.26
Structural Rating (Joint Condition)	Age	0.05	0.10	0.07	0.00	0.03	0.06	0.34
Structural Rating (Alignment)	Age	0.05	0.06	0.06	0.06	0.04	0.12	0.13
Observation (N)		(616)	(308)	(607)	(6)	(1183)	(176)	(17)

TABLE 21

RESULTS OF STATISTICAL ANALYSIS OF ALL SURVEY DATA STRATIFIED BY WATERSHED AREAS FOR RCP

Dependent Variable	Independent Variable	R^2 Values By Cropland	Livestock	Forest	Mining	Vegetation/ Pasture	Residential	Other
Durability Rating (Material)	Age	0.16	0.20	0.09	0.52	0.19	0.09	0.13
Durability Rating (Softening)	Age	0.05	0.13	0.04	0.92	0.06	0.00	0.26
Durability Rating (Weathering Above Flow Line)	Age	0.08	0.15	0.05	0.92	0.10	0.01	0.23
Durability Rating (Erosive Losses)	Age	0.11	0.17	0.12	0.52	0.17	0.09	0.12
Durability Rating (Spalling)	Age	0.04	0.05	0.02	0.92	0.06	0.01	0.31
Structural Rating	Age	0.14	0.03	0.01	0.06	0.09	0.02	0.20
Structural Rating (Cracks)	Age	0.02	0.02	0.00	0.94	0.02	0.00	0.06
Structural Rating (Joint Condition)	Age	0.16	0.03	0.01	0.06	0.09	0.03	0.15
Structural Rating (Alignment)	Age	0.16	0.02	0.04	0.06	0.12	0.03	0.11
Observations (N)		(347)	(133)	(352)	(3)	(927)	(284)	(28)

TABLE 22

RESULTS OF STATISTICAL ANALYSIS OF
FIELD TESTS FOR CSP
(N=153)

Dependent Variable	Independent Variables	R^2
Structural Rating	Voltage (2-Pin)	0.00
	Resistance (Single Probe)	0.00
	Resistance (4-Pin)	0.00
	Resistance (Soil-Pipe)	0.01
	Moisture	0.01
	Voltage (Single Probe)	0.01
	Thickness at 12 Position	0.00
	Thickness at 9 Position	0.00
	Thickness at 6 Position	0.04
	Thickness at 3 Position	0.08
	Age	0.03
Durability Rating (Material)	Voltage (2-Pin)	0.00
	Resistance (Single Probe)	0.00
	Resistance (4-Pin)	0.01
	Resistance (Soil-Pipe)	0.00
	Moisture	0.00
	Voltage (Single Probe)	0.02
	Thickness at 12 Position	0.00
	Thickness at 9 Position	0.01
	Thickness at 6 Position	0.23
	Thickness at 3 Position	0.00
	Age	0.04

LABORATORY TESTS FOR CSP
(N=153)

Dependent Variable	Independent Variable	R^2
Structural Rating	Soil Box (Minimum Resistance	0.02
	pH	0.01
	Chloride Content	0.00
	Total Water Hardness	0.06
	Conductance	0.00
	Age	0.03
Durability Rating (Material)	Soil Box (Minimum Resistance)	0.00
	pH	0.00
	Chloride Content	0.01
	Total Water Hardness	0.00
	Conductance	0.00
	Age	0.04

TABLE 23

RESULTS OF STATISTICAL ANALYSIS OF FIELD TESTS FOR RCP
(N=118)

Dependent Variable	Independent Variable	R^2
Structural Rating	Resistance (Single Probe)	0.02
	Voltage (2-Pin)	0.00
	Resistance (4-Pin)	0.01
	Moisture	0.00
	Age	0.06
Durability Rating (Material)	Resistance (Single Probe)	0.01
	Voltage (2-Pin)	0.02
	Resistance (4-Pin)	0.01
	Moisture	0.02
	Age	0.02

LABORATORY TESTS FOR RCP
(N=118)

Dependent Variable	Independent Variable	R^2
Structural Rating	Soil Box (Minimum Resistance	0.01
	pH	0.00
	Chloride Content	0.00
	Total Water Hardness	0.00
	Conductance	0.02
	Age	0.06
Durability Rating (Material)	Soil Box (Minimum Resistance)	0.01
	pH	0.00
	Chloride Content	0.01
	Total Water Hardness	0.01
	Conductance	0.00
	Age	0.02

PHOTOGRAPHS

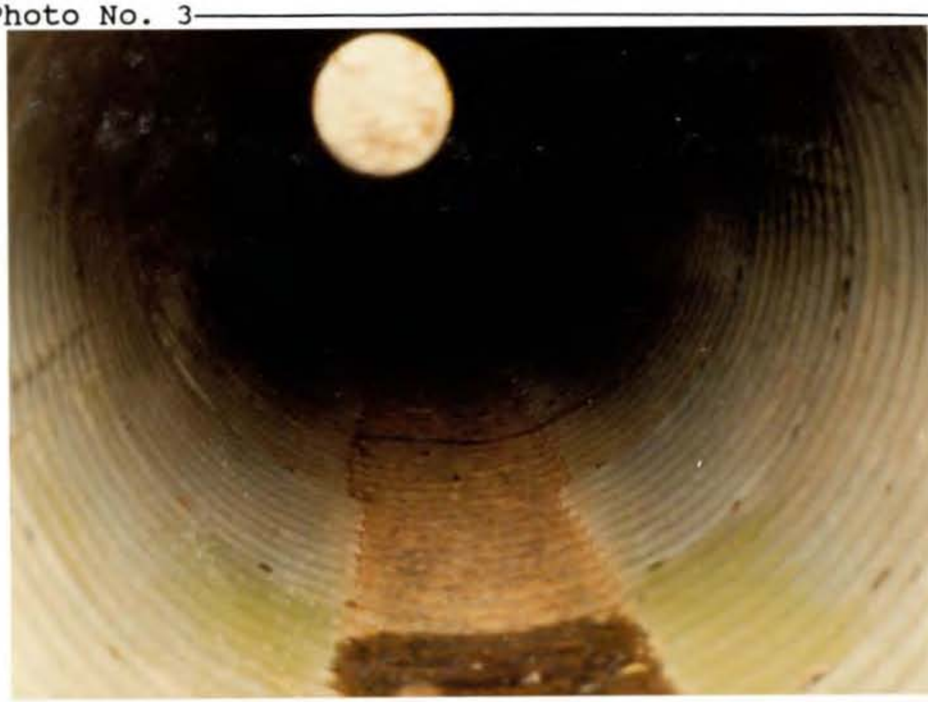
Photo No. 1

Typical zinc-coated corrugated steel pipe. Route J, Ralls County, Log Mile 7.47, Placed in 1979.

Photo No. 2

Typical reinforced concrete pipe. Route I-70, Lafayette County, Log Mile 17.44, Placed in 1962.

Photo No. 3



This is considered a "good" CSP. There is no perforation of the base metal and no structural deformations. The zinc coating has been removed along the flow line and rusting has started. Lafayette County, Route U, Log Mile 3.02, Placed in 1960.

Photo No. 4

This is considered a "good" CSP. There is no perforation of the base metal and no structural deformations. The zinc coating has been removed along the flow line and rusting has started. Bollinger County, Route W, Log Mile 2.827, Placed in 1961.

Photo No. 5

This is considered a "good" RCP. The joints are still sealed and there is only slight exposure of aggregate in flow line. Franklin County, Route 47, Log Mile 3.74, Placed in 1962.

Photo No. 6

This is considered a "good" RCP. The joints are still sealed (no settlement) and there is slight exposure of the aggregate in the flow line. Gentry County, Route 136, Log Mile 10.7, Placed in 1957.

Photo No. 7

This is considered a "bad" CSP. There is loss of base metal allowing water infiltration into the base soil. Gentry County, Route Z, Log Mile 3.58, Placed in 1941.

Photo No. 8

This is considered a "bad" CSP. There is appreciable loss of base metal. The base soil is being washed out from under the pipe. Lewis County, Route H, Log Mile 1.6, Placed in 1962.

Photo No. 9

This is considered a "bad" CSP. The base metal has been eliminated almost the length of the pipe. The base soil is rutted. High flow rates are indicated by the algae on the sides of the pipe. Henry County, Route CC, Log Mile 3.31, Placed in 1957.

Photo No. 10

This is considered a "bad" RCP. There is major settlement along the length of the pipe. Debris has filled in at the outlet. Adair County, Route 63, Log Mile 4.91, Placed in 1942.

Photo No. 11

This is considered a "bad" RCP. There is structural damage (cause is unknown) and there is high abrasive wear in the material. The water does not flow freely and stands in the pipe. High water levels are indicated by the algae on the sides. Bates County, Route 18, Log Mile 0.73, Placed in 1936.

Photo No. 12

This is considered a "bad" RCP. There is major wear in the flow line exposing the aggregate. Butler County, Route 67, Log Mile 13.33, Placed in 1936.

Photo No. 13

Replacement of culvert pipe generally requires complete closure of the road. Heavy equipment is necessary to dig the overburden off the pipe.

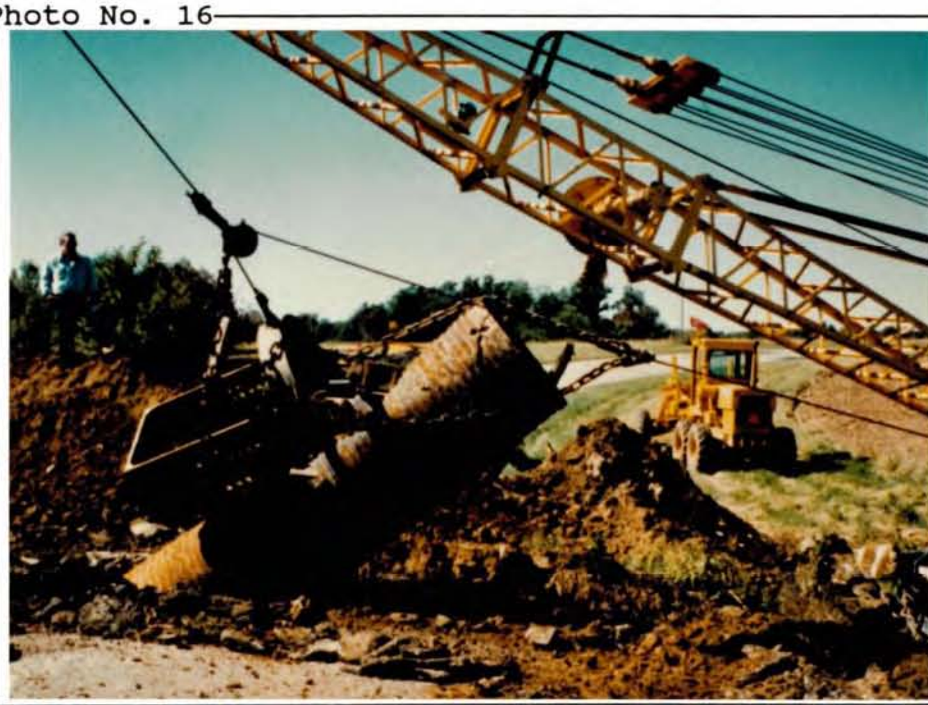
Photo No. 14

Fill height over the pipe is a big factor in the time required for a pipe's replacement.

Photo No. 15

Fill height also determines the extent of settlement which will ultimately occur thus causing continued maintenance problems.

Photo No. 16



The old pipe is removed.

Photo No. 17

Invert deterioration has progressed for the full length of the pipe.

Photo No. 18

Water flowing through the deteriorated pipe had begun to cause extensive wash out of bedding material and fill under the pipe.

Photo No. 19

After the bottom of the trench is reconstructed and graded, bedding material is placed in the trench and the new pipe installed.

Photo No. 20

Very shortly after the replacement is finished, the settlement of the backfill material causes the "graveyard" depression which must be patched and repatched until it becomes stable

Photo No. 21

Beginning the full width removal of CSP.

Photo No. 22

Complete closure of road or significant periods where traffic is not permitted to continue to use the road is necessary.

Photo No. 23

Pipe being removed is quite often in severe state of deterioration.

Photo No. 24

Preparation of pipe bed for new pipe. Traffic is generally allowed to clear during this operation.

Photo No. 25

Placing new pipe. A block must be placed in the end of the pipe next to centerline to prevent dirt entrance during removal of second half of pipe.

Photo No. 26

Filling over new pipe.

Photo No. 27

Removal of second half of pipe.

Photo No. 28

Connection of new pipe at centerline.

Photo No. 29

Finishing grading of backfill material.

Photo No. 30

Old pipe which was removed.

APPENDIX A

SUMMARY OF 1931-1946 CULVERT SURVEYS

AND

RESULTS OF 1964 MISSOURI STATE HIGHWAY DEPARTMENT

CULVERT SURVEY

SUMMARY OF 1931 - 1946 CULVERT SURVEYS

In the early thirties a most comprehensive state wide culvert survey was undertaken in Missouri. A total of 1349 installations were considered in this survey representing culverts in place prior to about 1925. This was considered a good sample of culverts in service at that time but would not necessarily be considered a good sample of culverts presently in service, as our highway system has been expanded considerably since that time.

Culvert rating tables, patterned after those used by Georgia and Tennessee for similiar surveys, were prepared. In these tables each mode of deterioration was subdivided into progressive stages such that the percentage of the total life expended could be estimated. Each culvert in the survey was given a material condition rating and a structural condition rating from these tables. From a combined material and structural rating and the age of the culvert, the rate of deterioration and an estimate of the life expectancy were estimated.

In this survey the rate of deterioration had to be assumed uniform from time of installation to end of service. This was due to the fact that we had only one rating on each culvert and this rating at a fairly early age, 4 to 9 years. It was quite evident that a second survey of these culverts would be required to validate our rating tables, and our life expectancies derived from these tables. At this time no other state had such information as no state had made a second survey or had attempted to rate culverts of an age greater than 12 years.

In 1946-47 all of the installations in the original study, where possible, were resurveyed. The age of these installations at the time of this survey ranged from 19 to 24 years. The rating tables used in this resurvey were the same as those used in the original survey with the exception that more detailed descriptions of deterioration were included. A comparison of the two surveys indicated that the rating tables were somewhat inaccurate at early stages of disintegration but realistic for more pronounced disintegration. This meant that our first survey taken at early life over-estimated yearly deterioration and consequently underestimated expected life. Results of the 1946-47 survey indicated that the rating tables for more pronounced deterioration gave results consistent with actual experience records as to expected life.

Life expectancies for pipe culverts for the various service types were studied with respect to geographic location. From the 1946-47 survey it was found that corrugated metal pipes in the swamp sections of Southeast Missouri had a much higher rate of deterioration than corrugated metal pipes of similiar service type in other locations within the state. This was the only indication that geographic location had on effect on culvert life in this survey. The results obtained from the 1946-47 survey are shown in the following table, for the entire state, Southeast Missouri only, and the entire state excluding Southeast Missouri.

PIPE CULVERT
LIFE EXPECTANCIES
1946-47 SURVEY

	Avg. for Entire State	All locations Except S.E., Mo.	S.E., Mo. Only
CROSS DRAIN			
VCP	80	79	97
RCP	78	75	93
CMP	45	47	37
SIDE ROAD			
VCP	37	33	42
RCP	77	73	100
CMP	48	51	37
FARM ENT.			
VCP	25	98	45
RCP	70	67	88
CMP	53	54	49

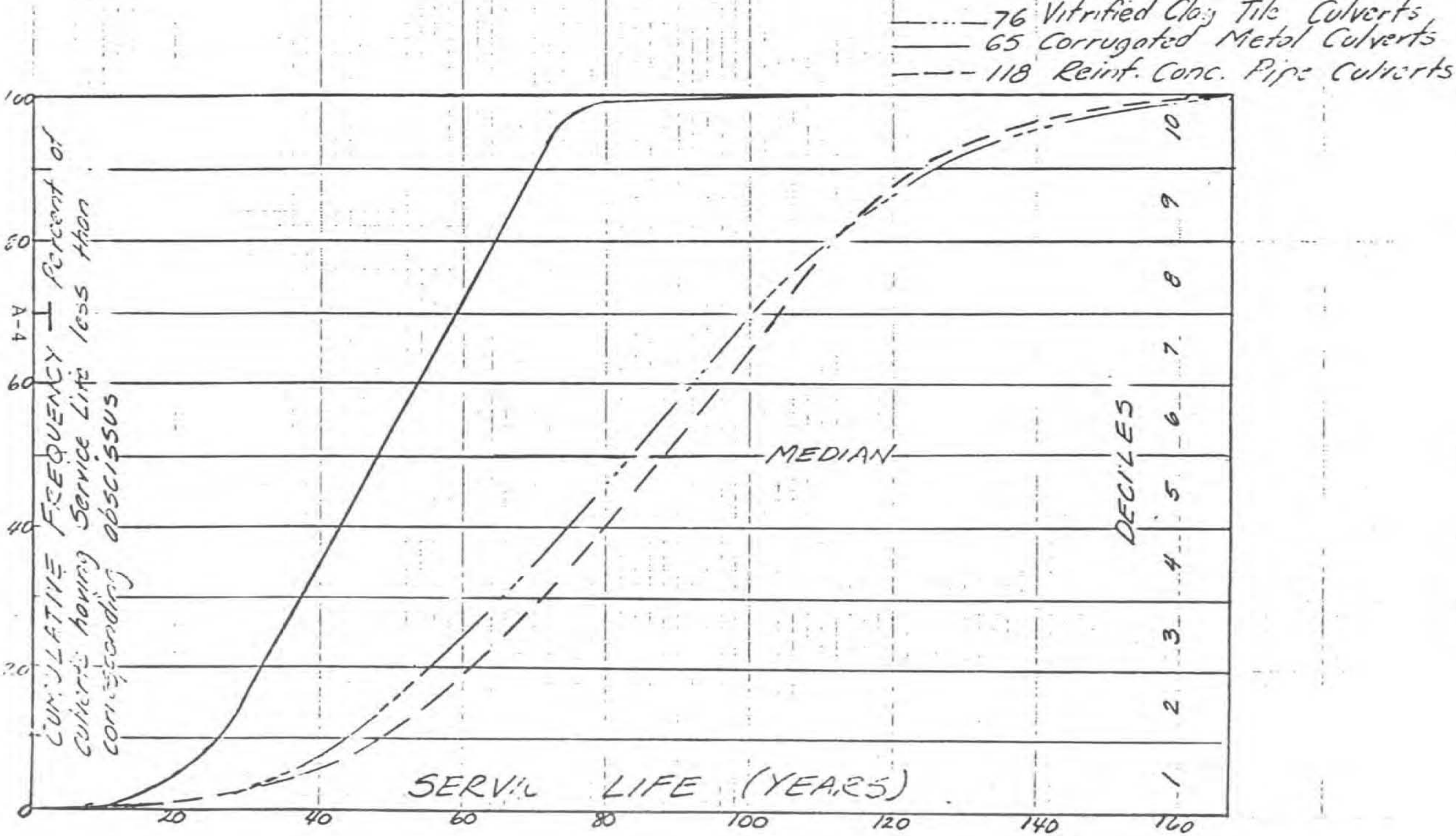
From the preceding tabulation shown it can be seen that the life expectancy of VCP and to a lesser extent RCP appears to be quite erratic for side road and farm entrance facilities. This is due to the effect of depth of cover upon the rigid type pipe. A well defined trend towards higher deterioration with lesser cover was found for these types of pipe.

Considering only the cross drain pipe, cummulative frequency distributions for RCP, CMP and VCP for the entire state, are shown in the following figure. From this figure we would estimate that we would lose the following percentages of the various types of cross drain pipe at the indicated age.

Age	% CMP Lost	% RCP Lost	% VCP Lost
10	0	0	0
20	5	1	1
30	17	3	3
40	35	6	7
50	54	11	15

From the results of these surveys and additional information obtained after the 1946-47 survey, we would draw the following

CUMULATIVE FREQUENCY DISTRIBUTION
CROSS DRAIN CULVERTS - CMP, RCP & VCT



conclusions:

1 - Our present rating charts appear to be valid and gives realistic life expectancies when the degree of deterioration is moderate to severe (approximately 20 years). These rating charts should be up graded for slight deterioration as they tend to underestimate the life expectancy. Our 1946-47 survey, within sampling limitations, would be considered quite valid.

2 - Service entrance pipe are so dependent on the depth of cover that any comparison between types of culvert pipe should take this into consideration.

3 - Our 1946-47 survey indicated that culverts in one geographic area differed significantly from the state average. This area was the Southeast "Bootheel" area of the state which is very flat, has a high water table and prolonged periods of standing water. In this area the CMP culverts showed significantly greater deterioration and a subsequent lesser life expectancies.

Since this survey, other areas have come to our attention which were not available and/or not sampled in our survey, where the life expectancy of CMP culverts would be appreciably less than the state average. In 1958 a cursory type investigation indicated that there were sizable areas in the Southwest portion of the state where run off waters were slightly acidic. In these areas the life of CMP culverts was significantly less than the state average. Additional isolated areas in the Northcentral portion of the state have been found in the vicinity of coal mines where CMP culverts have deteriorated rapidly. In the Southeast swamps, the Southwest acidic soil areas, and the Northcentral coal mine regions the deterioration of RCP and VCP was comparable to that found in our statewide survey.

4 - The life expectancy of a RCP or VCP cross drain culvert is some 160% to 250% of that of a CMP. Within the life expectancy of a major system roadbed, 30 to 50 years, we would expect to have at least five times as many replacements with CMP than with RCP or VCP.

5 - The RCP in use today with our improved method of construction and control would probably give us greater life than the RCP included in this survey.

6 - The CMP in use today would probably have about the same life expectancy as the CMP included in this survey. We would expect that while our present spelter coating would be superior to that of culvert pipe in 1925, our present base metal could be inferior to that used in 1925.

7 - The end point or zero rating for a culvert of any type was assumed to be when the facility ceased to perform its designated function. This is not necessarily the proper time to replace a culvert. It may be economically feasible to replace a culvert sometime before it ceases to function to protect earth fills, to avoid undercutting and/or to facilitate replacement.

RESULTS OF 1964

MISSOURI STATE HIGHWAY DEPARTMENT

CULVERT SURVEY

PURPOSE

The purpose of this investigation is to determine and compare the service life of concrete and corrugated metal cross drain culvert pipe in Missouri. Factors which influence deterioration in either or both types of culverts will be reported.

SCOPE

It is intended in this study to provide a complete coverage of corrugated metal and concrete cross drain pipe culverts within the state. Projects with corrugated metal cross drain pipe are available generally only on the Supplementary System and are available in number in each county. Projects with concrete cross drain pipe are generally found only on the Primary System and are not as readily available as the corrugated metal cross drain pipe in most counties. For this reason, two projects with corrugated metal and one project with concrete cross drain pipe were selected from each county within the state. A total of 2149 corrugated metal and 880 concrete cross drain pipe were rated. The locations of all culverts surveyed are documented and on file should a resurvey be desired in the future.

The projects were selected at random for this survey -- two on the supplementary and one on the primary system in each county -- from a list of projects furnished by each District. When additional projects were necessary, the selection was made in the field. Projects were selected in the more prominent soil types of each county. Projects built between 1935 and 1940 were selected when available. Other projects built prior to 1950 were selected when necessary to obtain complete coverage. In general, ten culverts were rated on each project. Culverts were eliminated from this study because of the following:

(1) Too wet or filled to rate

(2) Extended and, for that reason, not visible.

