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ABSTRACT

The product of a 1972 Dental Health Branch contract with the U.S. Public Health Service, this manual is designed to aid in the development of school fluoridation programs and presents: background information on general concepts relating to the action of fluoride on teeth; discussions dealing with community and school fluoridation studies; and the school fluoridation system developed and used in Kentucky. Specifically this guide includes: (1) Introduction (statistical information re fluoridation in general and the Kentucky project in particular); (2) Concepts of Fluoride Action; (3) Belated Full-Time Exposure to Fluoridated Community Water Supplies (three studies documenting the effects of fluoridation); (4) Belated Part-Time Consumption of Fluoridated Water (two studies); (5) Studies on Rural School Fluoridation (four major studies, one of which involves a school served by naturally fluoridated well water and three which involve controlled fluoridation of the school water supply); (6) Initial Rural School Survey Procedures; (7) Installation of School Fluoridation Equipment; (8) Charging and Calibration (fluoridation equipment); (9) Surveillance; (10) Maintenance; (11) Important Administrative Considerations; (12) Appendix (sample forms, equipment lists and photographs of equipment that are used in school fluoridation which might prove useful to agencies and schools interested in instituting a fluoridation program). (JC)

A MANUAL FOR

RURAL SCHOOL FLUORIDATION

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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A MANUAL FOR RURAL SCHOOL FLUORIDATION

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TABLE OF CONTENTS

4

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PART A
Section I

INTRODUCTION

It has been known since the 1950's that the consumption of optimally fluoridated water will dramatically and safely reduce the incidence of dental decay. Numerous and exhaustive dental studies, involving both natural and controlled fluoridation in the United States and other countries, have documented this fact beyond question. Fluoridation has been ranked with vaccination, pasteurization of milk and chlorination of water as one of the most important public health measures ever developed.

In the United States, 45.5 percent (95,584,900) of the total population is served by fluoridated public water supplies. This is 58.7 percent of the population served by public water supplies. About 23 percent (46 million) of the total population is located in rural areas and is not served by public water supplies, areas which also tend to have scarce dental resources. In states with a relatively large rural population, such as Kentucky, the proportion of the population not served by public water supplies is substantially higher than 23 percent.

The lack of public water supplies in rural areas prompted the Division of Dental Health, USPHS, to consider the development of an alternative and practical method of providing fluoridated water in rural areas. Beginning in 1954, a series of studies were initiated to explore the feasibility and effectiveness of fluoridating rural elementary and secondary school water supplies. When favorable results were found during the early portions of these studies, several states became interested in the procedure as a practical method of elevating the level of oral health in their rural areas. The Division of Dental Health in the North Carolina Department of Human Resources seized the initiative and implemented a vigorous school fluoridation program that has become a model for other states.

In Kentucky, initial steps in developing a school fluoridation program began in 1971 as a result of a dental public health residency project designed for a rural county in southeastern Kentucky by a faculty member of the Department of Community Dentistry, University of Kentucky College of Dentistry. The project was a cooperative effort of the University, the Dental Health Branch of the Bureau for Health Services, Department for Human Resources and the Mountain Comprehensive Health Corporation - an OEO program in that rural county. Kentucky is an ideal state for the development of school fluoridation since 34 percent of the population is not served by public water supplies. It is estimated that 75,000 school children in 250 rural schools could ultimately benefit from the measure.

In 1972, the Dental Health Branch sought and obtained a contract with the Division of Dental Health, USPHS, to develop and implement a school fluoridation program for Kentucky. This manual is a product of that contract.

Sections of the manual provide background information on general concepts relating to the action of fluoride on teeth, discussions dealing with community and school fluoridation studies, and the school fluoridation system developed and used in Kentucky.