(3) Removed, with no culvert now in place.

(4) Replaced due to new construction.

(5) No identification tag (CMP).

(6) Replaced due to failure (an attempt was made to determine date of replacement, in which case the culvert would be included in this survey).

(7) Culvert placed such that it does not function.

METHODS

A school of instruction was held in the Main Office to acquaint and train district Materials personnel in the rating of culverts. This school included explanation of the rating tables and field examination of local culverts. During the survey the field crews were visited periodically to insure uniform interpolation of the rating tables.

RATING TABLES

The life expectancy of the culvert pipe is based on the assumption that the pipe is subject to a uniform rate of deterioration to failure. The yearly deterioration is calculated from an estimated rating system based on their present condition and age. The present condition (Final Rating) is a combination of the structural and material ratings.

All culverts were rated from the attached rating tables. The culvert report forms and instructions are also attached.

These tables were originally patterned after tables used by Georgia and Tennessee. (Rating charts used by the Tennessee State Highway Department for their culvert investigation are included in the Armco Handbook of Drainage and Construction Products; 1958 edition, chapter 16, Methods of Determining Durability.) These tables have been clarified and slightly modified from experience on our previous culvert surveys of 1931-32 and 1946-47.

In our last culvert survey of 1946-47, these tables were evaluated and found to give realistic results. To insure that these tables were valid, a limited number of both types of pipe surveyed in 1931-32 and again in 1946-47 (average age approximately 22 years) were re-surveyed in 1964. Many of the culverts included in the previous survey were not available due to route relocations. Some of the culverts re-surveyed are now included in the county road system.

The life expectancy of the concrete pipe re-surveyed was found to be slightly higher than the previous survey, while the life expectancy of the corrugated metal pipe was generally somewhat lower. The individual corrugated metal pipe did not all deteriorate at the estimated rate, however, the average yearly deterioration remained fairly constant between surveys. This, we feel, with the evaluation from the previous surveys, validates these tables for culverts of the age selected for study.

DISCUSSION OF DATA

This report is based on the field inspection and evaluation of 2149 corrugated metal and 880 concrete cross drain pipe culverts. Tables 1 and 2, attached, show the number and relative condition of all corrugated metal and concrete pipe culverts that are included in this report. Culverts of each type are grouped in years of service life for each district. The total distribution, cumulative distribution and cumulative percent are shown for all districts combined, and on separate sheets for each district separately. The cumulative total and percent, shown on the table, represent the number and percent of the culverts having an estimated service life equal to or less than that shown.

Cumulative distribution curves for each district and all districts combined are also attached. These curves show the cumulative frequency plotted against service life in years. From such a curve the percentage of culverts expected to be replaced by a given age can be determined. The median point is plotted on each curve. The median is the age at which we would expect to have replaced 50 percent of the culverts. Because of the extreme skewness of the distribution curves, the median service life rather than the average service life has been used in this study.

Table 3 shows the number and relative condition of the concrete pipe with and without end protection (headwall and wing-wall). A cumulative distribution curve for both conditions is also included. End protection was not a factor affecting the service life of corrugated metal pipe. Corrugated metal pipe was not downgraded for ends damaged by graders, etc.

Table 4 below, a summation of Tables 1, 2, and 3, shows the percentage of each type of culvert that would require replacement by the indicated age. The median age for each type is also shown.

TABLE 4

Estimated Percentage of Pipe Lost at Indicated Age

Age (Years)	Concrete Pipe: With End Protection	Concrete Pipe: Without End Protection	Concrete Pipe: All	Corrugated Metal Pipe
0	0	0	0	0
5	0	0	0	0
10	0	0	0	0
15	0.2	0	0.1	0
20	0.2	1.2	0.6	1.0
25	0.5	2.4	1.3	3.5
30	1.1	4.0	2.2	11.7
35	1.6	6.1	3.3	31.4
40	2.2	10.4	5.2	47.6
45	2.9	13.4	6.8	59.1
50	3.9	17.1	8.9	67.8
Median	106	87	101	41

An illustration of the material condition of all corrugated metal pipe over twenty years of age is shown for each district and all districts combined. Table 5 shows that, of the 1678 corrugated metal pipe surveyed between 22-3/4 and 31-3/4 years of age, 37.2 percent have small holes to the entire invert rusted out. This represents material ratings from 10 to 0. The remaining 471 corrugated metal pipe rated are between 13 and 18-1/4 years of age. The condition of this group of culverts is also shown in Table 5. Four percent of this group have small holes to the entire invert rusted out. In contrast to this, only one concrete pipe was found to have severe erosion in the invert.

The median life expectancy of corrugated metal and concrete pipe for each county is shown on the attached maps. A cross mark indicates culverts were not available, and a figure followed by an asterisk (*) indicates a very small number of culverts. The counties having a median life expectancy below the state median (41 for corrugated metal, and 101 for concrete pipe) are shown as shaded areas.

SUMMARY

This report is based on the field inspection and evaluation of 2149 corrugated metal and 880 concrete cross drain pipe culverts. This survey covers the corrugated metal pipe in 112 counties and concrete pipe in 95 counties. Culverts of the age desired were either not available or not rateable in the counties excluded.

All culverts on the projects selected were included in this survey, provided they were functioning, regardless of the size of the drainage area. This could account for the skewness of the data; however, we feel that this data is representative and that culverts properly located and functioning will have a service life close to that predicted.

The material condition of the corrugated metal pipe and the structural condition of the concrete pipe were generally the conditions that controlled the final ratings, and estimated life expectancy. The difference in life expectancy shown in Table 3 between concrete pipe with and without end protection was generally due to the joint condition of the end sections. The concrete pipe with end protection was found to have a longer life expectancy.

The Highway Planning Road Life Study of the Primary System found that the life of high type pavement, including resurfacing, could be expected to last some 50 years.

In 50 years we would expect, from this culvert survey, to have replaced 68 percent of our corrugated metal pipe, 3.9 percent of our concrete pipe with end protection, and 17.1 percent of our concrete pipe without end protection.

The concrete cross drain pipe (with and without end protection) were found on this survey to have a life expectancy about the same as was found in our last culvert survey 1946-47. In 50 years from our prior survey, we estimated that some 11 percent of the concrete pipe would require replacement, compared to some 9 percent on this survey.

The corrugated metal cross drain pipe were found on this survey to have a life expectancy somewhat less than was found on our last culvert survey 1946-47. From our prior survey, we estimated that in 50 years we would have lost some 54 percent of our corrugated metal pipe, compared with some 68 percent on this survey.

Thirty-seven percent of the corrugated metal culverts on this survey, in service 22 to 32 years, and 4 percent of the corrugated metal culverts in service 13 to 18-1/4 years had small holes to the entire invert rusted out.

TABLE 1

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

Corrugated Metal Pipe Culverts
All Districts

Service Life, Years	District 1	2	3	4	5	6	7	8	9	10	Total	Cumulative* Total	Cumulative* %
0-10	0	0	0	0	0	0	0	0	0	0	0	0	0
11-15	0	0	0	0	0	0	0	0	0	0	0	0	0
16-20	0	0	2	2	3	4	9	0	1	0	21	21	1.0
21-25	2	9	7	4	5	12	9	1	0	5	54	76	3.5
26-30	8	4	32	14	28	26	28	13	5	19	177	252	11.7
31-35	22	18	69	35	58	42	56	29	37	57	423	675	31.4
36-40	21	43	42	32	47	28	37	28	28	41	347	1022	47.6
41-45	21	40	15	31	22	20	17	19	23	39	247	1269	59.1
46-50	9	20	7	15	23	20	11	23	30	31	189	1458	67.8
51-55	10	11	4	10	11	18	15	12	28	13	132	1590	74.0
56-60	8	10	5	16	9	7	9	18	4	11	97	1687	78.5
61-65	13	9	7	10	5	8	4	12	14	4	86	1773	82.5
66-70	9	6	7	7	4	3	11	13	9	5	74	1847	85.9
71-75	7	4	2	9	7	7	4	5	8	1	54	1901	88.5
76-80	13	13	7	11	6	5	3	11	9	0	78	1979	92.1
81-85	7	9	3	5	2	4	2	4	0	3	39	2018	93.9
86-90	5	5	1	4	0	2	3	7	0	0	27	2045	95.2
91-95	5	4	0	3	3	3	0	3	0	2	23	2068	96.2
96-100	2	0	0	2	1	0	1	0	1	0	7	2075	96.6
101-105	1	2	0	1	0	1	0	2	1	0	8	2083	96.9
106-110	3	2	0	0	1	1	0	0	1	0	8	2091	97.3
111-115	0	1	0	1	0	0	0	2	0	1	5	2096	97.5
116-120	2	0	1	2	2	1	0	0	0	0	8	2104	97.9
121-125	0	1	0	2	1	2	0	0	0	0	6	2110	98.2
126-130	1	0	0	0	1	1	0	1	0	0	4	2114	98.4
131-135	2	0	0	1	1	0	0	2	0	0	6	2120	98.7
136-140	3	2	0	1	2	0	0	0	0	0	8	2128	99.0
141-145	2	0	1	1	0	0	0	0	0	0	4	2132	99.2
146-150	1	0	0	0	0	0	0	0	0	0	1	2133	99.3
151-155	0	1	0	1	0	0	0	0	0	0	2	2135	99.3
156-160	2	0	0	0	1	1	0	1	0	0	5	2140	99.6
161+	2	1	0	1	2	1	0	2	0	0	9	2149	100.0
Total	181	215	212	221	245	217	219	208	199	232			

* Number and percent of culverts having an estimated service life equal to or less than indicated.

TABLE 2

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

Concrete Pipe Culverts
All Districts

Service Life, Years	District 1	2	3	4	5	6	7	8	9	10	Total	Cumulative* Total	Cumulative* %
0-10	0	0	0	0	0	0	0	0	0	0	0	0	0
11-15	0	1	0	0	0	0	0	0	0	0	1	1	0.1
16-20	0	1	0	0	1	2	0	0	0	0	4	5	0.6
21-25	1	2	0	2	1	0	0	0	0	0	6	11	1.3
26-30	0	4	0	2	0	2	0	0	0	0	8	19	2.2
31-35	3	3	0	2	2	0	0	0	0	0	10	29	3.3
36-40	2	2	2	5	2	1	2	0	0	1	17	46	5.2
41-45	0	4	1	4	3	1	0	0	0	1	14	60	6.8
46-50	0	6	1	3	1	6	0	1	0	0	18	78	8.9
51-55	6	3	2	14	2	4	2	0	0	0	33	111	12.6
56-60	1	6	0	3	1	5	6	0	1	0	23	134	15.2
61-65	0	7	3	2	2	10	5	0	0	3	32	166	18.9
66-70	1	6	0	3	1	5	4	1	4	5	30	196	22.3
71-75	1	6	4	4	1	6	6	4	3	2	37	233	26.5
76-80	5	4	1	8	3	4	5	4	9	1	44	277	31.5
81-85	2	7	1	9	1	4	6	2	0	4	36	313	35.6
86-90	2	5	0	7	1	5	10	5	2	7	44	357	40.6
91-95	1	1	2	2	4	6	4	4	3	5	32	389	44.2
96-100	3	1	2	2	3	10	7	6	1	2	37	426	48.4
101-105	2	2	1	2	1	9	12	2	8	3	42	468	53.2
106-110	2	5	4	3	1	9	5	3	2	8	42	510	58.0
111-115	2	1	4	7	2	7	16	7	4	4	54	564	64.1
116-120	7	0	4	0	9	6	5	3	6	4	44	608	69.1
121-125	4	0	3	6	5	6	6	3	6	6	45	653	74.2
126-130	3	1	4	4	9	3	7	1	6	3	41	694	78.9
131-135	4	0	2	1	3	1	7	1	6	1	26	720	81.8
136-140	3	0	5	7	8	0	0	1	2	0	26	746	84.8
141-145	6	1	1	0	1	1	2	1	2	3	18	764	86.8
146-150	0	1	0	0	3	0	4	2	3	0	13	777	88.3
151-155	2	0	0	2	4	1	0	0	11	0	20	797	90.6
156-160	1	0	5	0	3	0	3	0	2	2	16	813	92.4
161+	6	3	4	3	23	1	7	11	9	0	67	880	100.0
Total	70	83	56	107	101	115	131	62	90	65			

* Number and percent of culverts having an estimated service life equal to or less than indicated.

TABLE 3

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

Concrete Pipe Culverts
With and Without End Protection
All Districts

Service Life, Years	With End Protection (Headwall and Wingwall) No.	Cumulative* Total	Cumulative* %	Without End Protection No.	Cumulative * Total	Cumulative * %
0-10	0	0	0	0	0	0
11-15	1	1	0.2	0	0	0
16-20	0	1	0.2	4	4	1.2
21-25	2	3	0.5	4	8	2.4
26-30	3	6	1.1	5	13	4.0
31-35	3	9	1.6	7	20	6.1
36-40	3	12	2.2	14	34	10.4
41-45	4	16	2.9	10	44	13.4
46-50	6	22	3.9	12	56	17.1
51-55	8	30	5.4	25	81	24.7
56-60	9	39	7.1	14	95	29.0
61-65	16	55	10.0	16	111	33.8
66-70	22	77	13.9	8	119	36.3
71-75	23	100	18.1	14	133	40.5
76-80	28	128	23.2	16	149	45.4
81-85	24	152	27.5	12	161	49.1
86-90	33	185	33.5	11	172	52.4
91-95	22	207	37.5	10	182	55.5
96-100	27	234	42.4	11	193	58.8
101-105	27	261	47.3	14	207	63.1
106-110	35	296	53.6	7	214	65.2
111-115	37	333	60.3	15	229	69.8
116-120	25	358	64.9	21	250	76.2
121-125	27	385	69.7	18	268	81.7
126-130	25	410	74.3	16	284	86.6
131-135	21	431	78.1	5	289	88.1
136-140	18	449	81.3	8	297	90.5
141-145	15	464	84.1	3	300	91.5
146-150	11	475	86.1	2	302	92.1
151-155	6	481	87.1	14	316	96.3
156-160	15	496	89.9	1	317	96.6
161+	56	552	100.0	11	328	100.0

* Number and percent of culverts having an estimated service life equal to or less than indicated.

TABLE 5

MATERIAL RATING FREQUENCY
CULVERT SURVEY-1964

Corrugated Metal Pipe Culverts
in Service Over 20 Years and Under 20 Years
All Districts

District	Age Range	Total Number	Percent Having Material Rating Equal to or Less Than Indicated Invert Material Rating* 15	10	5	0
1	23-1/4 - 29-1/4	115	18.3	11.3	9.6	6.1
2	23 - 31-1/4	139	59.0	32.4	18.7	2.9
3	23 - 30	150	81.4	69.3	53.3	30.0
4	22-3/4 - 31-1/4	155	46.4	41.9	32.9	15.5
5	24 - 28-3/4	186	70.0	45.2	31.2	14.5
6	23 - 29-1/2	167	50.9	37.1	25.1	8.4
7	23-3/4 - 31-3/4	182	55.5	45.1	35.7	25.3
8	23-1/4 - 30	195	40.0	26.7	17.4	8.7
9	23 - 29	189	36.0	27.0	6.8	0.0
10	24 - 29	200	42.0	33.0	20.5	6.5
All Districts	22-3/4 - 31-3/4	1678	50.2	37.2	25.1	11.7
All Districts	13 - 18-1/4	471	11.5	4.0	1.5	0.2

* Corrugated Metal Culverts Material Rating

Rating	Material Condition	Description
30-15	Corroded or abraded nearly through	Complete rusting of invert with heavy pitting and loss of base metal ranging from 60% to 90%. In the upper extreme of this range metal is easily dented with light blows of pick, while at the lower extreme metal is punctured easily by light blows of pick.
10	Small hole or holes in invert	One or more small holes (maximum size 1") in invert.
5	Areas of invert rusted out	One or more larger holes in invert (from 1" holes to 1/2 of invert rusted out).
0	Complete invert rusted out.	

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 1

Service Life, Years	Reinforced Concrete Pipe			Corrugated Metal Pipe		
		Cumulative			Cumulative	
	No.	Total	%	No.	Total	%
0-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	0	0	0	0	0	0
21-25	1	1	1.4	2	2	1.1
26-30	0	1	1.4	8	10	5.5
31-35	3	4	5.7	22	32	17.7
36-40	2	6	8.6	21	53	29.3
41-45	0	6	8.6	21	74	40.9
46-50	0	6	8.6	9	83	45.9
51-55	6	12	17.1	10	93	51.4
56-60	1	13	18.6	8	101	55.8
61-65	0	13	18.6	13	114	63.0
66-70	1	14	20.0	9	123	68.0
71-75	1	15	21.4	7	130	71.8
76-80	5	20	28.6	13	143	79.0
81-85	2	22	31.4	7	150	82.9
86-90	2	24	34.3	5	155	85.6
91-95	1	25	35.7	5	160	88.4
96-100	3	28	40.0	2	162	89.5
101-105	2	30	42.9	1	163	90.1
106-110	2	32	45.7	3	166	91.7
111-115	2	34	48.6	0	166	91.7
116-120	7	41	58.6	2	168	92.8
121-125	4	45	64.3	0	168	92.8
126-130	3	48	68.6	1	169	93.4
131-135	4	52	74.3	2	171	94.5
136-140	3	55	78.6	3	174	96.1
141-145	6	61	87.1	2	176	97.2
146-150	0	61	87.1	1	177	97.8
151-155	2	63	90.0	0	177	97.8
156-160	1	64	91.4	2	179	98.9
161+	6	70	100.0	2	181	100.0

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 2

Service Life, Years	Reinforced Concrete Pipe No.	Cumulative Total	Cumulative %	Corrugated Metal Pipe No.	Cumulative Total	Cumulative %
0-10	0	0	0	0	0	0
11-15	1	1	1.2	0	0	0
16-20	1	2	2.4	0	0	0
21-25	2	4	4.8	9	9	4.2
26-30	4	8	9.6	4	13	6.1
31-35	3	11	13.3	18	31	14.4
36-40	2	13	15.7	43	74	34.4
41-45	4	17	20.5	40	114	53.0
46-50	6	23	27.7	20	134	62.3
51-55	3	26	31.3	11	145	67.4
56-60	6	32	38.6	10	155	72.1
61-65	7	39	47.0	9	164	76.3
66-70	6	45	54.0	6	170	79.1
71-75	6	51	61.4	4	174	80.9
76-80	4	55	66.3	13	187	87.0
81-85	7	62	74.7	9	196	91.2
86-90	5	67	80.7	5	201	93.5
91-95	1	68	81.9	4	205	95.3
96-100	1	69	83.1	0	205	95.3
101-105	2	71	85.5	2	207	96.3
106-110	5	76	91.6	2	209	97.2
111-115	1	77	92.8	1	210	97.7
116-120	0	77	92.8	0	210	97.7
121-125	0	77	92.8	1	211	98.1
126-130	1	78	94.0	0	211	98.1
131-135	0	78	94.0	0	211	98.1
136-140	0	78	94.0	2	213	99.1
141-145	1	79	95.2	0	213	99.1
146-150	1	80	96.4	0	213	99.1
151-155	0	80	96.4	1	214	99.5
156-160	0	80	96.4	0	214	99.5
161+	3	83	100.0	1	215	100.0

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 3

Service Life, Years	Reinforced Concrete Pipe			Corrugated Metal Pipe		
		Cumulative			Cumulative	
	No.	Total	%	No.	Total	%
0-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	0	0	0	2	2	0.9
21-25	0	0	0	7	9	4.2
26-30	0	0	0	32	41	19.3
31-35	0	0	0	69	110	51.9
36-40	2	2	3.6	42	152	71.7
41-45	1	3	5.4	15	167	78.8
46-50	1	4	7.1	7	174	82.1
51-55	2	6	10.7	4	178	84.0
56-60	0	6	10.7	5	183	86.3
61-65	3	9	16.1	7	190	89.6
66-70	0	9	16.1	7	197	92.9
71-75	4	13	23.2	2	199	93.9
76-80	1	14	25.0	7	206	97.2
81-85	1	15	26.8	3	209	98.6
86-90	0	15	26.8	1	210	99.0
91-95	2	17	30.4	0	210	99.0
96-100	2	19	33.9	0	210	99.0
101-105	1	20	35.7	0	210	99.0
106-110	4	24	42.9	0	210	99.0
111-115	4	28	50.0	0	210	99.0
116-120	4	32	57.1	1	211	99.5
121-125	3	35	62.5	0	211	99.5
126-130	4	39	69.6	0	211	99.5
131-135	2	41	73.2	0	211	99.5
136-140	5	46	82.1	0	211	99.5
141-145	1	47	83.9	1	212	100.0
146-150	0	47	83.9			
151-155	0	47	83.9			
156-160	5	52	92.9			
161+	4	56	100.0			

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 4

Service Life, Years	Reinforced Concrete Pipe No.	Cumulative Total	Cumulative %	Corrugated Metal Pipe No.	Cumulative Total	Cumulative %
0-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	0	0	0	2	2	0.9
21-25	2	2	1.9	4	6	2.7
26-30	2	4	3.7	14	20	9.0
31-35	2	6	5.6	35	55	24.9
36-40	5	11	10.3	32	87	39.4
41-45	4	15	14.0	31	118	53.4
46-50	3	18	16.8	15	133	60.2
51-55	14	32	30.0	10	143	64.7
56-60	3	35	32.7	16	159	71.9
61-65	2	37	34.6	10	169	76.5
66-70	3	40	37.4	7	176	79.6
71-75	4	44	41.1	9	185	83.7
76-80	8	52	48.6	11	196	88.7
81-85	9	61	57.0	5	201	91.0
86-90	7	68	63.6	4	205	92.8
91-95	2	70	65.4	3	208	94.1
96-100	2	72	67.3	2	210	95.0
101-105	2	74	69.2	1	211	95.5
106-110	3	77	72.0	0	211	95.5
111-115	7	84	78.5	1	212	95.9
116-120	0	84	78.5	2	214	96.8
121-125	6	90	84.1	2	216	97.7
126-130	4	94	87.9	0	216	97.7
131-135	1	95	88.8	1	217	98.2
136-140	7	102	95.3	1	218	98.6
141-145	0	102	95.3	1	219	99.1
146-150	0	102	95.3	0	219	99.1
151-155	2	104	97.2	1	220	99.5
156-160	0	104	97.2	0	220	99.5
161+	3	107	100.0	1	221	100.0

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 5

Service Life, Years	Reinforced Concrete Pipe No.	Reinforced Concrete Pipe Cumulative Total	Reinforced Concrete Pipe Cumulative %	Corrugated Metal Pipe No.	Corrugated Metal Pipe Cumulative Total	Corrugated Metal Pipe Cumulative %
0-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	1	1	1.0	3	3	1.2
21-25	1	2	2.0	5	8	3.3
26-30	0	2	2.0	28	36	14.7
31-35	2	4	4.0	58	94	38.3
36-40	2	6	5.9	47	141	57.6
41-45	3	9	8.9	22	163	66.5
46-50	1	10	9.9	23	186	75.9
51-55	2	12	11.9	11	197	80.4
56-60	1	13	12.9	9	206	84.1
61-65	2	15	14.9	5	211	86.1
66-70	1	16	15.9	4	215	87.7
71-75	1	17	16.8	7	222	90.7
76-80	3	20	19.8	6	228	93.1
81-85	1	21	20.8	2	230	93.9
86-90	1	22	21.8	0	230	93.9
91-95	4	26	25.7	3	233	95.1
96-100	3	29	28.7	1	234	95.5
101-105	1	30	29.7	0	234	95.5
106-110	1	31	30.7	1	235	95.9
111-115	2	33	32.7	0	235	95.9
116-120	9	42	41.6	2	237	96.7
121-125	5	47	46.5	1	238	97.2
126-130	9	56	55.4	1	239	97.5
131-135	3	59	58.4	1	240	98.0
136-140	8	67	66.3	2	242	98.8
141-145	1	68	67.3	0	242	98.8
146-150	3	71	70.3	0	242	98.8
141-155	4	75	74.3	0	242	98.8
156-160	3	78	77.2	1	243	99.2
161+	23	101	100.0	2	245	100.0

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 6

Service Life, Years	Reinforced Concrete Pipe			Corrugated Metal Pipe		
		Cumulative			Cumulative	
	No.	Total	%	No.	Total	%
0-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	2	2	1.7	4	4	1.8
21-25	0	2	1.7	12	16	7.4
26-30	2	4	3.5	26	42	19.4
31-35	0	4	3.5	42	84	38.7
36-40	1	5	4.3	28	112	51.6
41-45	1	6	5.2	20	132	60.8
46-50	6	12	10.4	20	152	70.0
51-55	4	16	13.9	18	170	78.3
56-60	5	21	18.3	7	177	81.6
61-65	10	31	27.0	8	185	85.3
66-70	5	36	31.3	3	188	86.6
71-75	6	42	36.5	7	195	89.9
76-80	4	46	40.0	5	200	92.2
81-85	4	50	43.5	4	204	94.0
86-90	5	55	47.8	2	206	94.9
91-95	6	61	53.0	3	209	96.3
96-100	10	71	61.7	0	209	96.3
101-105	9	80	69.6	1	210	96.8
106-110	9	89	77.4	1	211	97.2
111-115	7	96	83.5	0	211	97.2
116-120	6	102	88.7	1	212	97.7
121-125	6	108	93.9	2	214	98.6
136-130	3	111	96.5	1	215	99.1
131-135	1	112	97.4	0	215	99.1
136-140	0	112	97.4	0	215	99.1
141-145	1	113	98.3	0	215	99.1
146-150	0	113	98.3	0	215	99.1
151-155	1	114	99.1	0	215	99.1
156-160	0	114	99.1	1	216	99.5
161+	1	115	100.0	1	217	100.0

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 7

Service Life, Years	Reinforced Concrete Pipe			Corrugated Metal Pipe		
		Cumulative			Cumulative	
	No.	Total	%	No.	Total	%
0-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	0	0	0	9	9	4.1
21-25	0	0	0	9	18	8.2
26-30	0	0	0	28	46	21.0
31-35	0	0	0	56	102	46.6
36-40	2	2	1.5	37	139	63.5
41-45	0	2	1.5	17	156	71.2
46-50	0	2	1.5	11	167	76.3
51-55	2	4	3.1	15	182	83.1
56-60	6	10	7.6	9	191	87.2
61-65	5	15	11.5	4	195	89.0
66-70	4	19	14.5	11	206	94.0
71-75	6	25	19.1	4	210	95.9
76-80	5	30	22.9	3	213	97.2
81-85	6	36	27.5	2	215	98.2
86-90	10	46	35.1	3	218	99.5
91-95	4	50	38.1	0	218	99.5
96-100	7	57	43.5	1	219	100.0
101-105	12	69	52.6			
106-110	5	74	56.5			
111-115	16	90	68.7			
116-120	5	95	72.5			
121-125	6	101	77.1			
126-130	7	108	82.4			
131-135	7	115	87.8			
136-140	0	115	87.8			
141-145	2	117	89.3			
146-150	4	121	92.4			
151-155	0	121	92.4			
156-160	3	124	94.7			
161+	7	131	100.0			

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 8

Service Life, Years	Reinforced Concrete Pipe			Corrugated Metal Pipe		
		Cumulative			Cumulative	
	No.	Total	%	No.	Total	%
0-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	0	0	0	0	0	0
21-25	0	0	0	1	1	0.5
26-30	0	0	0	13	14	6.7
31-35	0	0	0	29	43	20.7
36-40	0	0	0	28	71	34.1
41-45	0	0	0	19	90	43.3
46-50	1	1	1.6	23	113	54.3
51-55	0	1	1.6	12	125	60.1
56-60	0	1	1.6	18	143	68.8
61-65	0	1	1.6	12	155	74.5
66-70	1	2	3.2	13	168	80.8
71-75	4	6	9.7	5	173	83.2
76-80	4	10	16.1	11	184	88.5
81-85	2	12	19.4	4	188	90.4
86-90	5	17	27.4	7	195	93.8
91-95	4	21	33.9	3	198	95.2
96-100	6	27	43.5	0	198	95.2
101-105	2	29	46.8	2	200	96.2
106-110	3	32	51.6	0	200	96.2
111-115	7	39	62.9	2	202	97.1
116-120	3	42	67.7	0	202	97.1
121-125	3	45	72.6	0	202	97.1
126-130	1	46	74.2	1	203	97.6
131-135	1	47	75.8	2	205	98.6
136-140	1	48	77.4	0	205	98.6
141-145	1	49	79.0	0	205	98.6
146-150	2	51	82.3	0	205	98.6
151-155	0	51	82.3	0	205	98.6
156-160	0	51	82.3	1	206	99.0
161+	11	62	100.0	2	208	100.0

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 9

Service Life, Years	Reinforced Concrete Pipe No.	Reinforced Concrete Pipe Cumulative Total	Reinforced Concrete Pipe Cumulative %	Corrugated Metal Pipe No.	Corrugated Metal Pipe Cumulative Total	Corrugated Metal Pipe Cumulative %
0-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	0	0	0	1	1	0.5
21-25	0	0	0	0	1	0.5
26-30	0	0	0	5	6	3.0
31-35	0	0	0	37	43	21.6
36-40	0	0	0	28	71	35.7
41-45	0	0	0	23	94	47.2
46-50	0	0	0	30	124	62.3
51-55	0	0	0	28	152	76.4
56-60	1	1	1.1	4	156	78.4
61-65	0	1	1.1	14	170	85.4
66-70	4	5	5.6	9	179	89.9
71-75	3	8	8.9	8	187	94.0
76-80	9	17	18.9	9	196	98.5
81-85	0	17	18.9	0	196	98.5
86-90	2	19	21.1	0	196	98.5
91-95	3	22	24.4	0	196	98.5
96-100	1	23	25.5	1	197	99.0
101-105	8	31	34.4	1	198	99.5
106-110	2	33	36.7	1	199	100.0
111-115	4	37	41.1			
116-120	6	43	47.8			
121-125	6	49	54.4			
126-130	6	55	61.1			
131-135	6	61	67.8			
136-140	2	63	70.0			
141-145	2	65	72.2			
146-150	3	68	75.6			
151-155	11	79	87.8			
156-160	2	81	90.0			
161+	9	90	100.0			

FREQUENCY DISTRIBUTION
CULVERT SURVEY-1964

District 10

Service Life, Years	Reinforced Concrete Pipe			Corrugated Metal Pipe		
		Cumulative			Cumulative	
	No.	Total	%	No.	Total	%
0-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	0	0	0	0	0	0
21-25	0	0	0	5	5	2.2
26-30	0	0	0	19	24	10.3
31-35	0	0	0	57	81	34.9
36-40	1	1	1.5	41	122	52.6
41-45	1	2	3.1	39	161	69.4
46-50	-	-	3.1	31	192	82.8
51-55	-	-	3.1	13	205	88.4
56-60	-	-	3.1	11	216	93.1
61-65	3	5	7.7	4	220	94.8
66-70	5	10	15.4	5	225	97.0
71-75	2	12	18.5	1	226	97.4
76-80	1	13	20.0	-	226	97.4
81-85	4	17	26.1	3	229	98.7
86-90	7	24	36.9	-	229	98.7
91-95	5	29	44.6	2	231	99.6
96-100	2	31	47.7	-	231	99.6
101-105	3	34	52.3	-	231	99.6
106-110	8	42	64.6	-	231	99.6
111-115	4	46	70.8	1	232	100.0
116-120	4	50	76.9			
121-125	6	56	86.2			
126-130	3	59	90.8			
131-135	1	60	92.3			
136-140	-	60	92.3			
141-145	3	63	96.9			
146-150	-	-	96.9			
151-155	-	-	96.9			
156-160	2	65	100.0			
161+						

Final Rating - Yearly Deterioration - Life Expectancy Calculations for Corrugated Metal and Reinforced Concrete Pipe

The life expectancy and yearly deterioration of culvert pipe are calculated from an estimated rating system. The culverts are rated as to material condition and also as to structural condition. The final rating is computed from the structural and material ratings. The mean of the inlet and outlet rating is the material rating. The F.R. (final rating) equals the lower of the two ratings added to the square root of the difference between the two ratings.

The average Y.D. (yearly deterioration) is computed from the age of the pipe at the time of rating and the final rating as shown:

$$\text{Y.D.} = \frac{100 - \text{F.R.}}{\text{Age}}$$

The L.E. (life expectancy) is calculated from the computed yearly deterioration as follows:

$$\text{L.E.} = \frac{100}{\text{Y.D.}}$$

It can be seen in the formula for the final rating that a culvert with a zero final rating must have both material and structural rating at zero and actually cease to function as a culvert.

Example:

Material Rating		Structural Rating	Age
I	O		
50	60	80	20 yrs.

$$\text{F.R.} = (80 - 55)^{1/2} + 55 = 5 + 55 = 60$$

$$\text{Y.D.} = \frac{100 - 60}{20} = 2.00$$

$$\text{L.E.} = \frac{100}{2.00} = 50$$

Determine age to nearest three months. Carry Y.D. to nearest one hundredth; carry F.R. and L.E. to the nearest whole number.

REINFORCED CONCRETE PIPE

Material Rating

Rating	Softening	Weathering or Disintegration	Erosive Losses	Spalling
90	None	Practically none	None	None
85	Slight	Very slight	Very slight	Slight in a few places
80	Slight	Slight	Slight	Occasional slight
75	Moderate	Slight	Moderate	Moderate
70	Moderate	Moderate	Appreciable	Moderate
65-50	Appreciable	Appreciable	Advanced	Moderate
45-30	Advanced	Advanced	Deep	Advanced
25-10	Deep	Extreme in barrel	Very deep	Extreme
5	Completely through	Through pipe	Eroded through in places	

CONCRETE PIPE
STRUCTURAL RATING

Rating	Cracks and Conditions Resulting From Cracks	Joint Condition	Alignment
90	Fine or short cracks in end sections.	Tight	Straight or smooth
85	Short or fine cracks and/or full coarse crack in an end section.	1 or more joint loosening	Sections of pipe not on smooth alignment. Some joints off vertically 0 to 1/48D from line of adjacent joints.
80	One full fine crack and/or 1 full coarse crack in each end section.	1 joint loosened and/or both end joints loosened.	Sections of pipe not on smooth alignment. Some joints off 1/48D to 1/24D from line of adjacent joints.
75	Two full fine cracks and/or 1 full open crack in an end section.	2 or 3 joints loosened and/or one or both end joints open.	Sections of pipe not on smooth alignment. Some joints off 1/24D to 1/16D from line of adjacent joints.
70-65	One or two full coarse cracks or 3 or more full fine cracks and/or 1 full open crack in both end sections plus other cracks coarse or fine.	4 or more joints loosened and/or one or both end joints open or open and faulted not over 1/12D.	Sections of pipe not on smooth alignment. Some joints off over 1/16D or waviness so great that adverse grade in one or more sections traps water or soil.
60-45	Two or more sections with 2 full coarse cracks or one or more sections with 3 or 4 full coarse cracks (or 1 full open plus 1 full coarse). And/or one or two end sections broken into 4 or more pieces by open cracks and flattened.	One joint open 0 to 1" or faulted not over 1/12D and/or one or both end sections open and faulted over 1/12D.	
40-25	One or more sections with 3 or 4 full cracks at least 2 of which are open separating pipe into 2 or more pieces, still in place. Slight flattening of diameter and/or faulting of cracks.	One joint open over 1" and/or faulted over 1/12D or two or more joints open and/or faulted less than 1/12D.	

Rating	Cracks and Conditions Resulting from Cracks	Joint Condition	Alignment
20-5	One or more sections broken into 4 or more separate pieces by open cracks and pieces loose or gone allowing undercutting or fill to fall into culvert.	Opening or faulting so badly that fills falling into culvert or undercutting endangers culvert.	
0	Culvert in need of immediate replacement.		

Definitions:

Loosening = Spigot has moved in bell but opening between end of spigot and base of socket is less than 1/2 depth of socket.

Loosened = Opening between end of spigot and base of socket is greater than 1/2 depth of socket and less than depth of socket.

Open = Spigot is out of bell.

CORRUGATED METAL CULVERTS
MATERIAL RATING

RATING	MATERIAL CONDITION	DESCRIPTION
90	No rust	No discoloration evident but spangles may be obliterated and invert darkened. (Only culverts at least 10 years old will be given this rating; culverts less than 10 years old will be given a pro-rated rating between 99 and 90, depending on age.)
85	Slight spot rust	Slight discoloration in spots of 1" maximum size, which are easily removed by wire brushing. These spots are not visible after brushing.
80	Moderate spot rust	More visible discoloration in spots of 1" maximum size, accompanied by light nodular or warty growth and/or light pitting of surface. When brushed lightly with wire brush these spots are clearly visible and depth of pits and/or loss of base metal is estimated at approximately 10%.
75	Appreciable spot rust	Deep discoloration in spots of 1" maximum size accompanied by medium coatings of warty or nodular growth or pitting. When surface is brushed lightly with wire brush these spots are clearly visible and depth of pits and/or loss of base metal is estimated at 20%.
75	Areas of slight to light rust	Areas larger than spots to a maximum of 1/4 of invert covered with a slight discoloration. When these areas are brushed no pitting or loss of base metal is evident.
70	Considerable areas of slight to light rust	Same as above in areas from 1/4 of invert to 3/4 of invert.
65	Light rust invert	Same as above completely covering invert. Very slight pitting may be noticed but no loss of base metal.
60	Moderate rust invert	Invert completely covered with rust, with a light coating of warty or nodular growth and/or light pitting. Rust areas are clearly visible after brushing with depth of pits and loss of base metal estimated at 10%.

RATING	MATERIAL CONDITION	DESCRIPTION
55	Appreciable rust invert	Invert completely covered with rust, with a medium coating of warty or nodular growth and/or medium pitting. Rust areas are clearly visible after brushing with depths of pits and loss of base metal estimated at 20%.
50-35	Advanced rust invert	Invert completely covered with rust, with a heavy coating of growth and/or decided pitting. Depth of pits and loss of base metal estimated at 30 to 50%. At upper extreme of range metal cannot be dented by light blows of geologist pick while at lower extreme the metal can be dented.
30-15	Corroded or abraded nearly through	Complete rusting of invert with heavy pitting and loss of base metal ranging from 60% to 90%. In the upper extreme of this range metal is easily dented with light blows of pick, while at the lower extreme metal is punctured easily by light blows of pick.
10	Small hole or holes in invert	One or more small holes (maximum 1") in invert.
5	Areas of invert rusted out	One or more larger holes in invert (from 1" holes to 1/2 of invert rusted out).
0	Complete invert rusted out.	

CORRUGATED METAL CULVERTS

Structural Rating

Rating	Alignment	Deflection	Joint Condition
90	Straight-sag or deviation in alignment less than 1/4" per 10' length of culvert.	Less than 1/40D	Tight
85	Slight sag or deviation of alignment slightly in excess of 1/4" per 10' length of culvert.	1/40D to 1/20D	Loosening - A small movement
80	Slight sag or deviation of alignment slightly in excess of 1/4" per 10' length of culvert.	1/40D to 1/20D	Loosened - Movement at joints without being open.
75	Moderate sag or deviation of alignment of about 1/2" per 10' length of culvert.	1/40D to 1/20D	Loosened - Movement at joints without being open.
70	Moderate sag or deviation of alignment of about 1/2" per 10' length of culvert.	1/40D to 1/20D	Opening
65	Appreciable sag or deviation of alignment of 1" per 10' length of culvert.	1/20D to 1/8D	Opening
60-55	Appreciable sag or deviation of alignment of 1" per 10' length of culvert.	1/20D to 1/8D	Joints pulled apart without vertical movement.
50-35	Advanced sagging or deviation in alignment	More than 1/8D	Joints open due to vertical movement of sections or seams being torn at rivets.

Rating	Alignment	Deflection	Joint Condition
30-15	Extreme sagging or change of alignment.	Barrel being crushed down.	Vertical movement causing joints to open with fill falling in or serious undercutting or faulting between sections.
10-5	Extremely bad sagging or change of alignment.	Barrel crushed down.	Joints opened at bands to extent that fill is falling in and nearly blocking flow. Seams torn out at rivets about to cause collapse.
0	Culvert no longer functions.		

Alignment - When rating off for lack of correct alignment a differentiation should be made if possible between angles between sections apparently built in and those formed by fill settlement. Generally, the former are not detrimental if the slopes of both sections are sufficient to prevent concentration of water and the joints are closed. Also, a differentiation should be made between poor alignment caused by angles between sections and an actual bending of a section which is likely to develop into a more serious condition.

Deflection is the formation of the cross-section of the pipe and is recorded as the maximum amount in inches by which any diameter (usually the vertical) is shortened. Under this heading may be included dents due to impact (by rocks in backfilling or traffic with lack of cover) but do not rate off as severely for short dents as for deflection which generally occurs for some distance along the pipe.

CULVERT INSPECTION REPORT
Reinforced Concrete Pipe

COUNTY ______________________ DATE INSPECTED ______________

ROUTE ______________________ ODOMETER ______________

PROJECT OR SECTION ______________________ STATION ______________

DIA.	LENGTH Pipe	LENGTH Section	SERVICE TYPE	DEPTH OF COVER Inlet	DEPTH OF COVER Outlet	DRAINS	SLOPE

SCOURING I	SCOURING O	FILLING I	FILLING O	WATER I	WATER O	ABRASIVE MAT. Amount	ABRASIVE MAT. Type	FLOW Cont.	FLOW Int.	WATERSHED

END PROTECTION

STRUCTURAL CONDITION

JOINTS

TIGHTNESS		SMOOTHNESS	
Tight		Smooth	
Loosening		Sli.Rough	
Loosened		Rough	
Open		Very Rough	

ALIGNMENT

	Vert.	Horiz.
Straight		
Sli. Wavy		
Wavy		
Very Wavy		

MATERIAL CONDITION

Softening

Disintegration

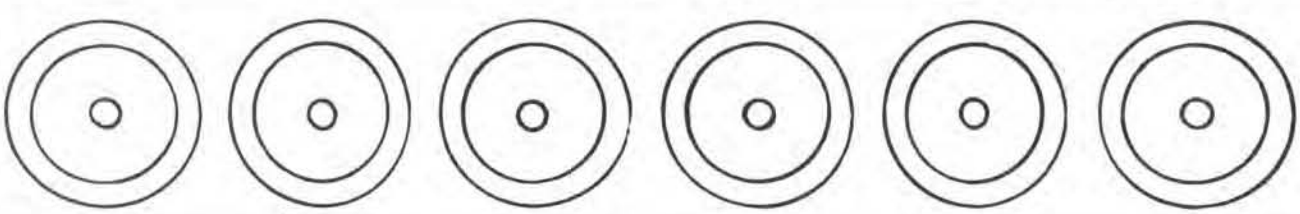
Erosion

Spalling

RATING

Material I	Material O	Structural

F.R.	Y.D.	L.E.



Remarks:

CULVERT INSPECTION REPORT
Corrugated Metal Pipe

COUNTY ______________________ DATE INSPECTED ______________

ROUTE ______________________ ODOMETER ______________

PROJECT OR SECTION ______________ STATION ______________

DIA.	LENGTH	SERVICE TYPE	DEPTH OF COVER Inlet	Outlet	DRAINS	SLOPE

RIVET POSITION Inlet	Outlet	LAP POSITION Inlet	Outlet	Identification Tag
				Brand Date Gage

Scouring I	O	Filling I	O	Water I	O	Abrasive Mat. Amount	Type	Flow Cont.	Int.	Watershed

END PROTECTION

STRUCTURAL CONDITION

Alignment Vert.	Horiz.	Deflection	Joint Condition	Remarks

MATERIAL CONDITION

Inlet ______________________

Center ______________________

Outlet ______________________

RATING

Material I	O	Structural	F.R.	Y.D.	L.E.

Remarks:

INSTRUCTIONS FOR CULVERT INSPECTION REPORT BLANKS

Reinforced Concrete Pipe

County - Route - Section - Project:- Fill in all information that applies.

Odometer:- Show odometer distance from some well defined point, which is used as a reference point throughout section or project and is described on "Culvert Survey Project Information" sheet.

Station:- If known, show station. If not known, place dash here.

Date Inspected:- Show date of inspection.

Diameter:- Show nominal diameter of pipe.

Length:- Show approximate length of culvert and length of individual sections.

Service Type:- Show one of the two following types:
Cross-drainage, when under the roadway;
Side road, when under a private side road or crossroad.

Depth of Cover:- I (inlet) show minimum depth of cover under traveled surface. O (outlet) show maximum depth of cover.

Drains:- Indicate direction of flow through culvert by right or left when standing in the direction of the odometer readings.

Slope:- Show slope through culvert in percent grade.