PART A
Section II

CONCEPTS OF FLUORIDE ACTION

Laboratory and clinical studies conducted in several countries since the early 1930's have provided basic concepts of the action of fluoride upon the teeth. These concepts explain why fluoridation of water supplies is effective in reducing the incidence of dental decay and indicate that:

A. Fluorides apparently become incorporated into the structure of enamel so that the enamel, especially the outer surface, is more resistant to acids produced by certain types of microorganisms that are found in the mouth. The fluoride also possibly affects the bacteria themselves. Most of the fluoride in teeth is found in enamel and most of the fluoride in enamel is found in the outer 0.1 mm. Unerupted and newly formed teeth naturally contain some fluoride. Teeth acquire additional fluoride after eruption and for as long as they are retained in the mouth. However, teeth from areas having 1.0 ppm or more in the drinking water will have a much higher concentration of fluoride in the enamel than teeth from areas of low fluoride levels in the drinking water.

B. Fluoride is incorporated into the enamel in any one or all of three stages of enamel development. These stages are:

1. Period of Matrix Formation and Calcification

   This is the period when the enamel of the developing tooth is being formed. It is during this stage that fluoride is deposited throughout the enamel. Enamel is formed by cells called ameloblasts. These enamel forming cells are the most sensitive tissues in the body to excessive levels of fluorides. Excessive levels of fluoride in the drinking water during the enamel-formation period may disturb these cells, causing them to produce defective (mottled) enamel.

2. Period of Pre-eruptive Maturation

   Following enamel formation, a period of time lapses before the tooth erupts into the mouth (approximately 2 - 5 years). See Table I. During this period, the fully-formed enamel is surrounded by the tissues and tissue fluids of the jawbones. The enamel surface continues to acquire fluoride through contact with tissue fluids that contain fluoride. The amount of fluoride in the tissue fluids is dependent upon the fluoride content of the blood which in turn is dependent upon the amount of available fluoride consumed. Water is the primary source of such fluoride. Once the enamel has been formed, consumption of very high levels of fluoride (6 - 14 ppm in the drinking water) will not produce defects in the enamel.

3. Post-eruptive Period

After the tooth erupts into the mouth, the enamel continues to acquire fluoride in the outermost surface layer. This acquistion is through topical (surface) action with fluorides in food and water.

The primary source of fluoride is from the drinking water, and the amount acquired is related to the fluoride concentration of the water. Up to about 5.0 ppm fluoride in drinking water, most of the fluoride acquired topically is limited to the outer 0.1 mm of the enamel surface. Continuous consumption of water containing 5.0 ppm or more fluoride over a period of years will finally saturate the outer enamel surface and some of the deeper enamel layers will acquire higher fluoride levels.

C. Maximum decay-preventing benefits with minimal chances of mild fluorosis to the permanent teeth occur when water containing 0.7 - 1.2 ppm fluoride (depending upon climate) is regularly ingested from birth through the age of 18 years. At birth, only the permanent first molars have begun to form enamel. The formation of enamel continues through the age of 8 years (except third molars). All of the permanent teeth have usually erupted by the age of 13 with the exception of the third molars. (See Table I).

D. At the age of six, when children enter school, most of the permanent teeth are still located in the jawbones. The later erupting teeth, the canines, premolars and second molars are all in the later stages of enamel formation. Some of these late erupting teeth may be exposed to the fluorides in tissue fluids for 2 - 5 years between the completion of enamel formation and when the tooth erupts into the mouth.

E. Maintenance of maximum caries benefits, especially in the permanent molars, requires that the consumption of fluoridated water continue well beyond the eruption of the teeth into the mouth. As mentioned in Part B of this Section, the outer enamel surface continues to acquire fluoride after eruption as a result of topical action between the tooth surface and fluoridated water that is consumed.

The above concepts will help explain the findings of the various studies outlined in the following sections.