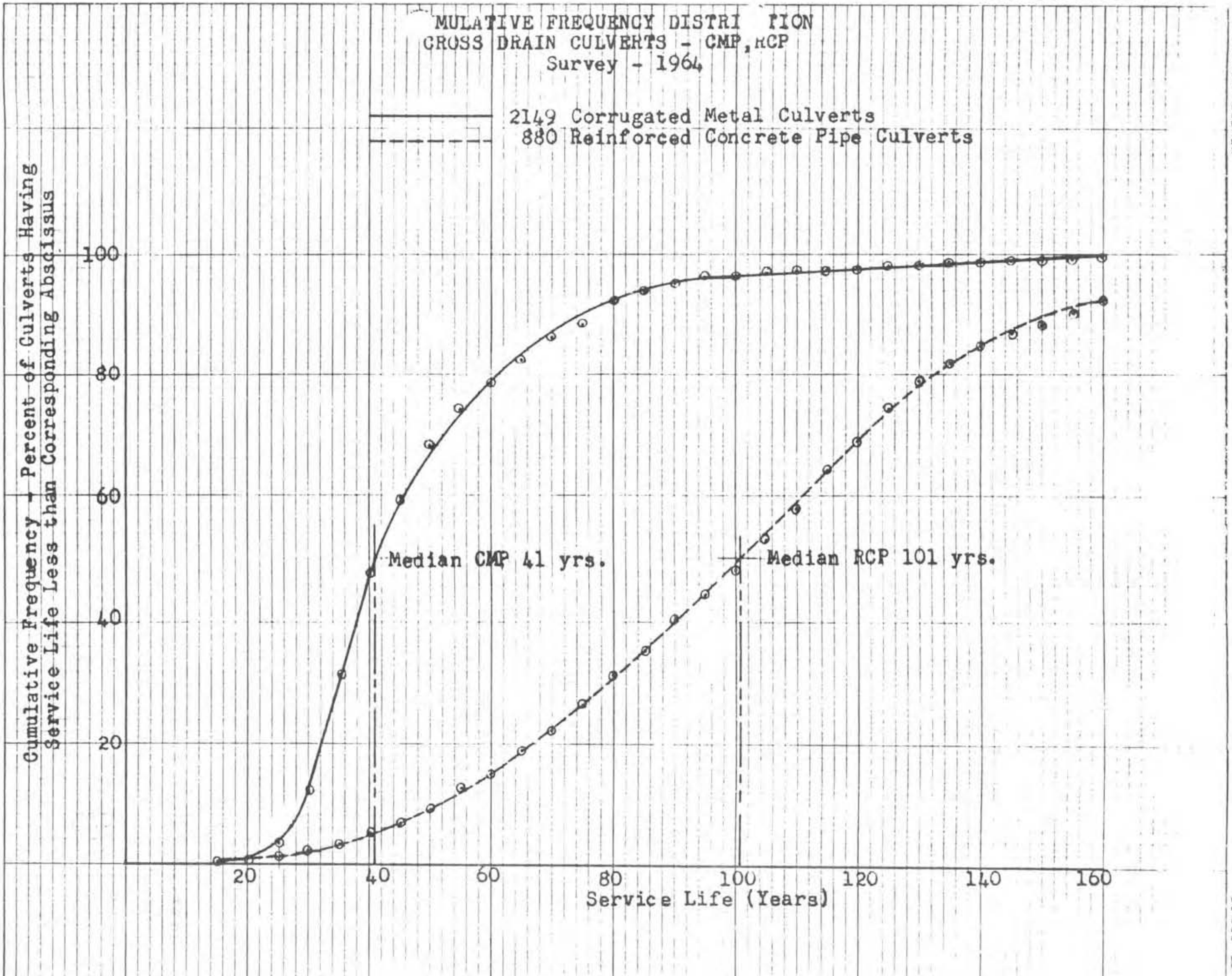
Scouring:- I (inlet), O (outlet) Place a check mark when scouring

Filling:- I (inlet), O (outlet) If filling, show depth in inches.

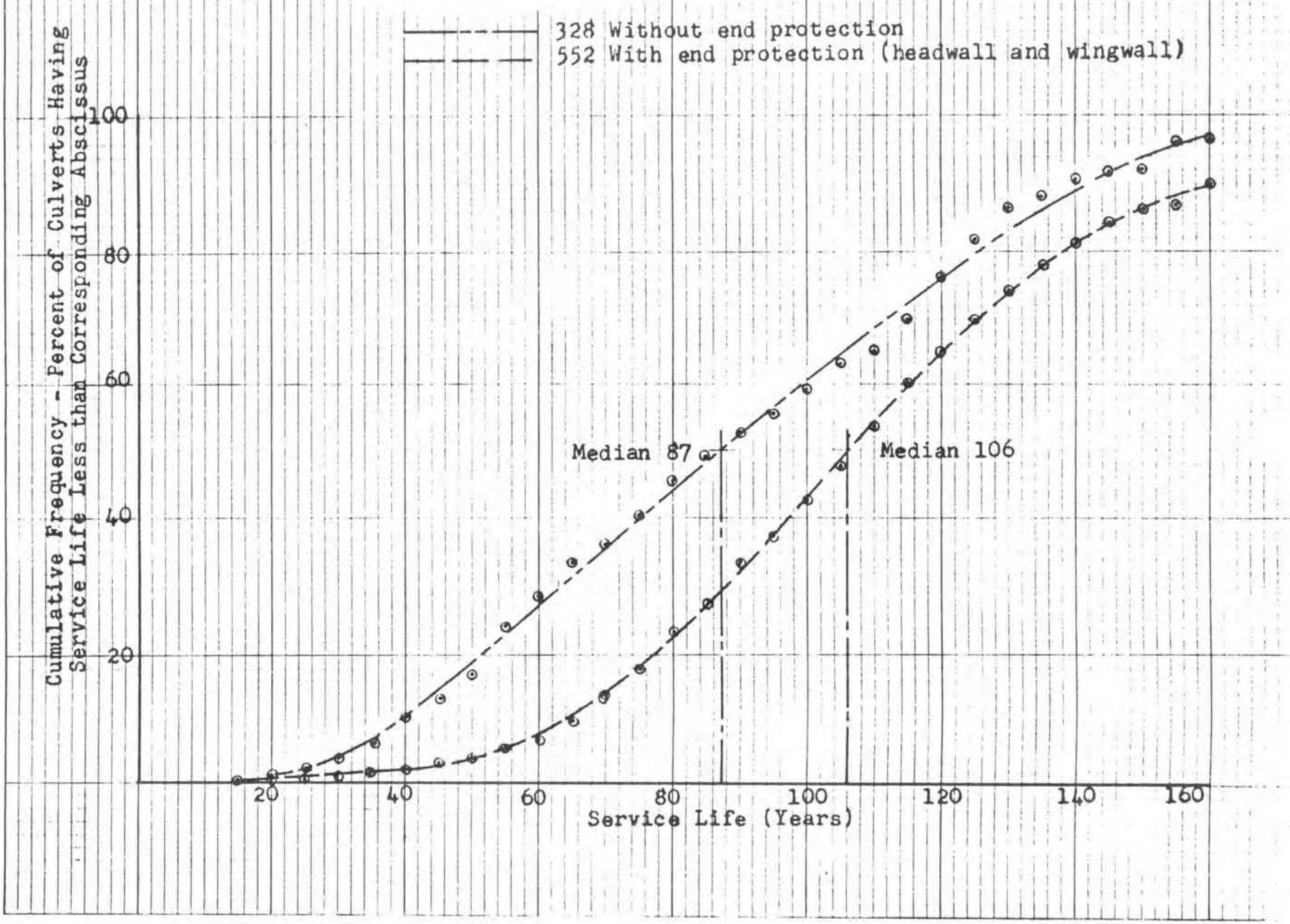
Water:- I (inlet), O (outlet) If water standing, show depth in inches.

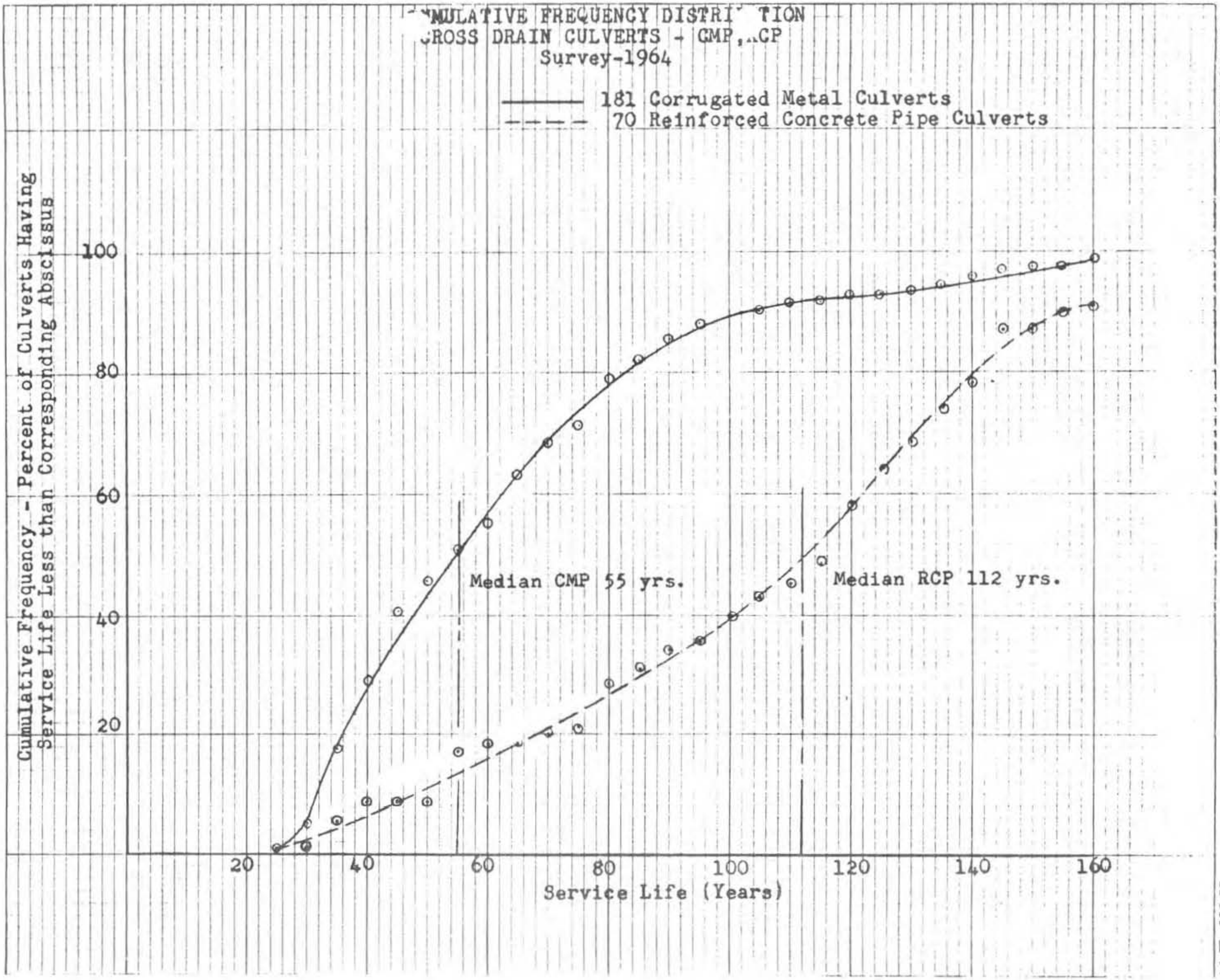
Abrasive Mat.:- Amount - state whether the amount of abrasive material carried through the culvert is small, moderate, or considerable.
Type - state whether material carried through culvert is silt, sand, or gravel, etc.

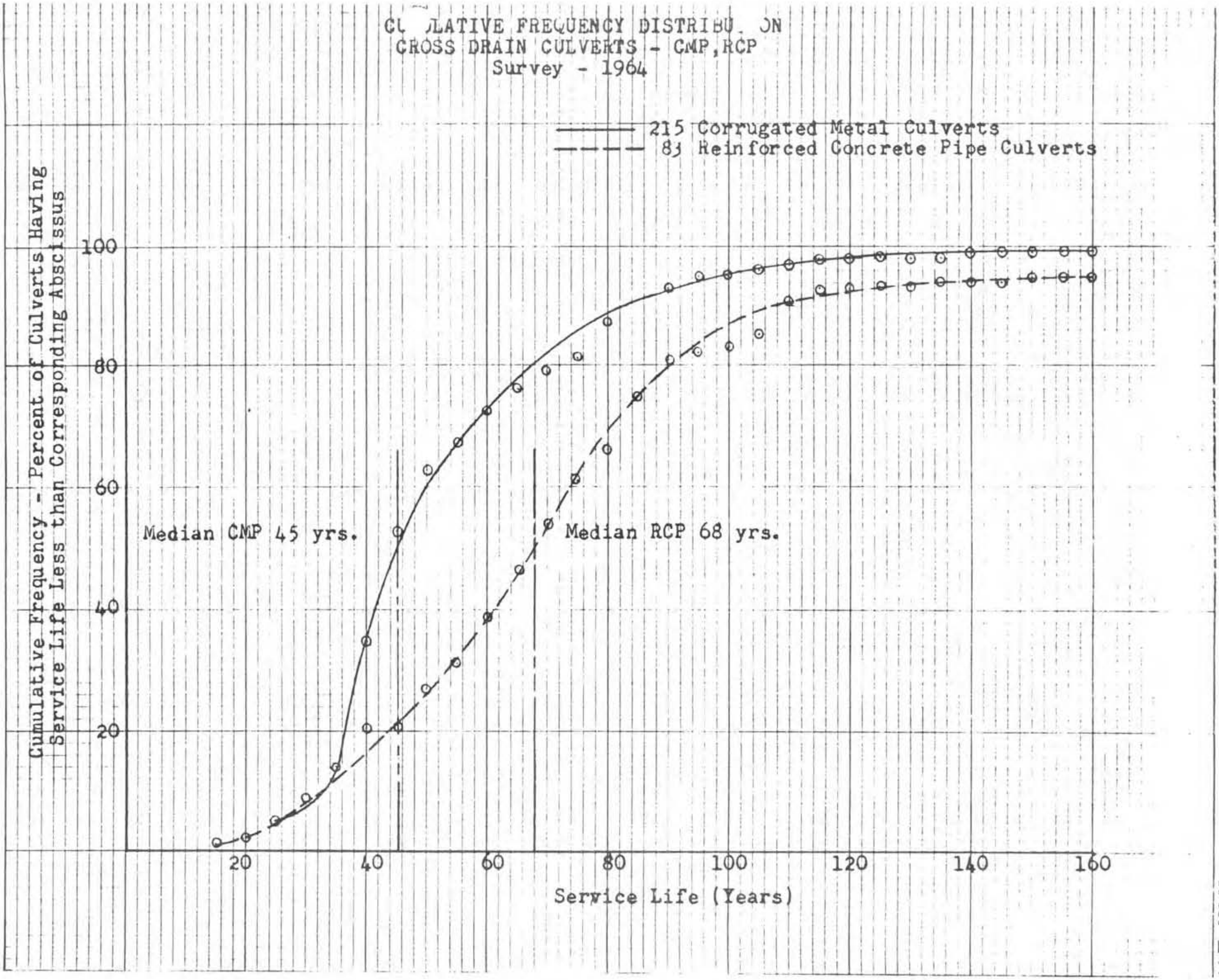
Flow:- Place check mark to show whether flow is continuous or intermittent.


MULATIVE FREQUENCY DISTRI TION
CROSS DRAIN CULVERTS - CMP, RCP
Survey - 1964
2149 Corrugated Metal Culverts
880 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having
Service Life Less than Corresponding Abscissus
100
80
60
40
20
Median CMP 41 yrs.
Median RCP 101 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)

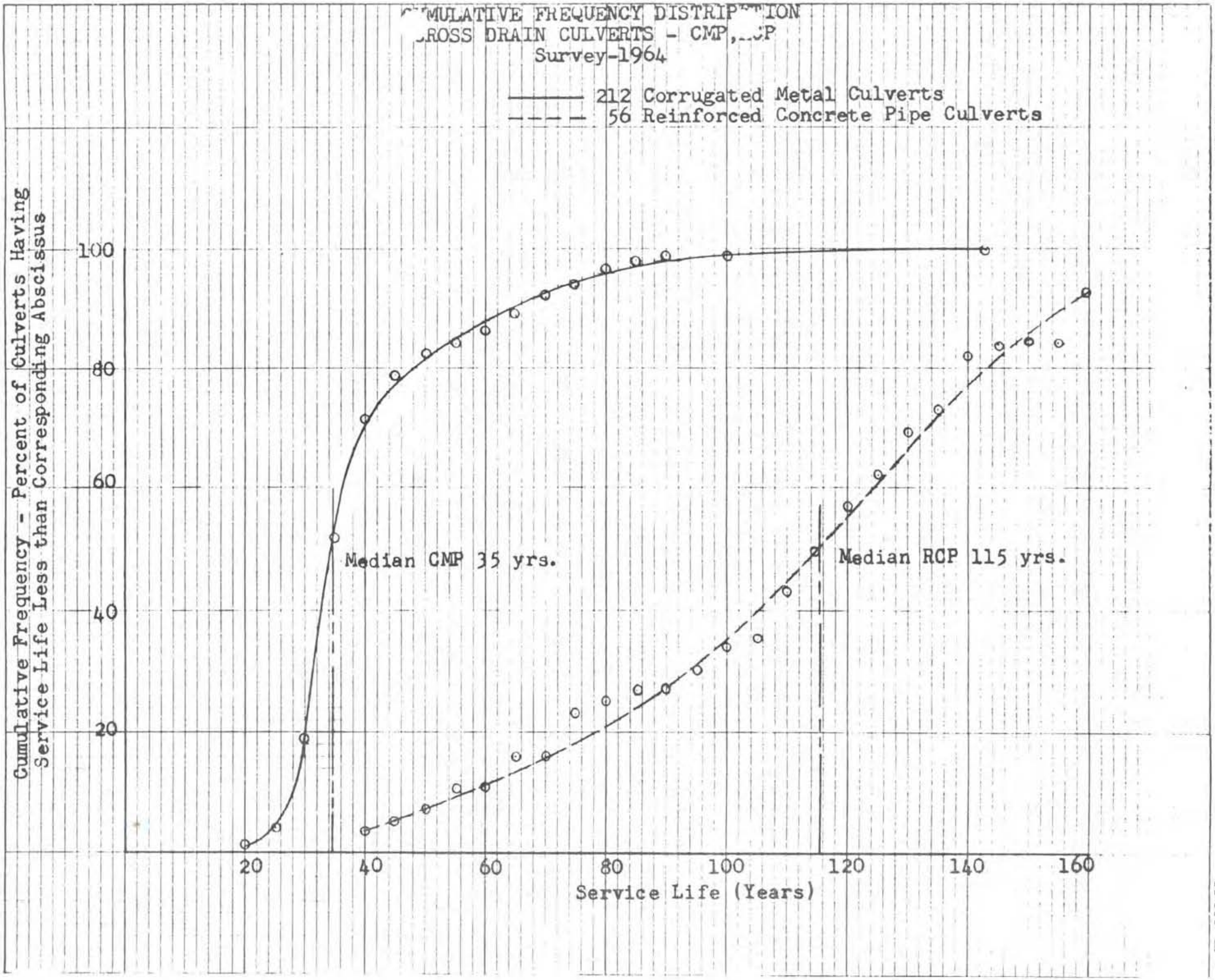
C(JLATIVE FREQUENCY DISTRIBU ON
CONCRETE PIPE CULVERTS WITH AND WITHOUT END PROTECTION
Survey - 1964
All Districts



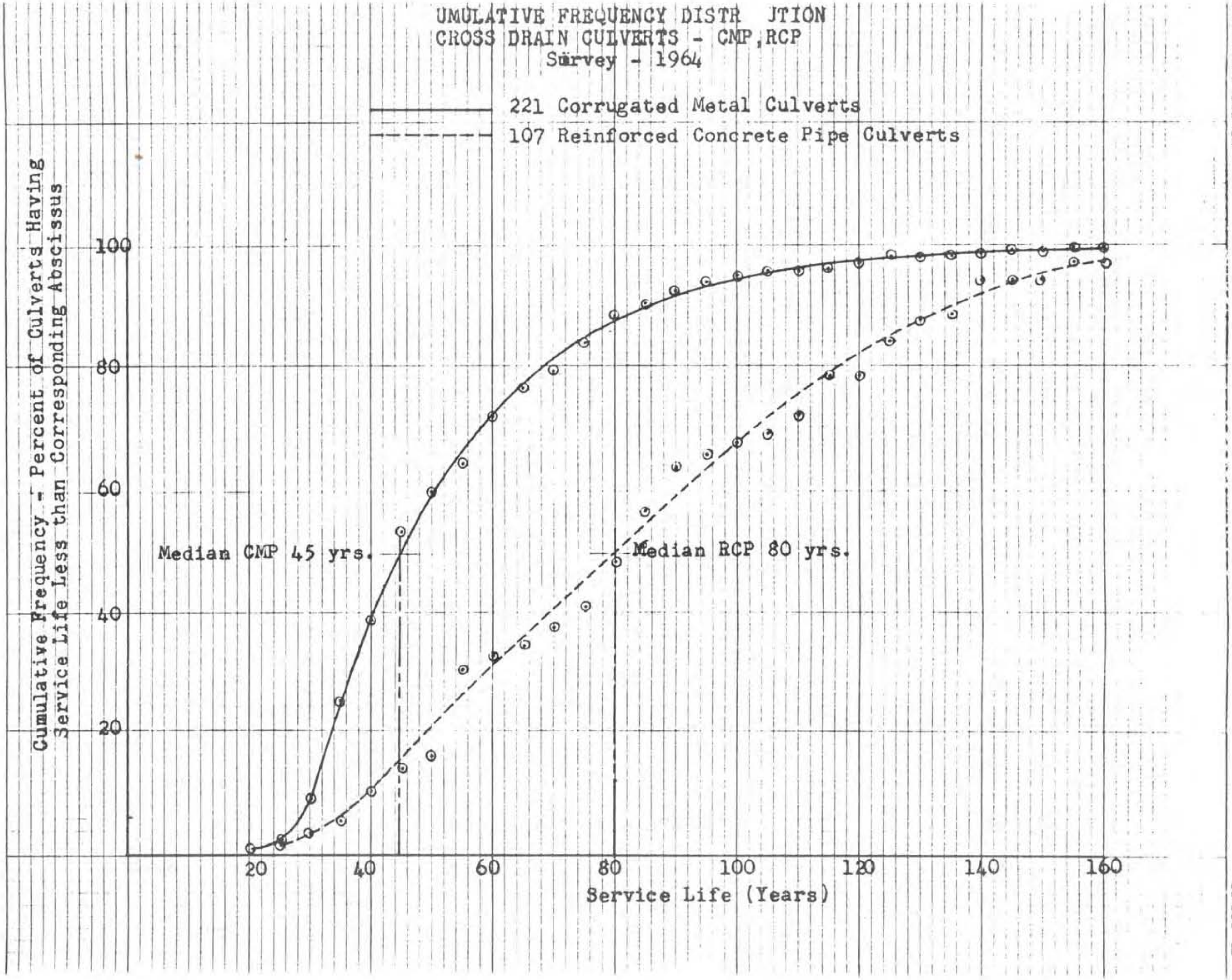

MULATIVE FREQUENCY DISTRI TION
CROSS DRAIN CULVERTS - CMP, CP
Survey-1964
181 Corrugated Metal Culverts
70 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having Service Life Less than Corresponding Abscissus
100
80
60
40
20
Median CMP 55 yrs.
Median RCP 112 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)



CU LATIVE FREQUENCY DISTRIBU ON
CROSS DRAIN CULVERTS - CMP, RCP
Survey - 1964
215 Corrugated Metal Culverts
83 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having Service Life Less than Corresponding Abscissus
100
80
60
40
20
Median CMP 45 yrs.
Median RCP 68 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)

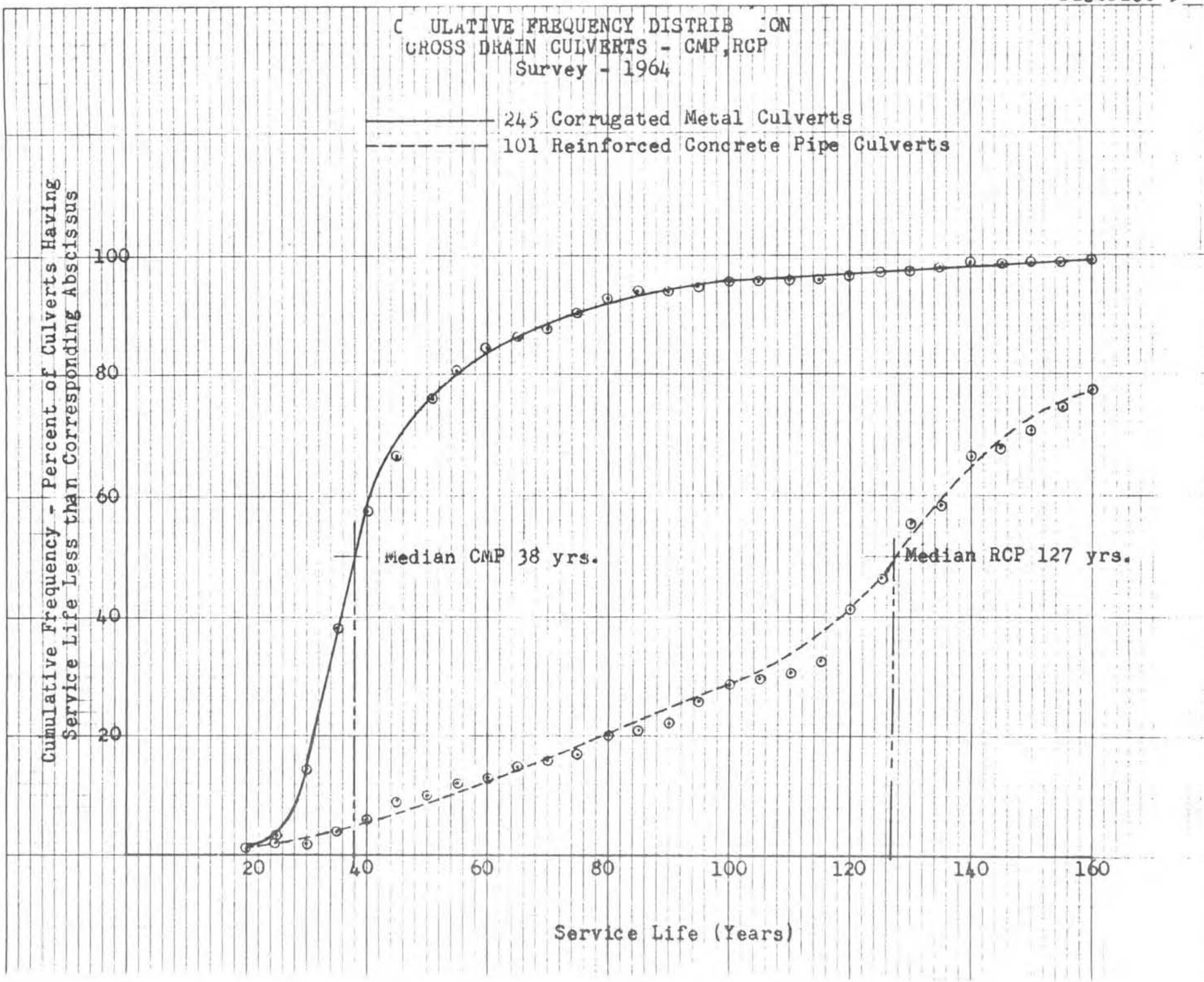


MULATIVE FREQUENCY DISTRIP ION
ROSS DRAIN CULVERTS - CMP,
Survey-1964
212 Corrugated Metal Culverts
56 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having
Service Life Less than Corresponding Abscissus
100
80
60
40
20
Median CMP 35 yrs.
Median RCP 115 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)

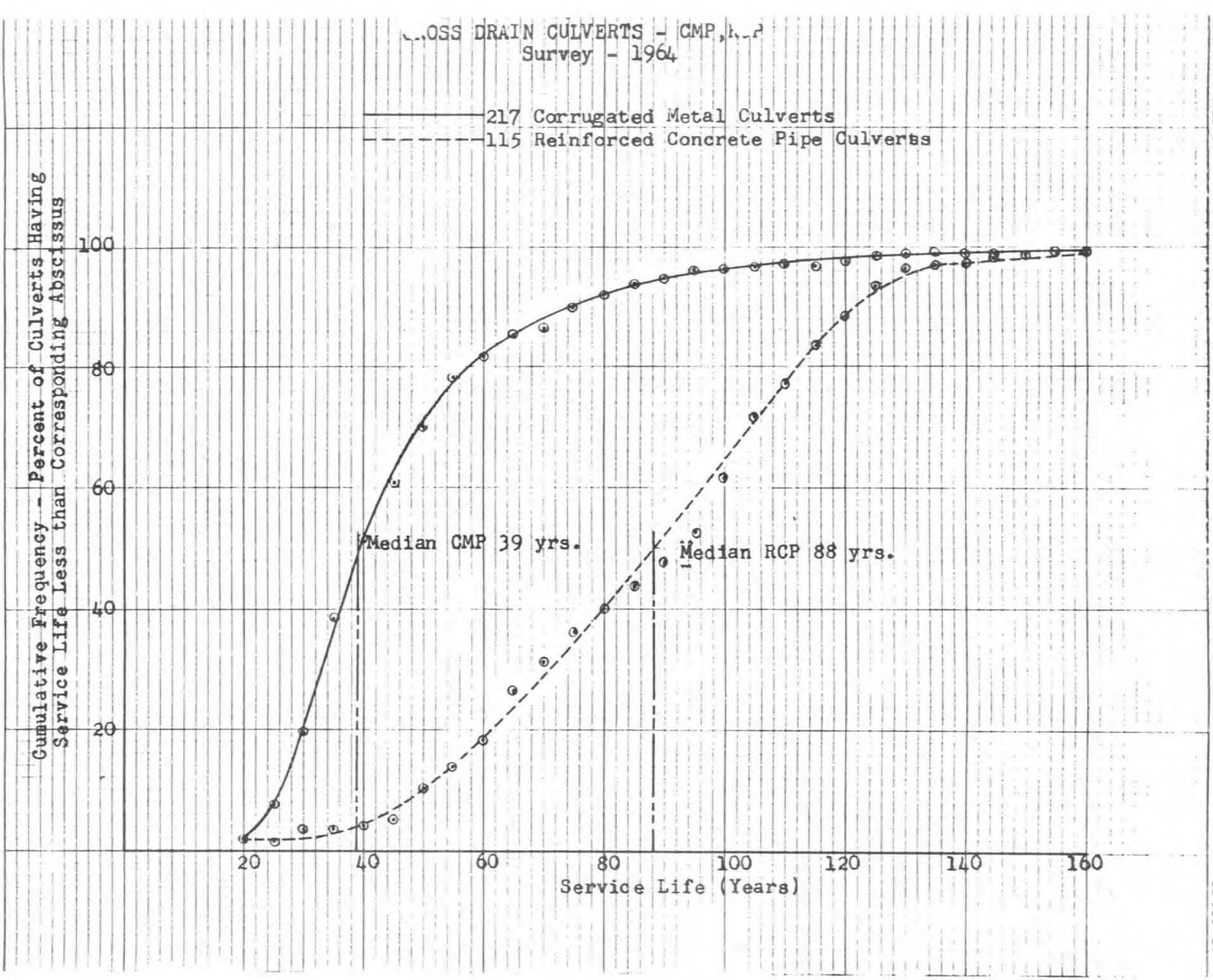


UMULATIVE FREQUENCY DISTR JTION
CROSS DRAIN CULVERTS - CMP,RCP
Sürvey - 1964
221 Corrugated Metal Culverts
107 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having Service Life Less than Corresponding Abscissus
Median CMP 45 yrs.
Median RCP 80 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)

District 5

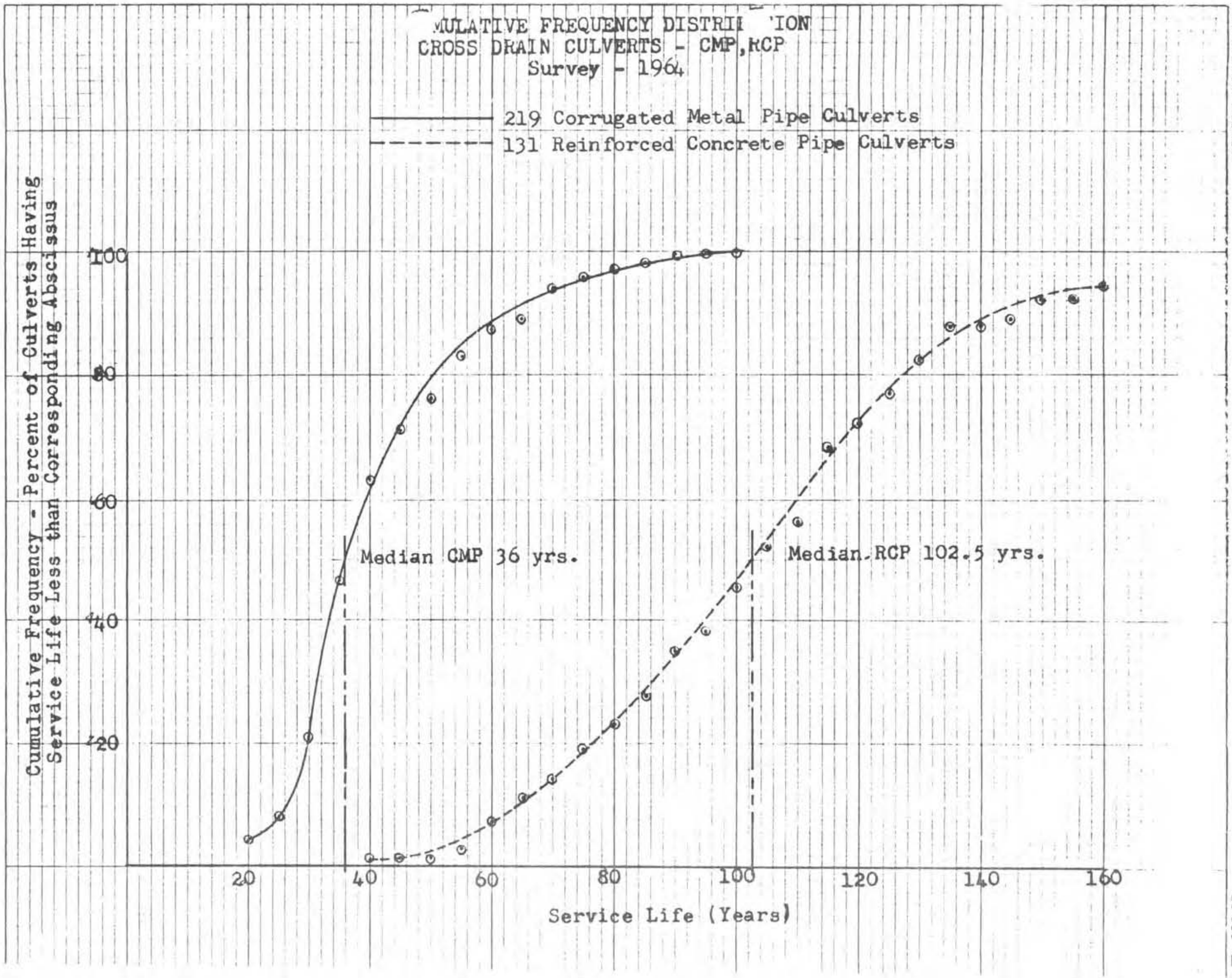


C ULATIVE FREQUENCY DISTRIB ION
CROSS DRAIN CULVERTS - CMP,RCP
Survey - 1964
245 Corrugated Metal Culverts
101 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having Service Life Less than Corresponding Abscissus
Median CMP 38 yrs.
Median RCP 127 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)

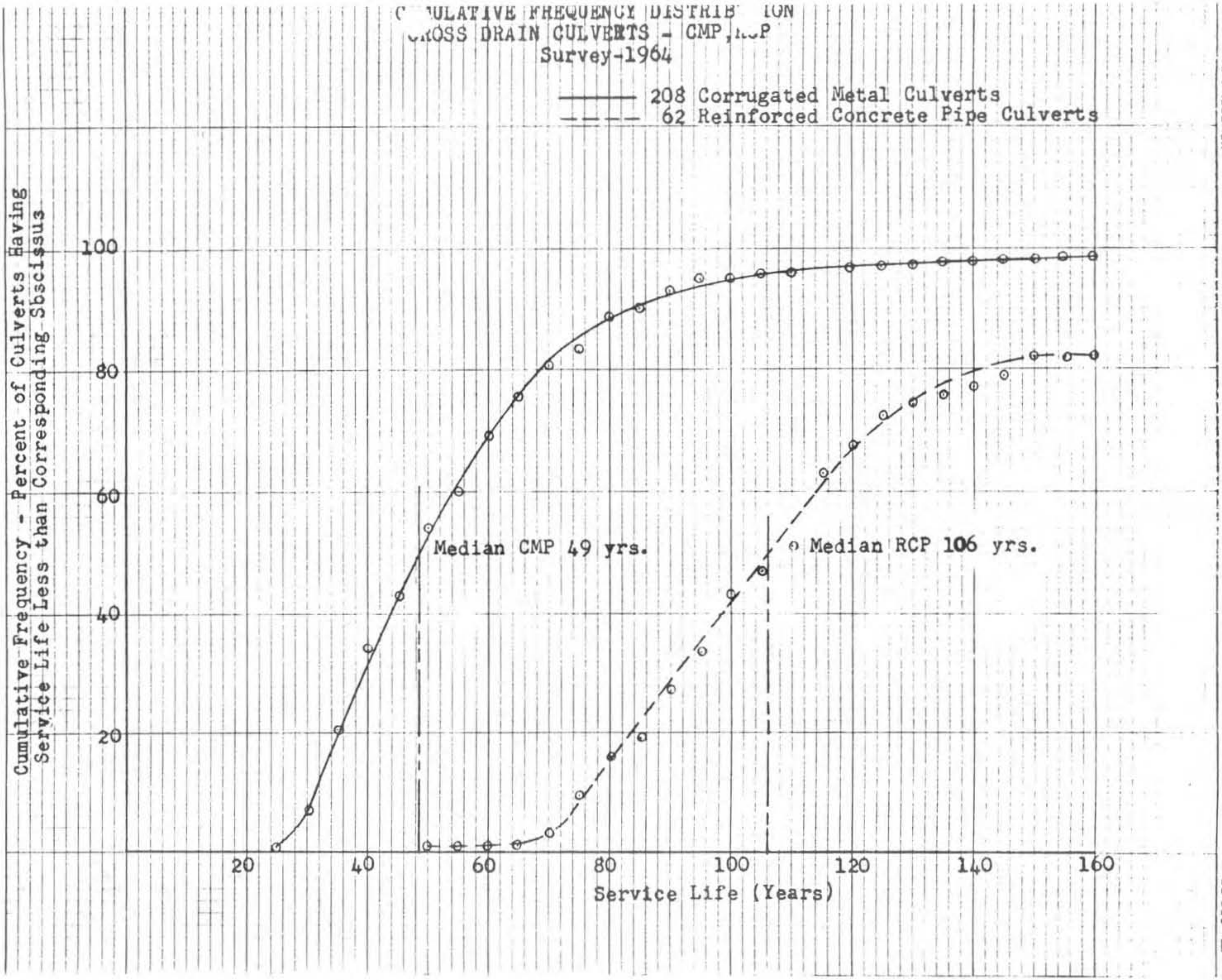


CROSS DRAIN CULVERTS - CMP, RCP
Survey - 1964
217 Corrugated Metal Culverts
115 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having Service Life Less than Corresponding Abscissus
100
80
60
40
20
Median CMP 39 yrs.
Median RCP 88 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)

District 7

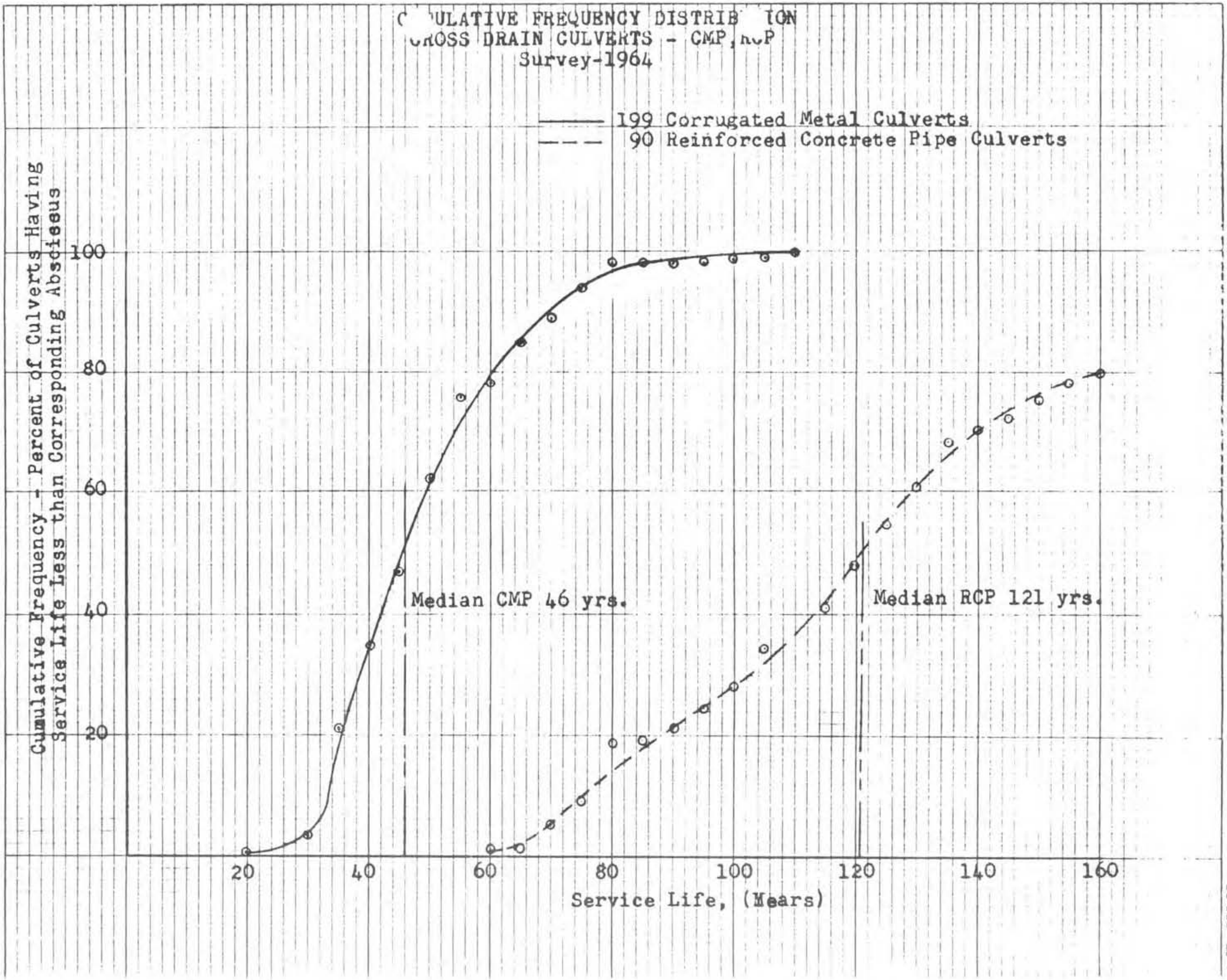


MULATIVE FREQUENCY DISTRIB TION
CROSS DRAIN CULVERTS - CMP, RCP
Survey - 1964
219 Corrugated Metal Pipe Culverts
131 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having Service Life Less than Corresponding Abscissus
100
80
60
40
20
Median CMP 36 yrs.
Median RCP 102.5 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)

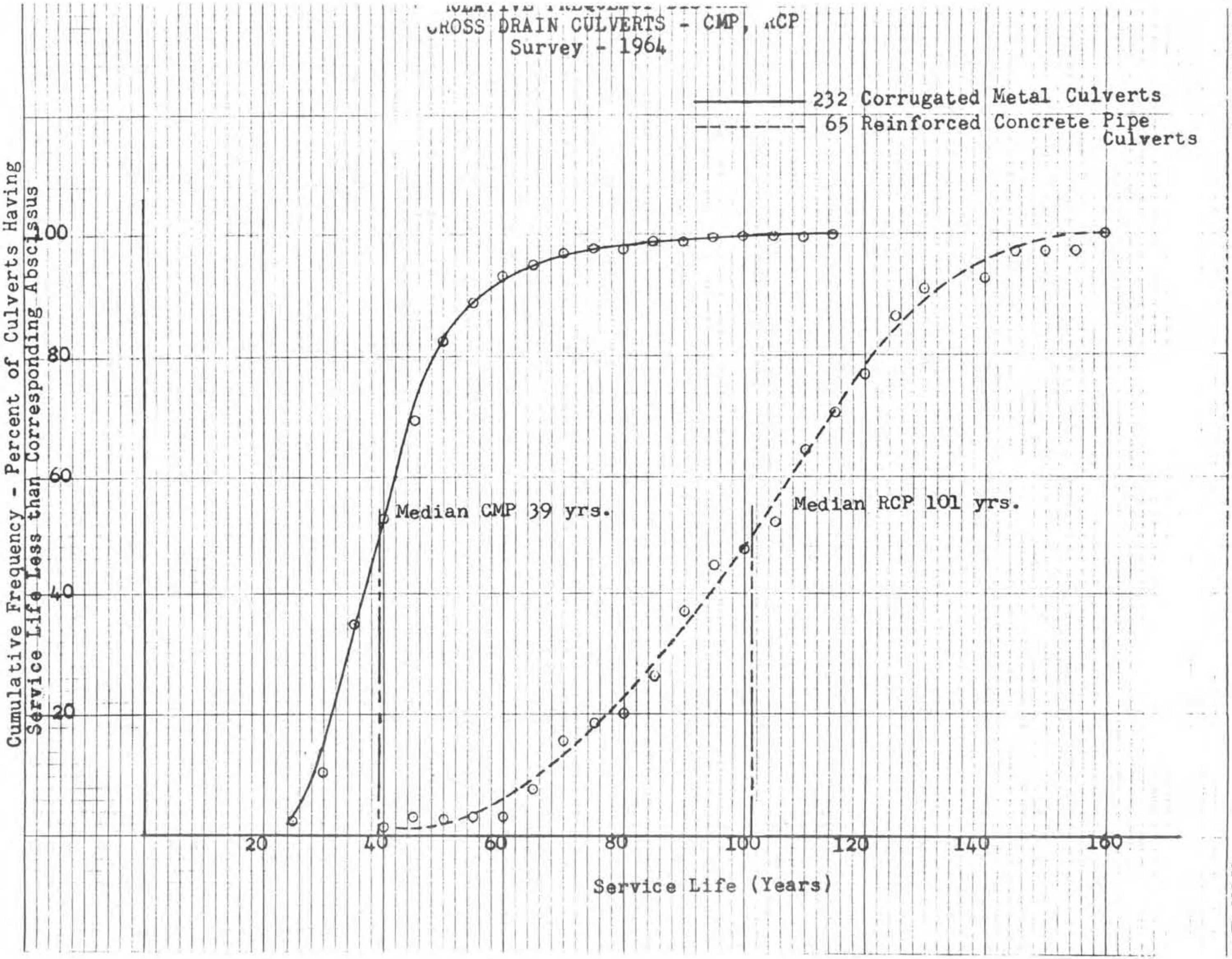


CUMULATIVE FREQUENCY DISTRIBUTION
CROSS DRAIN CULVERTS - CMP, RCP
Survey-1964
208 Corrugated Metal Culverts
62 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having
Service Life Less than Corresponding Sbscissus
100
80
60
40
20
Median CMP 49 yrs.
Median RCP 106 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)