TABLE I

AVERAGE DATES OF MINERALIZATION AND ERUPTION OF THE HUMAN DENTITION

PERMANENT TEETH

Tooth	Hard Tissue Formation Begins	Amount of Enamel Formed at Birth	Enamel Completed	Root Completed	Eruption
MAXILLA					
First incisor	3- 4 mos.	----	4- 5 yrs.	10 yrs.	7- 8 yrs.
Second incisor	10-12 mos.	----	4- 5 yrs.	11 yrs.	8- 9 yrs.
Cuspid	4- 5 mos.	----	6- 7 yrs.	13-15 yrs.	11-12 yrs.
First bicuspid	1 1/2-1 3/4 yrs.	----	5- 6 yrs.	12-13 yrs.	10-11 yrs.
Second bicuspid	2-2 1/4 yrs.	----	6- 7 yrs.	12-14 yrs.	10-12 yrs.
First molar	at birth	Sometimes a trace	2 1/2- 3 yrs.	9-10 yrs.	6- 7 yrs.
Second molar	2 1/3- 3 yrs.	----	7- 8 yrs.	14-16 yrs.	12-13 yrs.
Third molar	7- 9 yrs.	----	12-16 yrs.	18-25 yrs.	17-21 yrs.
MANDIBLE					
First incisor	3- 4 mos.	----	4- 5 yrs.	9-10 yrs.	6- 7 yrs.
Second incisor	3- 4 mos.	----	4- 5 yrs.	10 yrs.	7- 8 yrs.
Cuspid	4- 5 mos.	----	6- 7 yrs.	12-14 yrs.	9-10 yrs.
First bicuspid	1 3/4- 2 yrs.	----	5- 6 yrs.	12-13 yrs.	10-12 yrs.
Second bicuspid	2 1/4-2 1/2 yrs.	----	6- 7 yrs.	13-14 yrs.	11-12 yrs.
First molar	at birth	Sometimes a trace	2 1/2- 3 yrs.	9-10 yrs.	6- 7 yrs.
Second molar	2 1/3- 3 yrs.	----	7- 8 yrs.	14-15 yrs.	11-13 yrs.
Third molar	8-10 yrs.	----	12-16 yrs.	18-25 yrs.	17-21 yrs.

Taken from Stones' Oral and Dental Diseases, 1966

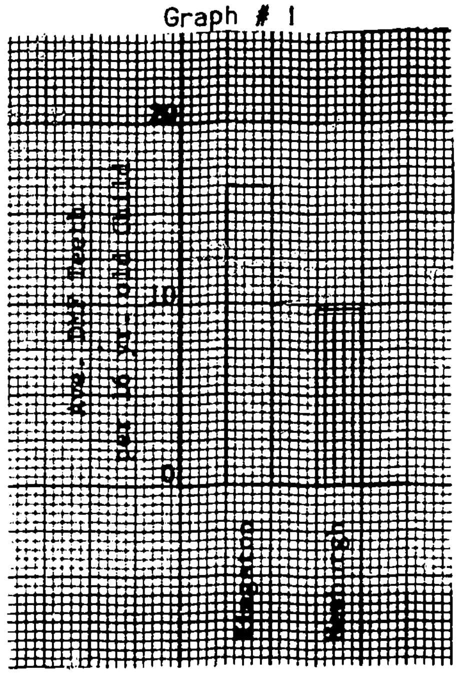
PART A
Section III

BELATED FULL-TIME EXPOSURE TO FLUORIDATED COMMUNITY WATER SUPPLIES

Several dental studies have been concerned, at least in part, with children who were six years of age or more before beginning to consume fluoridated community water on a regular, full-time basis. These studies revealed that even though the enamel formation of many of the permanent teeth had been completed before fluoridation began (except canines, second premolars, and second molars), significant reductions in decay in the permanent teeth had occurred. This decay reduction, especially in the early erupting teeth, is thought to be a result of a topical effect of tissue fluids containing fluoride upon unerupted teeth that have completed enamel formation and a similar effect of fluoridated water upon the enamel surface of erupted teeth. Three major studies on community fluoridation which support these effects are:

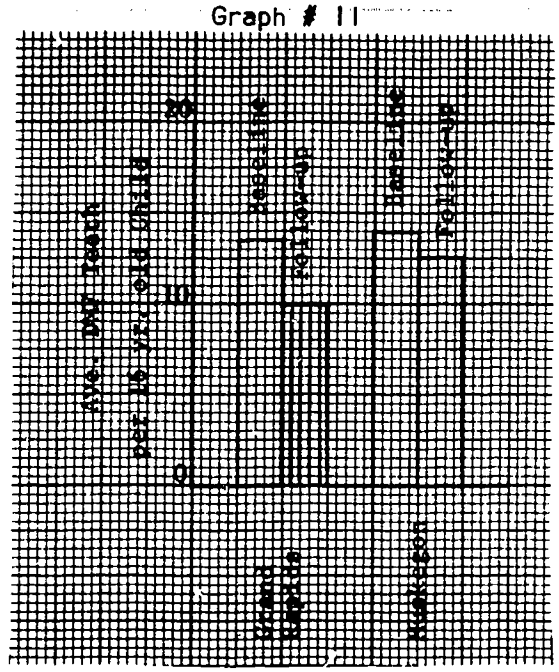
1. The controlled study in New York, involving the test city of Newburgh (fluoridated in 1945) and the control city of Kingston (nonfluoridated), was one of the most thorough and complete of these dental studies. This study revealed that after ten years of fluoridation in Newburgh 16-year-old children who had consumed water on a full-time basis since six years of age had experienced an average of 9.75 decayed, missing and filled permanent teeth per child. This was 41.0 percent less decay than the average of 16.49 decayed, missing and filled permanent teeth per child that was found in 16-year-old children in nonfluoridated Kingston (See graph # 1). In addition, 16-year-olds in Newburgh had experienced 32.5 percent fewer missing first molars and had 1.8 times more caries-free molars than children of the same age in Kingston.

Graph # 1



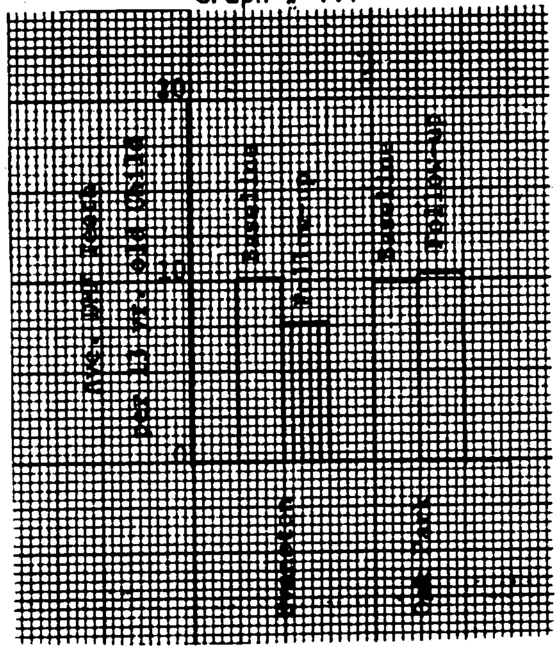
2. Another major controlled study involved the test city of Grand Rapids (fluoridated in 1945) and the control city of Muskegon (nonfluoridated), both located in Michigan. This study revealed that after ten years of fluoridation, 16-year-old children in Grand Rapids had experienced an average of 9.95 decayed, missing and filled permanent teeth per child. This was a decay reduction of 26.30 percent from 16-year-old children examined in Grand Rapids just before fluoridation began. Baseline and ten year follow-up examinations of 16-year-olds in nonfluoridated Muskegon revealed averages of 14.07 and 12.55 decayed, missing and filled permanent teeth per child. The 16-year-olds in Grand Rapids had experienced 29.3 percent and 20.7 percent less decay than 16-year olds examined in baseline and follow-up examinations in Muskegon (See graph # II). In addition, there were 1.8 times as many 16-year-old children in Grand Rapids who were free of decay compared to children of the same age in Muskegon.