District 9



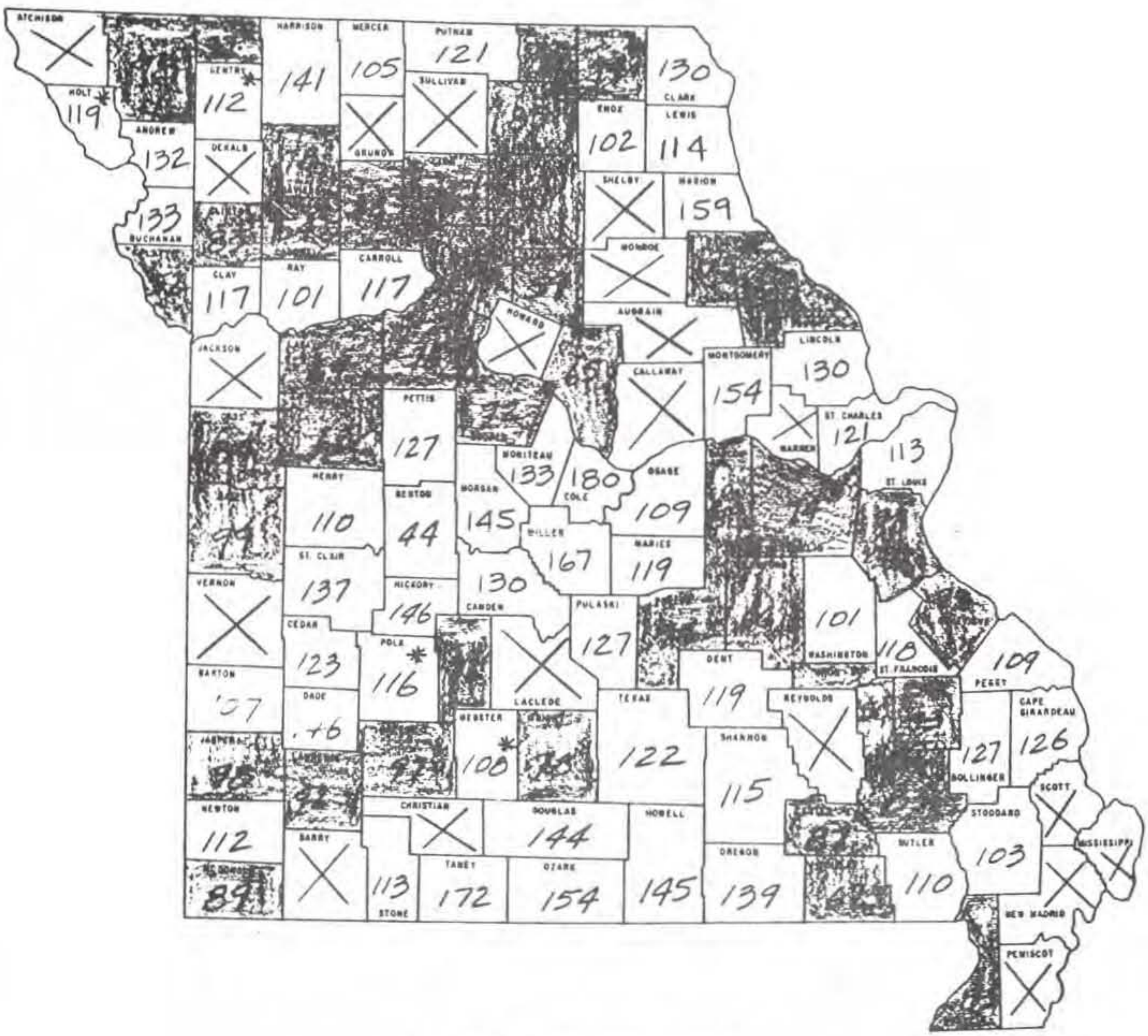
C ULATIVE FREQUENCY DISTRIB ION
CROSS DRAIN CULVERTS - CMP, RCP
Survey-1964
199 Corrugated Metal Culverts
90 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having
Service Life Less than Corresponding Abscissus
100
80
60
40
20
Median CMP 46 yrs.
Median RCP 121 yrs.
20
40
60
80
100
120
140
160
Service Life, (Years)


CROSS DRAIN CULVERTS - CMP, RCP
Survey - 1964
232 Corrugated Metal Culverts
65 Reinforced Concrete Pipe Culverts
Cumulative Frequency - Percent of Culverts Having Service Life Less than Corresponding Abscissus
Median CMP 39 yrs.
Median RCP 101 yrs.
20
40
60
80
100
120
140
160
Service Life (Years)

COUNTY MEDIAN LIFE EXPECTANCY

CULVERT SURVEY 1964

Concrete Pipe



State Median 101 Years

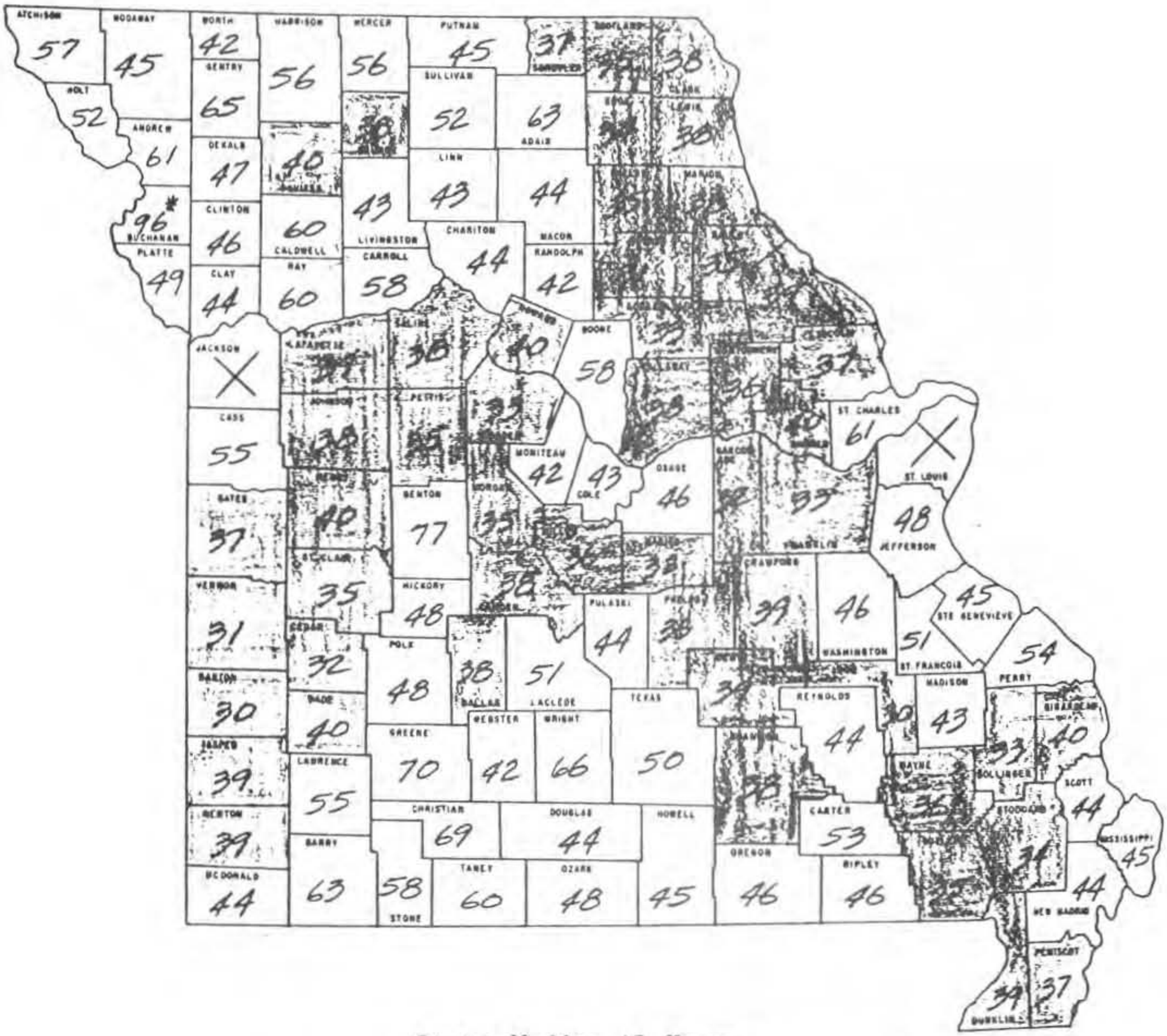
Shaded Counties Denote Median Below the State Median

X = Culverts were not available
* = Very small number of culverts

COUNTY MEDIAN LIFE EXPECTANCY

CULVERT SURVEY 1964

Corrugated Metal Pipe



State Median 41 Years

Shaded Counties Denote Median Below the State Median

X = Culverts were not available
* = Very small number of culverts

APPENDIX B

FIELD SURVEY SHEETS AND CULVERT SURVEY
PROGRAM PACKAGE

REV: 1/19/89

CMP CULVERT CONDITION SURVEY (CMP is defined as zinc coated steel corrugated pipe)	Inspector ____________ Date ____________

LOCATION County_______ Dist ___ Route _____Proj________________

Abandon: Yes___No___ Log Mile______________Log Mile Begin______________

IDENTIFICATION Date Installed_______________Surveyed in 1964 Yes___No___

Pipe Ident____________________Brand__________________Slope (%)___________

Diameter______inches; Length (total)_____feet; Section Length_______feet

End Finish: Rolled_____Band_____None_____ Gage_________________________

Corrugation Pattern______________________________Spiral_____Circular______

Date Pipe Replaced__________Liner Installed__________Type_______________

APPRAISAL Abrasive Load: Silt_____Sand_____Gravel_____

Flow of Stream: Continuous_______Intermittent_______Drift: Yes____No____

Watershed Type: Cropland___________Livestock___________Forest___________

Mining_______Vegetation/Pasture_______Residential_______Other_______

End Protection: Conc. Headwall _____Conc. Slope Protection_____Riprap____

Metal Flared End_____None_____Other_____

Condition of End Protection: Undermining_____Movement/Settlement________

Rusting_____Perforation_____Crushed_____Piping_____Other____________

Depth of Cover: Inlet__________feet Outlet__________feet

Water Standing in Pipe: Inlet: Yes___No___ Outlet: Yes___No___

Filling Material in Pipe: Inlet: Yes___No___ Outlet: Yes___No___

CMP DURABILITY (MATERIAL) RATING

Durability

9 New condition.

8___ Superficial rust in spots.
___ Slight discoloration.

7___ Moderate rust in spots.
___ Slight pitting.
___ Discoloration.
___ Loss of base metal in pitted areas, approximately 10%.
___ Some isolated bulges in barrel.

6___ Heavy rust.
___ Pitting.
___ Some thinning of base metal in isolated areas.
___ Minor flattening in bottom half and/or minor bulges in top half.

5___ Invert mostly covered with rust.
___ Loss of base metal under rust approximately 10%.
___ Severe pitting.
___ Loss of base metal in pitted area approximately 30%.
___ Bottom half flattened significantly and/or moderate bulges in top half.

4___ Appreciable rust in majority of pipe.
___ Inverts covered with rust.
___ Loss of base metal severe enough that deflection or penetration will occur when struck with hammer.
___ Significant distortion at isolated locations in top half, extreme flattening.

3___ Corroded or abraded nearly through.
___ Extensive heavy rust.
___ Deep pitting with 60 to 90% loss of base metal.
___ Metal may be punctured easily with light blow of hammer.
___ Distortion throughout pipe, lower third kinked, ponding water.

2___ Perforation in scattered locations.
___ Invert with minor perforation not causing significant exfiltration.
___ Extreme deflection, flattening of crown.

1___ Perforation extensive in inverts and/or extensive perforation in pipe due to corrosion.
___ Exfiltration causing erosion of fill material under or around pipe.
___ Partially collapsed with crown in reverse curve.

0___ Complete invert rusted out and/or bottom of pipe rusted out.
___ Failure, collapsed pipe.

CMP STRUCTURAL RATING

Joint and Seam Condition

9 All joints and seams tight.

8 One or more joints loosened less than 1/4 width of band.

7___ One or more joints loosened 1/8 to 1/4 width of band.
___ Slight faulting at one or more joints due to band loosening.
___ Slight movement of seams.

6___ One joint loosened greater than 1/4 width of band.
___ Minor opening of pipe seams.
___ Minor cracking of welds at seams or around rivets.
___ Slight infiltration, exfiltration.

5___ Two or more joints loosened greater than 1/4 width of band.
___ Faulting less than 1" on one or more joints due to band loosening.
___ Moderate opening of pipe seams.
___ Moderate cracking of welds at seams or around rivets.
___ Minor infiltration, exfiltration.

4___ One joint open exposing one edge of band and backfill material.
___ Faulting 1 to 2" of one or more joints due to band loosening.
___ Appreciable opening of pipe seams.
___ Appreciable cracking of welds at seams or around rivets.
___ Moderate infiltration, exfiltration.
___ Minor ponding of water or soil due to joint failure.

3___ Two or more joints open exposing one edge of band and backfill material.
___ Faulting of one or more joints greater than 2".
___ Pipe seams open exposing backfill.
___ Appreciable infiltration, exfiltration.
___ Moderate ponding of water or soil due to joint failure.

2___ Severe infiltration, exfiltration.
___ Appreciable water or soil ponding.
___ Severe seam failure.

1___ Severe faulting of all joints.
___ Pipe partially filled causing improper flow.

0 Failure of pipe due to joint or seam failure.

Alignment

9 Straight or smooth, new.

8 Slight deflection of pipe alignment, local areas, less than 1/4" in 10' length.

7___ Misalignment of joints 1/4 to 1/2" due to differential movement.
___ Minor deflection of pipe alignment 1/4 to 1/2" in 10' length.

6___ Misalignment of joints 1/2 to 1" due to differential movement.
___ Moderate deflection of pipe alignment without ponding water, 1/2 to 3/4" per 10' length.

5___ Misalignment of joints 1" to 2" due to differential movement.
___ Significant deflection of pipe alignment, 3/4 to 1" per 10' length.
___ Minor ponding of water or soil.

4___ Misalignment of joints greater than 2" due to differential movement.
___ Appreciable deflection of pipe alignment, 1" to 2" per 10' length.
___ Moderate ponding of water or soil.

3___ Major deflection of pipe alignment, 2 to 4" per 10' length.
___ Significant ponding of water or soil.

2___ Advanced deflection of pipe alignment, 4 to 6" per 10' length.
___ Advanced ponding of water or soil causing some flow constrictions.

1___ Alignment severe enough to impede proper flow, greater than 6" per 10' length.
___ Pipe partially filled from ponding of water or soil.

0 Failure of pipe due to alignment failure causing no flow.

RCP CULVERT CONDITION SURVEY

Inspector ____________________
Date ____________________

LOCATION County_______ Dist ___ Route _____ Proj ____________________

Abandon: Yes___No___Log Mile______________Log Mile Begin______________

IDENTIFICATION Date Installed_______________Surveyed in 1964 Yes___No___

Pipe Ident____________________Brand____________________Slope (%)__________

Diameter______inches; Length (total)______feet; Section Length_______feet

Date Pipe Replaced__________Liner Installed__________Type______________

APPRAISAL Abrasive Load: Silt_____Sand_____Gravel_____

Flow of Stream: Continuous_______Intermittent_______Drift: Yes____No____

Watershed Type: Cropland___________Livestock___________Forest___________

Mining_______Vegetation/Pasture_______Residential_______Other_______

End Protection: Conc. Headwall _____Conc. Slope Protection_____Riprap____

Precast Flared End_____None_____Other_____

Condition of End Protection: Undermining_____Movement/Settlement_______

Piping_____Scaling_____Spalling_____Cracking_____ Other_____________

Depth of Cover: Inlet__________feet Outlet__________feet

Water Standing in Pipe: Inlet: Yes___No___ Outlet: Yes___No___

Filling Material in Pipe: Inlet: Yes___No___ Outlet: Yes___No___

RCP DURABILITY (MATERIAL) RATING

	Rating Definition		Softening	Weathering Above Flow Line	Erosive Losses	Spalling
9	None		9	9	9	9
8	Slight	0-1/16" depth	8	8	8	8
7	Minor	1/16-1/8" depth	7	7	7	7
6	Moderate	1/8-1/4" depth	6	6	6	6
5	Significant	1/4-1/2" depth	5	5	5	5
4	Appreciable	1/2-3/4" depth	4	4	4	4
3	Major	3/4" depth	3	3	3	3
2	Advanced	Reinf. Exposed	2	2	2	2
1	Deep	Below Reinf.	1	1	1	1
0	Perforated	Completely Through	0	0	0	0

RCP STRUCTURAL RATING

Cracks and conditions resulting from cracks

9 No cracking

8 Fine or short cracks in end sections

7___ Short or fine cracks in barrel sections
___ Full coarse crack in an end section.

6___ One section with a full fine crack.
___ One full coarse crack in each end section.

5___ Two sections with full fine cracks.
___ One full open crack in an end section.

4___ One or two sections with full coarse cracks.
___ Three or more sections with full fine cracks.
___ One full open crack in both end sections plus other cracks coarse or fine.

3___ Two or more sections with two full coarse cracks.
___ One or more section with three or four full coarse cracks.
___ One or more sections with one full open plus one full coarse crack.
___ One or both end sections broken into four or more pieces by open cracks.

2___ One or more sections with three or four full cracks at least two of which are open, separating pipe into two or more pieces, still in place.
___ Slight shortening of vertical diameter.
___ Faulting of cracks in any section.

1___ One or more sections broken into four or more separate pieces by open cracks.
___ Pieces of sections loose or missing allowing undercutting or infiltration of fill.

0 Culvert in need of immediate replacement.

Joint Condition

9 All joints tight

8 One or more joints loosened less than 1/2 depth of bell and spigot.

7___ One intermediate joint loosened greater than 1/2 depth of bell and spigot.
___ Both end joints loosened less than 1/2 depth of bell and spigot.

6___ Two intermediate joints loosened greater than 1/2 depth of bell and spigot.
___ One end joint loosened greater than 1/2 depth of bell and spigot.
___ Slight cracking of bells or spigots.
___ Minor infiltration, exfiltration.

5___ Three intermediate joints loosened greater than 1/2 depth of bell and spigot.
___ Both end joints loosened greater than 1/2 depth of bell and spigot.
___ One end joint open.
___ Minor cracking of bells or spigots.
___ Moderate infiltration, exfiltration.
___ Faulting of one or two joints less than 1".

4___ Four or more intermediate joints loosened greater than 1/2 depth of bell and spigot.
___ Both end joints open exposing backfill.
___ One end joint faulted less than 2".
___ Moderate cracking of bells or spigots.
___ Appreciable infiltration, exfiltration.
___ Faulting of one or two intermediate joints greater than 1".

3___ One intermediate joint open exposing backfill.
___ Both end joints deflected over 2".
___ Significant cracking of bells or spigots.
___ Major infiltration, exfiltration.
___ Faulting of three or more intermediate joints greater than 1".

2___ Two or more intermediate joints open exposing backfill.
___ End sections separated and dropped.
___ Water ponding because of dislocation at joints.
___ Severe cracking of bells or spigots.
___ Advanced infiltration, exfiltration.
___ Faulting of one or more intermediate joints greater than 2".

1___ Deflection of intermediate joints causing severe ponding of water or soils.
___ Pipe partially filled causing significant flow problems.
___ Several sections dropped at ends of pipe.

0 Failure of pipe due to joint failures causing no flow.

Alignment

9 Straight or smooth, new.

8 Slight deflection of pipe alignment, local areas, less than 1/4" in 10' length.

7___ Misalignment of joints 1/4 to 1/2" due to differential movement.
___ Minor deflection of pipe alignment 1/4 to 1/2" in 10' length.

6___ Misalignment of joints 1/2 to 1" due to differential movement.
___ Moderate deflection of pipe alignment without ponding water, 1/2 to 3/4" per 10' length.

5___ Misalignment of joints 1" to 2" due to differential movement.
___ Significant deflection of pipe alignment, 3/4 to 1" per 10' length.
___ Minor ponding of water or soil.

4___ Misalignment of joints greater than 2" due to differential movement.
___ Appreciable deflection of pipe alignment, 1" to 2" per 10' length.
___ Moderate ponding of water or soil.
___ One end section open and slightly dropped.

3___ Major deflection of pipe alignment, 2 to 4" per 10' length.
___ Significant ponding of water or soil.
___ Both end sections open and slightly dropped.

2___ Advanced deflection of pipe alignment, 4 to 6" per 10' length.
___ Advanced ponding of water or soil causing some flow constrictions.
___ One or both end sections out of position.

1___ Alignment severe enough to impede proper flow, greater than 6" per 10' length.
___ Pipe partially filled from ponding of water or soil.

0 Failure of pipe due to alignment failure causing no flow.

CULVERT SURVEY Program Package

This program will prompt the operator for filing data from the field sheets that are used in the 1989 culvert survey. This program prompts the operator in a style that is compatible with the style of the field sheets. The program package was written in dBASE III+ programming language and is encrypted to prevent accidental tampering with the program. There are included two program files CULVERT.PRG and CULVPRT.PRG and two DBF files RCPCULVT.DBF and CMPCULVT.DBF. The CULVERT program is the main program to enter the field survey sheet data. The CULVPRT program is used to dump all of the contents of the two DBF files out to the printer. If there are any glitches in the program please contact us at (314) 751-1039 or (314) 751-1040 and ask for Stephen Derendinger or Bob Girard.

A backup copy of the program and associated files should first be made to a separate floppy disk in case of a loss of the programs or files. After the program is put into production, then, after every session of entering data a backup of the DBF files should be made for safety reasons, e.g. if a power failure or other interrupts occurs, then any open files will be compromised and become unusable. All work up to that point would be lost but, if a backup is available then only work that was done from the last backup is lost. If a power loss or other interrupts of the computer system should occur while running the CULVERT package then all files should be recopied from the backup disk to your work disk.

It would be better to run the program package on a hard disk system and we would highly recommend this method. To do this you need **approximately** 600K of space on your hard disk to complete the survey with associated files. To set up the hard disk first you need to make a directory. You need to type 'MD CULVERT' at the dos prompt. This will then reserve a space on the hard disk for the program and files. After you make the directory then you need to change the directory to the CULVERT directory by typing 'CD\CULVERT' at the dos prompt. Then you need to copy the program files to the CULVERT directory. To do this use the dos COPY or XCOPY command. This is done by typing at the dos prompt 'COPY A:*.* C:' or 'XCOPY A:*.* C:'. This will copy everything from disk A to your CULVERT directory on the hard disk. You will then be ready to run the culvert program on your computer

The culvert program package consists of two programs that are written in dBASE III+ programing language. The main program is CULVERT.PRG and is for entering the field data into a database, printing out data that was entered during each session, and a error routine to correct mistakes that may be found at a later date. The other program with the package is called CULVPRT.PRG and is for printing the contents of the database files (rcpculvt and cmpculvt) if loss of the hardcopy printouts occurs by accident.