Graph # II



3. A third major study was conducted in the test city of Evanston (fluoridated in 1947) and the control city of Oak Park (nonfluoridated), both located in Illinois. After seven years of exposure to fluoridated community water, 13-year-old children in Evanston had experienced an average of 7.6 decayed, missing and filled permanent teeth or 24.9 percent less decay than the 10.1 decayed, missing and filled teeth found in 13-year-olds from the same city just prior to fluoridation. When compared to baseline and follow-up examinations of 13-year-olds in the control city of Oak Park, children of the same age in Evanston after seven years of fluoridation had experienced 21.8 percent and 24.2 percent fewer decayed, missing and filled permanent teeth (See graph # III).

Graph # III



13

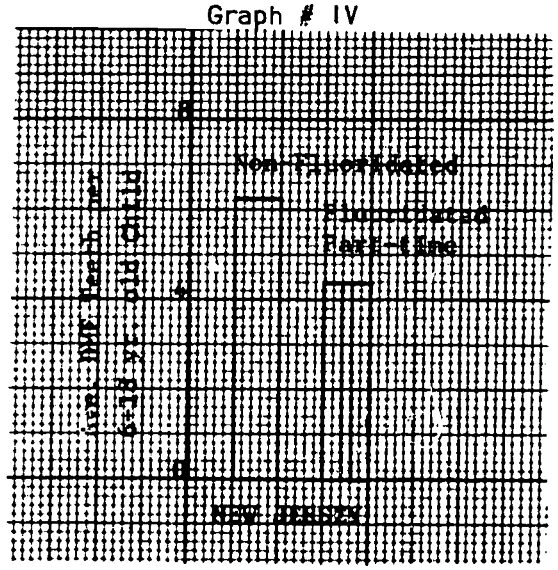
PART A
Section IV

BELATED PART-TIME CONSUMPTION OF FLUORIDATED WATER

There have been several studies involving children who consumed nonfluoridated water at home but attended schools served by fluoridated community water supplies. These studies revealed that these children, who did not begin consumption of fluoridated water until they were of school age and then only during school hours, received significant decay-preventing benefits to the permanent teeth. Two examples of these studies are:

1. An early study in New Jersey, conducted in 1945, dealt with a group of children six to eighteen years of age who had been born and continued to reside in nonfluoridated areas. These children, beginning at age six, attended schools served by community water supplies containing 1.2 - 2.2 ppm natural fluoride. The study revealed that these children had experienced an average of 4.4 decayed, missing and filled permanent teeth per child. Children examined from the same geographic area but who consumed nonfluoridated water exclusively, had experienced an average of 6.3 decayed, missing and filled permanent teeth per child. This is a 30.2 percent difference in the decay experience of the two groups. (See graph # IV).