When entering data with the culvert program it is important to make sure data entered into the program is correct before saving the data to disk. Most of the fields in the program will only accept certain entries for the data. Some will accept only date formats, some numbers, and quite a few will only accept (Y / N) for a yes or no answer. On the (Y / N) fields we will assume that any field left blank will be a no answer. This will save the operator the trouble of putting (Y / N) in every field and that only the fields that need a yes (Y) should be entered. Even so if the operator puts a no (N) in a field this will not affect the program or its outcome. If after careful editing of the data a mistake should be found. There is an error routine to delete bad data. This routine marks the record for deletion and then the record will need to be reentered. This will not physically remove the record but marks it for deletion.

There are ways to check on the integrity of the data being entered in the database. There are several keys on your keyboard that will allow you to view different screens of the data to check it before saving it to the database. These keys are the arrow keys, page up, page down, home, and end. The arrow key will move the cursor one space at a time to the right or to the left, and the up arrow moves to the left the down arrow moves to the right. The page up and the home keys will take you back to the previous screen. The page down and the end keys will take you to the next screen. The enter key will also take you to the next screen unless you are at the last screen which asks for explanations, and then it keeps you on that screen.

At the bottom of each screen there is a menu that tells you what some of the keys will do. You may move to any screen in the program without losing the data that has been entered. This data will stay on the screen until it is saved to the database. To save data to the database the operator has to be on the last screen (with the explanations), and at the bottom it has 'Save ^End'. This means to save the data to the database the CTRL key and the END key must be pressed at the same time. This action will then save the data to a database, print the record out on your printer, and then start the program back to the first screen ready, with the fields cleared, for more data to be entered in the database. The ESC key is used to quit the program and take the operator out of the current record being entered. This part of the program will allow the operator to change type of survey being entered or it will allow them to clear out the record that was being entered and then continue entering the same surveys again.

The printouts that the program produces should be kept for future use and also to check for integrity of the data that is now in the database. If there is a mistake in one of the records. The printout provides the operator with the record number, which is used by the program to delete the bad record. This record number is located on the far left of the printout.

STARTING CULVERT PROGRAM

To run the program the computer needs to be set to the culvert directory and then at the dos prompt type dbase. When the dot prompt appears then type DO CULVERT (fig 1). This will start the culvert program.

```
.DO CULVERT
Command Line      :<C:>
```

fig 1

RUNNING CULVERT PROGRAM

The first screen prompt is to set your printer to condensed print and to make sure that you have 14" greenbar paper inserted into the printer (fig 2). The program makes a printout of each record as it is put into the file for error checking later and condensed print on greenbar is the way the program is set up to print. If other paper is used or if other sized print is used then the program could abort or the printer would print off on its platen. After checking your printer you are ready to touch any key to continue.

```
SET YOUR PRINTER TO CONDENSED PRINT AND GREENBAR BEFORE PROCEEDING FURTHER

After checking printer --- PRESS ANY KEY TO CONTINUE
```

fig 2

The second screen prompt asks which type of culvert survey you will be entering (fig 3). There are only two correct responses to this question. Only RCP or CMP are allowed. If the wrong response is given the screen will tell you that you entered the wrong type of survey (fig 4). Press any key to continue after that and it will ask you to enter the survey again.

Which type of survey are you entering ? (RCP/ CMP)

---

fig 3

---

entered the wrong type of SURVEY -- PRESS ANY KEY TO CONTINUE

---

fig 4

The next screen prompt will ask if the records in the file that you are entering data into are correct or not (fig 5). This is the error routine for the data. There are two correct responses (Y)es or (N)o. If you type N then the program will go to its error routine. This will be covered later in the instructions. If you type Y then the program will continue normally to data entry.

Are all records for {RCP CMP} surveys that are entered into the computer correct ?

---

fig 5

The printer will then print what type of data is being entered and what day it was entered on (fig 6). The sheets that are printed out should be checked thoroughly for errors and kept for future reference.

Listing of {RCP CMP} CULVERT data entered on {DATE}

---

fig 6

The previous prompts are valid for both types of surveys and will appear each time the program is initiated or when you change type of survey data being entered.

RCP Screen Prompts

You are entering data for "RCP Culvert Condition Surveys"

Inspector Date inspected / /

LOC County County number District Route

Project Is this abandoned ?

Log mile . Description of log mile beginning

ID Date installed 19 Surveyed in 1964

Pipe ident Brand Slope %

Diameter (in) Length tot (ft) Section len (ft)

Date pipe replaced / / liner installed Type

Screen - Frwd ^PgDn, Abort ESC

fig 7

Inspector - Who did the inspection - enter initials only, but enter all three initials, first-middle-last
Date inspected - Date of inspection
County - County location of pipe
County number - County number of location of pipe
District - District number of location of pipe
Route - Route that pipe is located on
Project - Project number pipe originally installed under
Is this abandoned - (Y / N)
Log mile - Adjusted planning logmile
Description of log mile beginning - Where 0.000 is located
Date installed - Original year pipe installed
Surveyed in 1964 - (Y / N)
Pipe ident - Year / gage / class
Brand - Manufacturer
Slope - Slope to the nearest percent
Diameter (in) - Diameter nearest inch
Length tot (ft) - Total length of pipe nearest feet
Section len (ft) - Section length nearest feet
Date pipe replaced - If replaced when
Liner installed - (Y / N) Is there a liner
Type - If liner is installed what type of liner

You are entering data for "RCP Culvert Condition Surveys"

PPRA ABRASIVE LOAD: Silt Sand Gravel

FLOW OF STREAM: Continuous Intermittent Drift

WATERSHED TYPE: Cropland Livestock Forest

Mining Veget/past Residential Other

END PROT: Conc. Head Conc. Slope Prot Riprap

Precast Flared End Other

COND OF END PROT: Undermining Movement/Settlement

Piping Scaling Spalling Cracking Other

DEPTH OF COVER: Inlet Outlet

WATER STANDING IN PIPE: Inlet Outlet

FILLING MATERIAL IN PIPE: Inlet Outlet

Screen - Frwd ^PgDn, Abort ESC

fig 8

ABRASIVE LOAD
- Silt - (Y / N)
- Sand - (Y / N)
- Gravel - (Y / N)

FLOW OF STREAM
- Continuous - (Y / N)
- Intermittent - (Y / N)
- Drift - (Y / N)

WATERSHED TYPE
- Cropland - (Y / N)
- Livestock - (Y / N)
- Forest - (Y / N)
- Mining - (Y / N)
- Veget/past - (Y / N)
- Residential - (Y / N)
- Other - (Y / N) If yes give what kind

END PROT
- Conc. Head - (Y / N)
- Conc. Slope Prot - (Y / N)
- Riprap - (Y / N)
- Precast Flared End - (Y / N)
- Other - (Y / N) If yes give what kind

COND OF END PROT
- Undermining - (Y / N)
- Movement/Settlement - (Y / N)
- Piping - (Y / N)

Scaling - (Y / N)
Spalling - (Y / N)
Cracking - (Y / N)
Other - (Y / N) If yes give what kind

DEPTH OF COVER
Inlet - Cover in feet
Outlet - Cover in feet

WATER STANDING IN PIPE
Inlet - (Y / N)
Outlet - (Y / N)

FILLING MATERIAL IN PIPE
Inlet - (Y / N)
Outlet - (Y / N)

You are entering data for "RCP Culvert Condition Surveys"

RCP Durability (Material) Rating
Enter worst case rating

Enter reason for rating

Softening	Weathering Above Flow Line	Erosive Losses	Spalling

Screen - Frwd ^PgDn Back ^PgUp, Abort ESC

fig 9

Durability Enter worst case rating - Lowest durability rating given for the four possible
Softening - Enter field rating
Weathering above flow line - Enter field rating
Erosive losses - Enter field rating
Spalling - Enter field rating

You are entering data for "RCP Culvert Condition Surveys"

RCP Structural Rating
Enter worst case rating

Enter individual ratings

Cracks and conditions resulting from cracks	Joint Condition	Alignment

Screen - Frwd ^PgDn Back ^PgUp, Abort ESC

fig 10

Structural enter worst case rating - Lowest structural rating given out of the three possible
Cracks and conditions resulting from cracks - Enter field rating
Joint condition - Enter field rating
Alignment - Enter field rating

```
             You are entering data for "RCP Culvert Condition Surveys"
 ------------------------------------------------------------------------------
  Mark appropriate boxes for explanations for individual ratings with "Y"
 Cracks and conditions  ||                        ||
 resulting from cracks  ||    Joint Condition     ||       Alignment

    7: A   B            ||  7: A   B              ||  7: A   B
    6: A   B            ||  6: A   B   C   D      ||  6: A   B
    5: A   B            ||  5: A   B   C   D   E   F ||  5: A   B   C
    4: A   B   C        ||  4: A   B   C   D   E   F ||  4: A   B   C   D
    3: A   B   C   D    ||  3: A   B   C   D   E  ||  3: A   B   C
    2: A   B   C        ||  2: A   B   C   D   E   F ||  2: A   B   C
    1: A   B            ||  1: A   B   C          ||  1: A   B
            Save ^End, Screen - Frwd ^PgDn Back ^PgUp, Abort ESC
```

fig 11

The input for this screen will consist of matching the number and corresponding letter with the number and comment on the field sheets. As with the other one character entry fields in the program these are also (Y / N) fields and only the Y's need to be marked. All blanks will be considered to be no.

It is at this point that the operator should go back through the data to make sure that it is all entered correctly. This can be utilized by the use of the PgUp and PgDn keys. This also is the only point when entering RCP data that the record may be saved to the file. This is accomplished by using the Ctrl + End keys. After the record is saved to the file the program will reset all the variables and take the operator back to the beginning of the program to continue entering RCP CULVERT SURVEY data.

RCP STRUCTURAL RATING

Cracks and conditions resulting from cracks

9 No cracking

8 Fine or short cracks in end sections

7 A Short or fine cracks in barrel sections
B Full coarse crack in an end section.

6 A One section with a full fine crack.
B One full coarse crack in each end section.

5 A Two sections with full fine cracks.
B One full open crack in an end section.

4 A One or two sections with full coarse cracks.
B Three or more sections with full fine cracks.
C One full open crack in both end sections plus other cracks coarse or fine.

3 A Two or more sections with two full coarse cracks.
B One or more section with three or four full coarse cracks.
C One or more sections with one full open plus one full coarse crack.
D One or both end sections broken into four or more pieces by open cracks.

2 A One or more sections with three or four full cracks at least two of which are open, separating pipe into two or more pieces, still in place.
B Slight shortening of vertical diameter.
C Faulting of cracks in any section.

1 A One or more sections broken into four or more separate pieces by open cracks.
B Pieces of sections loose or missing allowing undercutting or infiltration of fill.

0 Culvert in need of immediate replacement.

Joint Condition

9 All joints tight

8 One or more joints loosened less than 1/2 depth of bell and spigot.

7 A One intermediate joint loosened greater than 1/2 depth of bell and spigot.
B Both end joints loosened less than 1/2 depth of bell and spigot.

6 A Two intermediate joints loosened greater than 1/2 depth of bell and spigot.
B One end joint loosened greater than 1/2 depth of bell and spigot.
C Slight cracking of bells or spigots.
D Minor infiltration, exfiltration.

5 A Three intermediate joints loosened greater than 1/2 depth of bell and spigot.
B Both end joints loosened greater than 1/2 depth of bell and spigot.
C One end joint open.
D Minor cracking of bells or spigots.
E Moderate infiltration, exfiltration.
F Faulting of one or two joints less than 1".

4 A Four or more intermediate joints loosened greater than 1/2 depth of bell and spigot.
B Both end joints open exposing backfill.
C One end joint faulted less than 2".
D Moderate cracking of bells or spigots.
E Appreciable infiltration, exfiltration.
F Faulting of one or two intermediate joints greater than 1".

3 A One intermediate joint open exposing backfill.
B Both end joints deflected over 2".
C Significant cracking of bells or spigots.
D Major infiltration, exfiltration.
E Faulting of three or more intermediate joints greater than 1".

2 A Two or more intermediate joints open exposing backfill.
B End sections separated and dropped.
C Water ponding because of dislocation at joints.
D Severe cracking of bells or spigots.
E Advanced infiltration, exfiltration.
F Faulting of one or more intermediate joints greater than 2".

1 A Deflection of intermediate joints causing severe ponding of water or soils.
B Pipe partially filled causing significant flow problems.
C Several sections dropped at ends of pipe.

0 Failure of pipe due to joint failures causing no flow.

Alignment

9 Straight or smooth, new.

8 Slight deflection of pipe alignment, local areas, less than 1/4" in 10' length.

7 A Misalignment of joints 1/4 to 1/2" due to differential movement.
B Minor deflection of pipe alignment 1/4 to 1/2" in 10' length.

6 A Misalignment of joints 1/2 to 1" due to differential movement.
B Moderate deflection of pipe alignment without ponding water, 1/2 to 3/4" per 10' length.

5 A Misalignment of joints 1" to 2" due to differential movement.
B Significant deflection of pipe alignment, 3/4 to 1" per 10' length.
C Minor ponding of water or soil.

4 A Misalignment of joints greater than 2" due to differential movement.
B Appreciable deflection of pipe alignment, 1" to 2" per 10' length.
C Moderate ponding of water or soil.
D One end section open and slightly dropped.

3 A Major deflection of pipe alignment, 2 to 4" per 10' length.
B Significant ponding of water or soil.
C Both end sections open and slightly dropped.

2 A Advanced deflection of pipe alignment, 4 to 6" per 10' length.
B Advanced ponding of water or soil causing some flow constrictions.
C One or both end sections out of position.

1 A Alignment severe enough to impede proper flow, greater than 6" per 10' length.
B Pipe partially filled from ponding of water or soil.

0 Failure of pipe due to alignment failure causing no flow.

CMP Screen Prompts

You are entering data for "CMP Culvert Condition Surveys"

Inspector ░░░░░░░░ Date inspected ░░/░░/░░

LOC County ░░░░░░░░ County number ░░░ District ░░ Route ░░░░░░

Project ░░░░░░░░░░ Is this abandoned ? ░

Log mile ░░.░░░ Description of log mile beginning ░░░░░░░░░░░░

ID Date installed 19░░ Surveyed in 1964 ░

Pipe ident ░░░░░░ Brand ░░░░░░░░░░░ Slope % ░░

Diameter (in) ░░ Length tot (ft) ░░ Section len (ft) ░░

End finish: Rolled ░ Band ░ None ░ Gage ░░

Corrugation pattern ░░░░░░ Spiral ░ Circular ░

Date pipe replaced ░░/░░/░░ liner installed ░ Type ░░░░░░░░░

Screen - Frwd ^PgDn, Abort ESC

fig 12

Inspector - Who did the inspection - enter initials only, but enter all three initials, first-middle-last
Date inspected - Date of inspection
County - County location of pipe
County number - County number of location of pipe
District - District number of location of pipe
Route - Route that pipe is located on
Project - Project number pipe originally installed under
Is this abandoned - (Y / N)
Log mile - Adjusted planning logmile
Description of log mile beginning - Where 0.000 is located
Date installed - Original year pipe installed
Surveyed in 1964 - (Y / N)
Pipe ident - Year / gage / class
Brand - Manufacturer
Slope - Slope to the nearest percent
Diameter (in) - Diameter nearest inch
Length tot (ft) - Total length of pipe nearest feet
Section len (ft) - Section length nearest feet
End finish Rolled - (Y / N) Is end rolled
End finish Banded - (Y / N) Is end banded
End finish None - (Y / N) No end finish
Gage - What is the gage of the steel
Corrugation pattern - What is the corrugation pattern

Spiral - (Y / N) Is corrugation in a spiral
Circular - (Y / N) Is corrugation circular
Date pipe replaced - If replaced when
Liner installed - (Y / N) Is there a liner
Type - If liner installed what type of liner

You are entering data for "CMP Culvert Condition Surveys"

PPRA ABRASIVE LOAD: Silt ░ Sand ░ Gravel ░

FLOW OF STREAM: Continuous ░ Intermittent ░ Drift ░

WATERSHED TYPE: Cropland ░ Livestock ░ Forest ░

Mining ░ Veget/past ░ Residential ░ Other ░

END PROT: Conc. Head ░ Conc. Slope Prot ░ Riprap ░

Metal Flared End ░ Other ░

COND OF END PROT: Undermining ░ Movement/Settlement ░

Rusting ░ Perforation ░ Crushed ░ Piping ░ Other ░

DEPTH OF COVER: Inlet ░ Outlet ░

WATER STANDING IN PIPE: Inlet ░ Outlet ░

FILLING MATERIAL IN PIPE: Inlet ░ Outlet ░
Screen - Frwd ^PgDn Back ^PgUp, Abort ESC

---

fig 13

ABRASIVE LOAD
- Silt - (Y / N)
- Sand - (Y / N)
- Gravel - (Y / N)

FLOW OF STREAM
- Continuous - (Y / N)
- Intermittent - (Y / N)
- Drift - (Y / N)

WATERSHED TYPE
- Cropland - (Y / N)
- Livestock - (Y / N)
- Forest - (Y / N)
- Mining - (Y / N)
- Veget/past - (Y / N)
- Residential - (Y / N)
- Other - (Y / N) If yes give what kind

END PROT
- Conc. Head - (Y / N)
- Conc. Slope Prot - (Y / N)
- Riprap - (Y / N)

Metal Flared End - (Y / N)
Other - (Y / N) If yes give what kind
COND OF END PROT
Undermining - (Y / N)
Movement/Settlement - (Y / N)
Rusting - (Y / N)
Perforation - (Y / N)
Crushed - (Y / N)
Piping - (Y / N)
Other - (Y / N) If yes give what kind
DEPTH OF COVER
Inlet - Cover in feet
Outlet - Cover in feet
WATER STANDING IN PIPE
Inlet - (Y / N)
Outlet - (Y / N)
FILLING MATERIAL IN PIPE
Inlet - (Y / N)
Outlet - (Y / N)

```
You are entering data for "CMP Culvert Condition Surveys"
=============================================================

            CMP Durability (Material) Rating

            Enter rating

Screen - Frwd ^PgDn Back ^PgUp, Abort ESC
```

fig 14

CMP durability (material) rating - Enter field rating

You are entering data for "CMP Culvert Condition Surveys"

CMP Structural Rating
Enter worst case rating

Enter individual ratings

Joint and Seam Condition | Alignment

Screen - Frwd ^PgDn Back ^PgUp, Abort ESC

fig 15

CMP structural rating worst case - Enter lowest rating from the two possible ratings
Joint and seam condition - Enter field rating
Alignment - Enter field rating

You are entering data for "CMP Culvert Condition Surveys"

Mark appropriate boxes for explanations for individual ratings with "Y"

Durability	Joint and Seam Condition	Alignment
8: A B		
7: A B C D E	7: A B C	7: A B
6: A B C D	6: A B C D	6: A B
5: A B C D E	5: A B C D E	5: A B C
4: A B C D	4: A B C D E F	4: A B C
3: A B C D E	3: A B C D E	3: A B
2: A B C	2: A B C	2: A B
1: A B C	1: A B	1: A B
0: A B		

Save ^End, Screen - Frwd ^PgDn Back ^PgUp, Abort ESC

fig 16

The input for this screen will consist of matching the number and corresponding letter with the number and comment on the field sheets. As with the other one character entry fields in the program these are also (Y / N) fields and only the Y's need to be marked. All blanks will be considered to be no.

It is at this point that the operator should go back through the data to make sure that it is all entered correctly. This can be utilized by the use of the PgUp and PgDn keys. This also is the only point when entering RCP data that the record may be saved to the file. This is accomplished by using the Ctrl + End keys. After the record is saved to the file the program will reset all the variables and take the operator back to the beginning of the program to continue entering CMP CULVERT SURVEY data.

CMP DURABILITY (MATERIAL) RATING

Durability

9 New condition.

8 A Superficial rust in spots.
B Slight discoloration.

7 A Moderate rust in spots.
B Slight pitting.
C Discoloration.
D Loss of base metal in pitted areas, approximately 10%.
E Some isolated bulges in barrel.

6 A Heavy rust.
B Pitting.
C Some thinning of base metal in isolated areas.
D Minor flattening in bottom half and/or minor bulges in top half.

5 A Invert mostly covered with rust.
B Loss of base metal under rust approximately 10%.
C Severe pitting.
D Loss of base metal in pitted area approximately 30%.
E Bottom half flattened significantly and/or moderate bulges in top half.

4 A Appreciable rust in majority of pipe.
B Inverts covered with rust.
C Loss of base metal severe enough that deflection or penetration will occur when struck with hammer.
D Significant distortion at isolated locations in top half, extreme flattening.

3 A Corroded or abraded nearly through.
B Extensive heavy rust.
C Deep pitting with 60 to 90% loss of base metal.
D Metal may be punctured easily with light blow of hammer.
E Distortion throughout pipe, lower third kinked, ponding water.

2 A Perforation in scattered locations.
B Invert with minor perforation not causing significant exfiltration.
C Extreme deflection, flattening of crown.

1 A Perforation extensive in inverts and/or extensive perforation in pipe due to corrosion.
B Exfiltration causing erosion of fill material under or around pipe.
C Partially collapsed with crown in reverse curve.

0 A Complete invert rusted out and/or bottom of pipe rusted out.
B Failure, collapsed pipe.

CMP STRUCTURAL RATING

Joint and Seam Condition

9 All joints and seams tight.

8 One or more joints loosened less than 1/4 width of band.

7 A One or more joints loosened 1/8 to 1/4 width of band.
B Slight faulting at one or more joints due to band loosening.
C Slight movement of seams.

6 A One joint loosened greater than 1/4 width of band.
B Minor opening of pipe seams.
C Minor cracking of welds at seams or around rivets.
D Slight infiltration, exfiltration.

5 A Two or more joints loosened greater than 1/4 width of band.
B Faulting less than 1" on one or more joints due to band loosening.
C Moderate opening of pipe seams.
D Moderate cracking of welds at seams or around rivets.
E Minor infiltration, exfiltration.

4 A One joint open exposing one edge of band and backfill material.
B Faulting 1 to 2" of one or more joints due to band loosening.
C Appreciable opening of pipe seams.
D Appreciable cracking of welds at seams or around rivets.
E Moderate infiltration, exfiltration.
F Minor ponding of water or soil due to joint failure.

3 A Two or more joints open exposing one edge of band and backfill material.
B Faulting of one or more joints greater than 2".
C Pipe seams open exposing backfill.
D Appreciable infiltration, exfiltration.
E Moderate ponding of water or soil due to joint failure.

2 A Severe infiltration, exfiltration.
B Appreciable water or soil ponding.
C Severe seam failure.

1 A Severe faulting of all joints.
B Pipe partially filled causing improper flow.

0 Failure of pipe due to joint or seam failure.

Alignment

9 Straight or smooth, new.

8 Slight deflection of pipe alignment, local areas, less than 1/4" in 10' length.

7 A Misalignment of joints 1/4 to 1/2" due to differential movement.
B Minor deflection of pipe alignment 1/4 to 1/2" in 10' length.