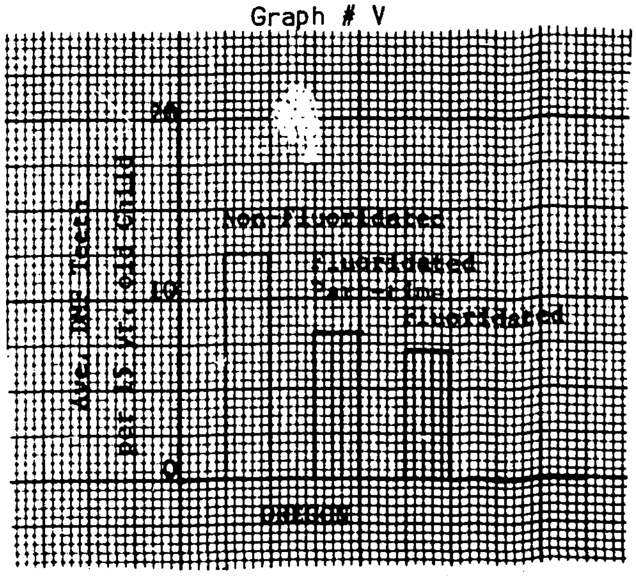
Graph # IV



2. A study conducted in Oregon in 1960 and 1961 involved three groups of school children. One group of these children lived in a nonfluoridated area but attended schools served by a community water supply fluoridated in 1953. Examinations of 15-year-old children from this group who had consumed fluoridated water during school hours for eight years revealed that they had experienced an average of 8.73 decayed, missing and filled permanent teeth per child. Examination of children of the same age in a nearby area who consumed

nonfluoridated water both at home and at school revealed that each child had experienced an average of 12.55 decayed, missing and filled permanent teeth. There was a 30.4 percent difference in the permanent tooth decay experience of children who drank the fluoridated school water and the children who consumed only nonfluoridated water. (See graph # V). The third group of children who consumed fluoridated water, both at home and at school since 1953, had fewer DMF teeth per child (7.27) than either of the first two groups.

Graph # V



15

PART A
Section V

STUDIES ON RURAL SCHOOL FLUORIDATION

There have been four important studies that deal specifically with rural school fluoridation. In these studies, three of which involved controlled fluoridation of the school water supply, and one which involved a school served by naturally fluoridated well water, the fluoride concentration was at least three times the level recommended for community fluoridation in the same weather zone. A higher concentration of fluoride was chosen in the three study schools with controlled fluoridation because:

1. Children six years of age and older spend about 20-25 percent of their waking hours in school each year. It was estimated that a similar proportion of total water intake was consumed while attending school.

2. Since children consume about one fourth of their daily water intake at school, it was hypothesized that a fluoride concentraion of three to four times that required for community fluoridation would be required to achieve decay-reducing benefits similar to those shown by children not exposed to optimally fluoridated community water supplies until they were of school age.

3. Earlier studies of children who migrated into areas where the water supply contained as much as 14 ppm of fluoride revealed that fluorosis did not occur in those teeth in which enamel formation was complete by the time these children began regular consumption of high fluoride levels.

The four specific studies on school fluoridation were:

1. The first controlled study of school fluoridation was initiated in 1954 in Charlotte Amalie, Virgin Islands, by the U.S. Public Health Service. Two elementary schools were fluoridated at a level of 2.3 ppm - a concentration that is slightly more than three times the optimum for community water supplies in that temperature zone. Three other elementary schools in the same area served as control schools. One of the test schools discontinued fluoridation during the study as a result of construction and renovation of the building and was excluded from the findings.

   At the six year follow-up examinations, children attending the test school had experienced 2.47 decayed, missing or filled permanent teeth per child as compared to children attending the control schools who had experienced 3.21 DMF teeth per child. This is a reduction of 21.9 percent in the DMF per child (See Table II).

16

TABLE II

COMPARISON OF DMF TEETH IN TEST AND CONTROL GROUPS
BY SCHOOL GROUPS, ST. THOMAS, VIRGIN ISLANDS

GRADE	TEST GROUP AVE. NO. DMF TEETH	CONTROL GROUP AVE. NO. DMF TEETH	% DIFFERENCE
2	0.57	0.94	35.6
3	1.08	1.71	38.9
4	2.36	2.10	9.4*
5	3.11	3.96	18.2
6	3.55	5.00	26.0
7	4.74	5.93	17.6
Total	2.47	3.21	21.9

*Increase in test group over control group

Adapted from: Horowitz, H.S., Law, F.E., and Pritzlor, T. Effect of School Water Fluoridation on Dental Caries, St. Thomas, Virgin Islands, Public Health Reports, Vol. 80, No. 5, May 1965, P. 384.