6 A Misalignment of joints 1/2 to 1" due to differential movement.
B Moderate deflection of pipe alignment without ponding water, 1/2 to 3/4" per 10' length.

5 A Misalignment of joints 1" to 2" due to differential movement.
B Significant deflection of pipe alignment, 3/4 to 1" per 10' length.
C Minor ponding of water or soil.

4 A Misalignment of joints greater than 2" due to differential movement.
B Appreciable deflection of pipe alignment, 1" to 2" per 10' length.
C Moderate ponding of water or soil.

3 A Major deflection of pipe alignment, 2 to 4" per 10' length.
B Significant ponding of water or soil.

2 A Advanced deflection of pipe alignment, 4 to 6" per 10' length.
B Advanced ponding of water or soil causing some flow constrictions.

1 A Alignment severe enough to impede proper flow, greater than 6" per 10' length.
B Pipe partially filled from ponding of water or soil.

0 Failure of pipe due to alignment failure causing no flow.

ESCAPE KEY ROUTINE

You have terminated action on this record by pressing the escape key -- this record will not be inserted

Do you wish to continue with entering data for {CMP RCP} data

fig 17

If the operator presses the ESC key the program terminates entering of data and does its error routine. The first screen in the error routine informs the operator that they have terminated the current entry and gives the operator a choice of continuing entering data for the culvert survey that was being entered (Y / N) (fig 17). If the operator wants to continue (Y), the program will clear the fields and return back to the first screen of the survey being entered. If the operator choses (N) not to continue the program then will bring up another screen to see what the operator then wants to do fig 18.

Do you want to quit (Q) or continue (C) to enter data for {RCP CMP}

fig 18

The next screen then asks if you want to quit or enter data for the other type of culvert survey than what you are entering (fig 18). If the operator wants to (Q)uit then the program will terminate and display the dBASE III+ dot prompt and print 'CULVERT SURVEY OPERATIONS TERMINATED'. The operator is then done with the program and entering data for any survey until the program is activated again. If the operator doesn't want to quit though and wants to continue to enter data for the other type of culvert survey than what they were entering, they would say (C) to continue.

This is the only place within the program where the operator may change the type of survey they are entering. The only other way this may be accomplished is by quitting the program and starting it back up from the beginning

ERROR ROUTINE

Enter the record number of the incorrect number so that it may be deleted out of the (RCP CMP) file. This will not affect the record number of the other records. This record will need to be reentered into the file thorough the CULVERT program. If you have made a mistake and don't wish to delete a record then return without entering any data.

This routine will continue until a 0 is entered

fig 19

If the operator answers the question at the first of the program (fig 5) that asks if the records for the type of culvert survey they are entering is correct, (N)o then they will see the error screen (fig 19). To use this routine you need to know the record number of the record that is bad. This number is located on the printout on the far left-hand side of the record. The operator would then key this number in and press the return key. This would then delete the record in question. Even though this deletes the record it doesn't change the record number of the rest of the records. This record would need to then be marked on the printout that it had been deleted so the printouts could be kept straight.

This routine will continue to prompt the operator for an entry until a 0 is entered to tell that no more records are to be deleted. Also if the operator accidently gets into this routine and doesn't want to delete a record entering a 0 will get you out of the routine without affecting any files.

NOTE:
This routine won't physically take the record out of the file but will mark it for deletion only. The file will stay

the same size and the record numbers won't change because of this. To insure the integrity of the files we ask that you at the district level not to get into the files and use the various dBASE III+ commands available to manipulate files, but use the error routine provided.

CULVERT SURVEY PRINTOUTS

The printouts are provided for error checking after the operator finishes entering field data in the computer. The headings above each field identify it. The names of the fields are shortened names so they may be use in the computer. There is an explanation of each field and its name for ease in putting each field with its counterpart on the field sheets.

The fields that are the hardest to follow will be the rating explanations fields. These fields are created internally in the program by combining all of the possible answers together into one field (fig 20).

```
pstrccc            rcpstrjcc                            rcpstralc
6 5 4  3   2  1    7 6   5     4      3    2      1     7 6 5  4   3  2  1
ABABABCABCDABCAB   ABABCDANCDEFABCDEFABCDEABCDEFABC     ABABABCABCDABCABCAB

pdurrtc                            cmpstrjsc                          cmpstralc
7   6   5    4   3    2  1  0      7  6   5     4      3     2  1     7 6 5  4  3 2 1
ABCDABCDABCDEABCDABCDEABCABCAB     ABCABCDABCDEABCDEFABCDEABCAB       ABABABCABCABABAB
```

fig 20

Depending on which explanations that were marked it will depend on the position of the 'Y' in the field as to what is in the computer.

RCPCULVT.DBF STRUCTURE

INS	Inspector
DATE	Date
CO	County
CONUM	County Number
DIS	District
RT	Route
PRO	Project
AB	Abandon Highway
LM	Log Mile
LMB	Log Mile Beginning
DTIN	Date Installed (Year Only)
S64	Surveyed in 64
PI	Pipe Ident
BRAND	Brand
SLOPE	Slope (%)
DIA	Diameter of Pipe Inches
LGHT	Length Ft. Total
LGHS	Length Ft. Sec
REP	Replaced
LIN	Liner Installed
LINTYP	Liner Type
ABSLDST	Abrasive Load Silt
ABSLDSD	Abrasive Load Sand
ABSLDGR	Abrasive Load Gravel
FSC	Flow Stream Continuous
FSI	Flow Stream Intermittent
DRIFT	Drift
WATSHCR	Watershed Type Cropland
WATSHLV	Watershed Type Livestock
WATSHFR	Watershed Type Forest
WATSHMI	Watershed Type Mining
WATSHVP	Watershed Type Veg/Pas
WATSHRE	Watershed Type Residential
WATSHOT	Watershed Other
WATSHOTEX	Watershed Other Explanation
ENDCOHE	End Protection Concrete Headwall
ENDSLPR	End Protection Slope Protection
ENDRIP	End Protection Riprap
ENDFLAR	End Protection Precast Flared
NONE	No End Protection
ENDOT	End Protection Other
ENDOTEX	End Protection Other Explanation
CEPTUM	Condition End Protection Undermining
CEPTMS	Condition End Protection Movement/Settlement
CEPTPR	Condition End Protection Piping
CEPTSP	Condition End Protection Scaling
CEPTSC	Condition End Protection Spalling
CEPTCP	Condition End Protection Cracking
CEPTOT	Condition End Protection Other
CEPTOTEX	Condition End Protection Other Explanation
DEPCOVI	Depth of Cover Inlet
DEPCOVO	Depth of Cover Outlet

RCPCULVT.DBF STRUCTURE

WATERO	Water Standing in Pipe Outlet
WATERI	Water Standing in Pipe Inlet
FILLI	Filling Material in Pipe Inlet
FILLO	Filling Material in Pipe Outlet
DURMATRAT	Durability (Material) Rating
DURSFT	Durability (Material) Rating Softening
DURWAF	Durability (Material) Rating Weathering Above Flow Line
DUREXL	Durability (Material) Rating Erosive Losses
DURSPA	Durability (Material) Rating Spalling
RCPSTRRAT	RCP Structural Rating
RCPSTRCC	RCP Structural Rating Cracks and Conditions
RCPSTRCCC	RCP Structural Rating Cracks and Conditions Comments
RCPSTRJC	RCP Structural Rating Joint Condition
RCPSTRJCC	RCP Structural Rating Joint Condition Comments
RCPSTRAL	RCP Structural Rating Alignment
RCPSTRALC	RCP Structural Rating Alignment Comments

CMPCULVT.DBF STRUCTURE

INS	Inspector
DATE	Date
CO	County
CONUM	County Num
DIS	District
RT	Route
PRO	Project
AB	Abandon Highway
LM	Log Mile
LMB	Log Mile Beginning
DTIN	Date Installed (Year Only)
S64	Surveyed in 64
PI	Pipe Ident.
BRAND	Brand
SLOPE	Slope (%)
DIA	Diameter of pipe inches
LGHT	Length ft. total
LGHS	Length ft. section
EFR	End Finished Rolled
EFB	End Finished Banded
EFN	End Finished None
GAGE	Gage
CORRPAT	Corrugation Pattern
CORRS	Corrugation Spiral
CORRC	Corrugation Circular
REP	Replaced
LIN	Liner Installed
LINTYP	Liner Type
ABSLDST	Abrasive Load Silt
ABSLDSD	Abrasive Load Sand
ABSLDGR	Abrasive Load Gravel
FSC	Flow Stream Continuous
FSI	Flow Stream Intermittent
DRIFT	Drift
WATSHCR	Watershed Type Cropland
WATSHLV	Watershed Type Livestock
WATSHFR	Watershed Type Forest
WATSHMI	Watershed Type Mining
WATSHVP	Watershed Type Veg/Pas
WATSHRE	Watershed Type Residential
WATSHOT	Watershed Type Other
WATSHOTEX	Watershed Other Explanation
ENDCOHE	End Protection Concrete Headwall
ENDSLPR	End Protection Concrete Slope Protection
ENDRIP	End Protection Riprap
ENDFLAR	End Protection Metal Flared
NONE	No End Protection
ENDOT	End Protection Other
ENDOTEX	End Protection Other Explanation
CEPTUM	Condition End Protection Undermining
CEPTMS	Condition End Protection Movement/Settlement
CEPTPR	Condition End Protection Rusting

CMPCULVT.DBF STRUCTURE

CEPTSP	Condition End Protection Perforation
CEPTSC	Condition End Protection Crushed
CEPTCP	Condition End Protection Piping
CEPTOT	Condition End Protection Other
CEPTOTEX	Condition End Protection Other Explanation
DEPCOVI	Depth of Cover Inlet
DEPCOVO	Depth of Cover Outlet
WATERO	Water Stand in Pipe Outlet
WATERI	Water Stand in Pipe Inlet
FILLI	Filling Material in Pipe Inlet
FILLO	Filling Material in Pipe Outlet
CMPDURRT	CMP Durability Rating
CMPDURRTC	CMP Durability Rating Comments
CMPSTRRAT	CMP Structural Rating
CMPSTRJS	CMP Structural Rating Joints and Seams
CMPSTRJSC	CMP Structural Rating Joints and Seams Comments
CMPSTRAL	CMP Structural Rating Alignment
CMPSTRALC	CMP Structural Rating Alignment Comments

CULVPRT.PRG

The CULVPRT program is a short program to print the files cmpculvt.dbf and rcpculvt.dbf on the 14" greenbar paper in condensed mode. This is used by typing at the prompt DO CULVPRT. This will automatically print out those files.

This is included in case that the printouts that were produced are accidently lost and you would need a printout of the files. The records that have been deleted won't be printed so the record numbers may be consecutive but skip where a deletion was made.

APPENDIX C

FIELD TEST DESCRIPTIONS

APPENDIX C

TEST PROCEDURES FOR FIELD TESTS

4-PIN RESISTANCE

The 4-pin resistance was conducted by placing four copper rods spaced two feet apart starting four feet from the pipe. Attach the leads from the soil resistance meter to the pins and adjust the meter to obtain a balanced reading. Multiply the reading by the section switch to read ohms directly. To get ohm-cm multiply the ohms by 383 (191.5 x spacing of the pins).

Photo No. C-1

2-PIN RESISTANCE

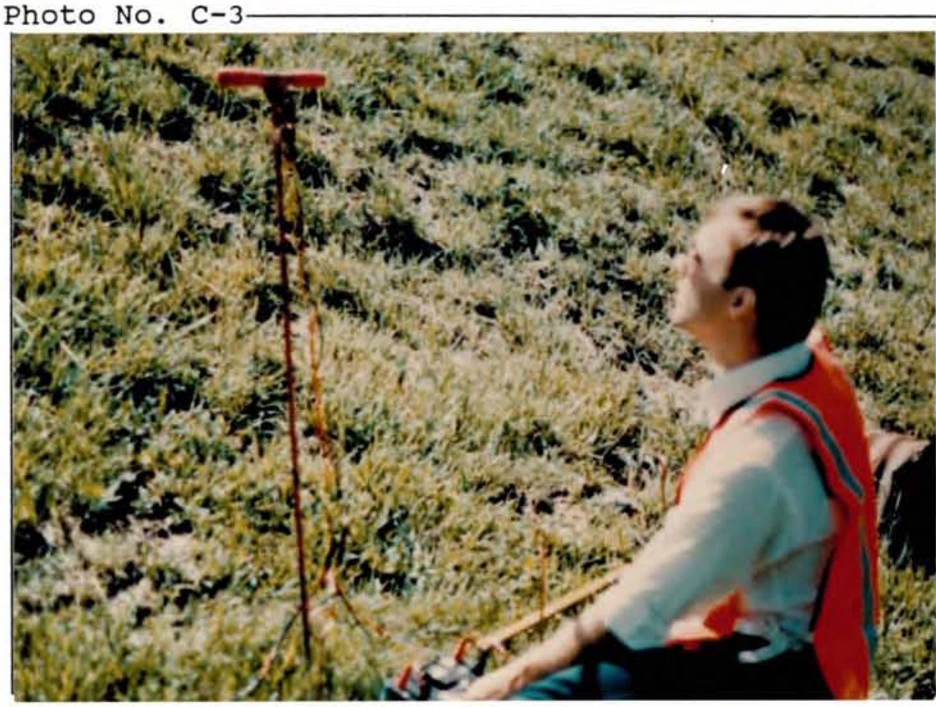
This test is only for CMP, it was used to determine the contact resistance of the pipe to the soil. Attach the leads of the soil resistance meter to the pipe and the first pin that is four feet from the pipe. Balance the meter and record the resistance directly from the meter.

Photo No. C-2

SINGLE PROBE RESISTANCE

The single probe was used to determine the resistance of the soil like the 4-pin method but may be easier to use in the field. Connect the soil resistance meter to the probe, balance the meter and read the resistance directly.

Photo No. C-3



SOIL TO PIPE VOLTAGE

This test was used to determine the corrosion rate of the CMP. Using a copper-copper sulfate half cell and a 3 1/2 digital volt meter attach the common of the volt meter to the pipe and the positive lead to the top of the half cell. Place the bottom of the half cell on the bare ground at the pin located four feet from the pipe. Record the reading in volts.

Photo No. C-4

2-PIN VOLTAGE

The 2-pin voltage is used to test the soil resistance to direct voltage and to help correlate the soil to pipe voltage. The lead attachment is the same as the soil to pipe voltage test except the lead that was connected to the pipe is connected to the pin four feet from the half cell. Record the reading in volts.

Photo No. C-5

THICKNESS

The thickness of the pipe is measured by an ultrasonic thickness meter. Measure the thickness of the CMP at the 12:00, 3:00, 6:00, and 9:00 positions. If rust is present use a wire brush to remove rust from the surface. Rust will cause erratic readings, so take a reading that will best describe the area being measured. Follow the instruments instructions for calibration and operation. Record the readings in inches.

Photo No. C-6

Photo No. C-7

SOIL SAMPLE

Take a soil sample from the flow line of the culverts inlet. This will give the proper indication as to what flows through the pipe. Place the sample into a plastic bag, seal, and label.

Photo No. C-8

APPENDIX D

LABORATORY TEST DESCRIPTIONS

APPENDIX D

LABORATORY TESTS

SOIL PREPARATION

The soil sample obtained in the field is weighed, then dried in an oven at 140 degrees Fahrenheit until completely dry. Re-weigh the soil to obtain the moisture content.

Photo No. D-1

The soil is now prepared by grinding it until about 2 kilograms passes through the #10 sieve. Put 600 grams of soil into a one quart jar and add to it 600 grams of distilled-deionized water. Put the lid on, shake the mixture, and let it set over night.

Photo No. D-2

Photo No. D-3

Filter out about 6 ounces of water from the mixture. If there is not enough standing water then a centrifuge can be used to obtain more free water. This water sample will be used for the following tests.

A pH/concentration/millivolt meter and the appropriate test probes will be needed for the next three tests.

pH

The pH test requires about 20 ml of sample water, a pH probe, and two pH standards. Calibrate the meter as per the instructions of the machine and test the sample for pH. Record the reading directly.

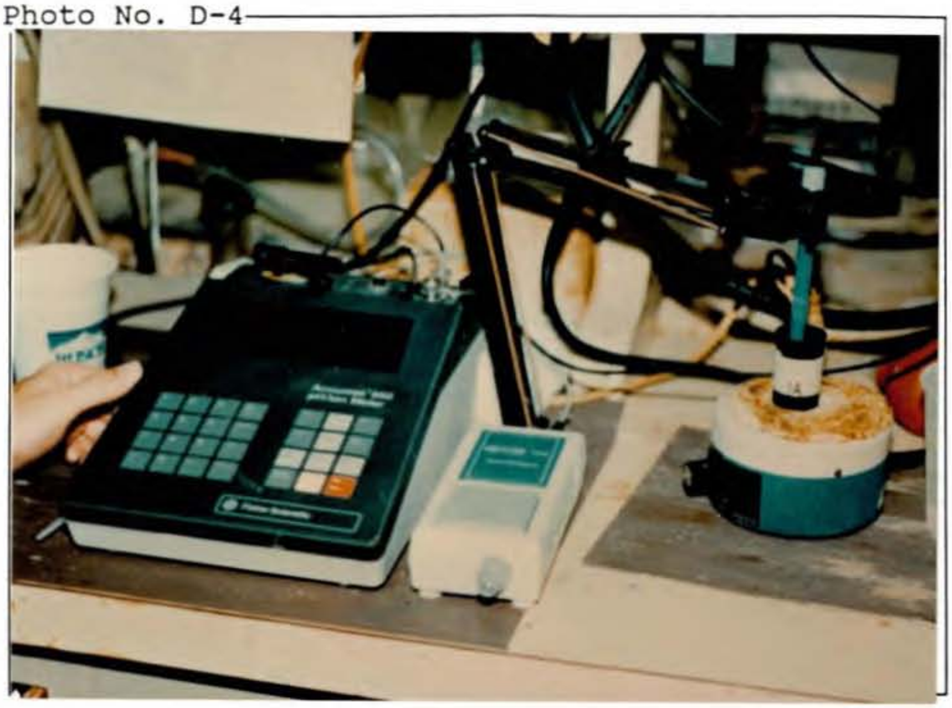
CHLORIDE

Chloride content requires 10 ml of sample water, 1 ml of ISA, two chloride standards at a ten fold difference, while containing a 1:10 ratio of ISA, and chloride probe. Combine the sample and the ISA and calibrate the meter to read concentration directly for ppm and record.

SULFIDE

Sulfide content is determined using 10 ml of sample water, 10ml of SAOB, a sulfide probe and reference cell, and two sulfide standards at a ten fold difference mixed 1:1 with SAOB. Calibrate the meter to read the sulfide content in ppm. Read the meter for the concentration in ppm and record.

Photo No. D-4



CONDUCTANCE

Using a conductance meter measure the conductance of the water sample using the appropriate quantity of sample water. Multiply the reading by the k value of the conductance probe. Record the number in milli-ohms.

Photo No. D-5

TOTAL HARDNESS

Using a total hardness tester determine the total hardness of the water in mg/liter. Follow the procedure supplied by the tester.

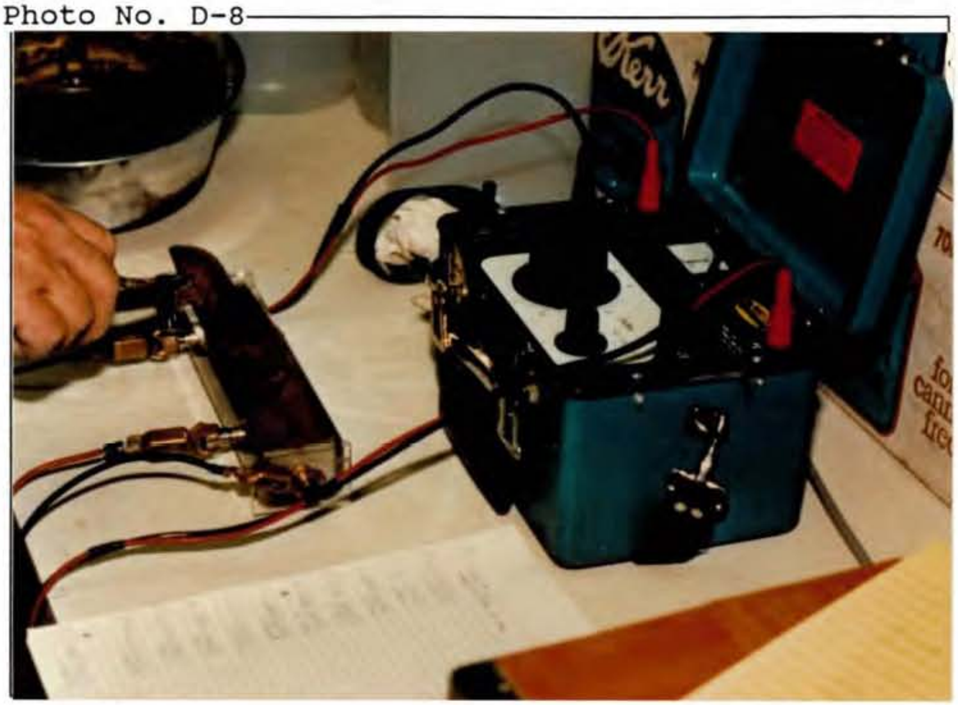
Photo No. D-6

Photo No. D-7

SOIL BOX (MINIMUM RESISTANCE)

Minimum resistance is determined by adding distilled-deionized water to 400 grams of prepared soil such to obtain the minimum resistance reading from the soil box. It was determined that an amount of water that creates a pudding like consistency will give the minimum resistance. Several water contents may be used to check the validity of this procedure. Use the field resistance meter to measure the resistance. Record the value in ohms.

Photo No. D-8



APPENDIX E

MAINTENANCE REPLACEMENT COSTS LAST

FIVE YEARS FOR CSP AND RCP

APPENDIX E

MAINTENANCE REPORT OF REPLACED CSP

YEAR	LINEAL FEET REPLACED	TOTAL COST OF MATERIAL	MATERIALS COST PER FOOT	TOTAL COST OF REPLACEMENT	NET COST PER FOOT
1985	30,354	$107,886.28	$ 3.55	$ 707,711.82	$23.32
1986	34,478	311,517.14	9.04	881,339.28	25.56
1987	37,048	323,147.38	8.72	1,032,464.30	27.87
1988	34,002	375,600.19	11.05	1,026,321.80	30.18
1989	42,774	426,256.11	9.96	1,272,496.73	29.75

MAINTENANCE REPORT OF REPLACE RCP

YEAR	LINEAL FEET REPLACED	TOTAL COST OF MATERIAL	MATERIALS COST PER FOOT	TOTAL COST OF REPLACEMENT	NET COST PER FOOT
1985	753	$ 12,497.81	$16.60	$30,768.36	$40.86
1986	1,170	11,810.22	10.09	37,666.16	32.19
1987	1,063	23,281.61	21.90	57,891.47	54.46
1988	858	2,630.81	3.06*	27,844.66	32.45
1989	1,308	19,853.73	15.18	57,457.21	43.93

*Lots of salvaged pipe used this year.