2. In the Spring of 1958, two rural schools (grades 1-12) in Pike County, Kentucky were fluoridated by the U.S. Public Health Service. These schools were fluoridated at 3.0 ppm fluoride or 3.3 times the optimum for community fluoridation in that area. All children attending these schools were given dental examinations in the Fall of 1957 for the purpose of establishing baseline data.

   Five years after fluoridation was initiated, dental examinations revealed that the average number of decayed, missing and filled permanent teeth per child in students aged 6-17 years had decreased from 7.17 in 1957 to 4.62 in 1963 - a reduction of 28.6 percent.

   In 1966, examinations after eight years of school fluoridation, the average number of decayed, missing and filled permanent teeth per child had decreased to 4.58 or 32.8 percent less than the baseline examinations (See Table III).

TABLE III

CHANGE IN MEAN DMF TEETH FROM 1957 TO 1966
BY AGE - PIKE COUNTY, KENTUCKY

AGE	1957 (BASELINE)	1966	% REDUCTION FROM 1957
Total	7.17	4.82*	32.8
6	1.01	0.44	56.4
7	2.17	1.12	48.4
8	2.93	1.88	35.8
9	3.90	2.16	44.6
10	5.14	3.22	37.4
11	6.70	4.21	37.2
12	8.18	5.16	36.9
13	8.86	5.83	34.2
14	11.15	7.38	33.8
15	12.27	8.28	32.5
16	12.81	9.66	24.6
17	12.51	10.93	12.6

*Adjusted to 1957 age distribution

Adapted from: Horowitz, H.S., Heifetz, S.B., Law, F. E., Driscoll, W.S., School Fluoridation Studies in Elk Lake, Pennsylvania, and Pike County, Kentucky - Results after Eight Years. A.J. Pub. H., Vol. 58, No. 12, Dec. 1968, p. 2245.

In 1970, twelve year follow-up examinations were conducted in Pike County. However, in 1967, one of the two project schools had been converted to a high school and grades 1-6 were sent to a new elementary school served by a water supply containing negligible fluoride. As a result, noncontinued patterns of consumption of fluoridated school water was produced in one study school. The remaining project school had an insufficient number of children to provide reliable statistical data. As a result, no findings were published on the twelve-year follow-up.

3. In 1958, during the same time period that the study in Pike County was initiated, one school (grades 1-12) in Elk Lake, Pennsylvania, was fluoridated at 5.0 ppm by the U.S. Public Health Service. This concentration of fluoride is about 4.5 times the optimum for school fluoridation in that temperature zone. As in Pike County, children attending the school were given baseline dental examinations.

In 1962, four years after the study, the average number of decayed, missing and filled permanent teeth per child had decreased from 7.71 in the baseline examinations to 5.82 - a reduction of 24.5 percent Follow-up examinations in 1966, eight years after fluoridation was initiated, revealed that the average number of decayed, missing and filled permanent teeth per child had decreased to 5.10 - a 33.9 percent reduction when compared to the 1958 baseline survey.

In 1970, final follow-up dental examinations (12 years) were conducted in this study. These examinations revealed that the average number of decayed, missing and filled teeth per child had decreased from 7.71 in 1958 to 4.71 in 1970 as a result of the twelve years of school fluoridation. This is a reduction of 39.0 percent. (Table IV and Graph # VI demonstrates this reduction).

TABLE IV

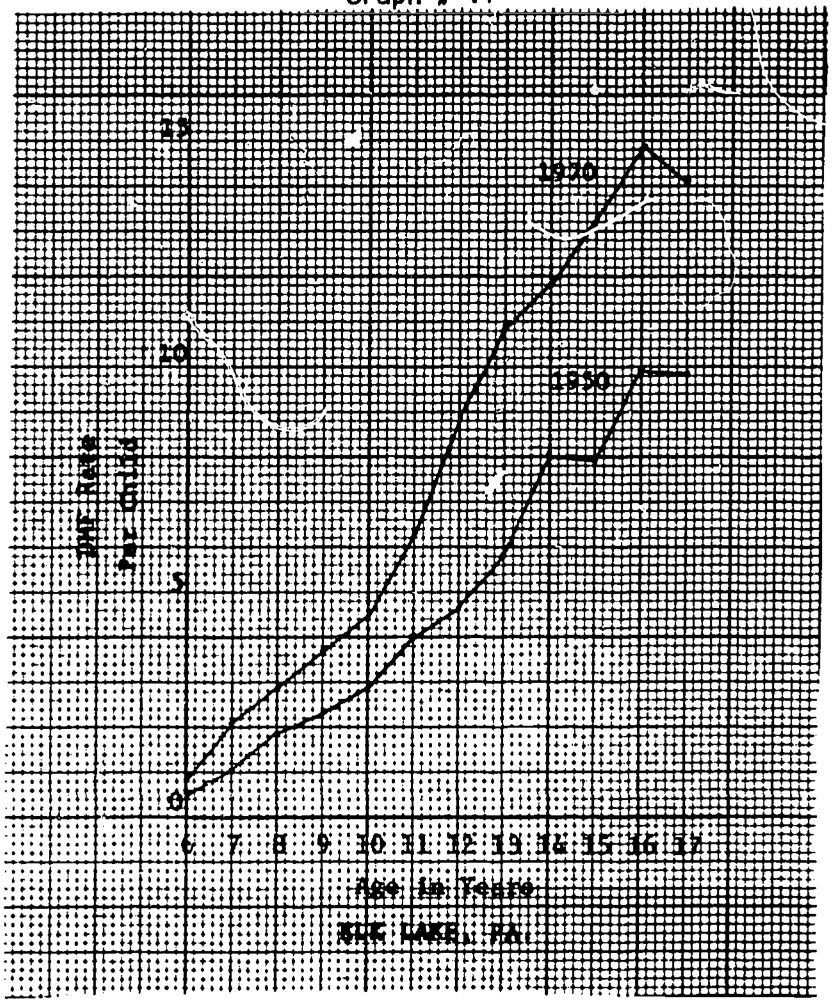
CHANGE IN MEAN DMF TEETH FROM 1958 TO 1970
BY AGE - ELK LAKE, PENNSYLVANIA

AGE	1958 (BASELINE)	1970	% REDUCTION FROM 1958
Total	7.72	4.71*	39.0
6	0.86	0.54	37.2
7	2.17	1.04	52.1
8	2.94	1.86	36.7
9	3.72	2.35	36.8
10	4.48	2.84	36.6
11	6.36	4.01	36.9
12	8.96	4.63	48.3
13	10.89	5.82	46.6
14	11.86	8.04	32.2
15	13.32	7.90	40.7
16	14.93	9.98	33.2
17	14.19	9.85	30.6

*Adjusted to 1958 age distribution

Adapted from: Horowitz, H.S., Heifetz, S.B., Law, F.E., Effect of School Water Fluoridation on Dental Caries; Final Results in Elk Lake, Pennsylvania, After 12 Years. JADA, Vol. 84, April 1972, p. 833

Graph # VI



This long-term study allowed the effects of school fluoridation to be more precisely determined than had previously been possible. These effects were:

A. The proximal surfaces (front and back-side tooth surfaces that touch the side surfaces of adjacent teeth in the same jaw) of teeth are protected to a greater extent than the occlusal (biting) surfaces or buccal (cheek-side) and lingual (tongue-side) tooth surfaces. Protection of these proximal surfaces is especially important since restoring these surfaces with dental fillings after they have decayed is more difficult, time consuming and expensive than other surfaces. The occlusal surfaces of premolar and molar teeth usually must be opened whether it is decayed or not to restore the proximal surfaces.

B. Teeth which erupted before or shortly after school fluoridation began (incisors and first molars) received less decay-reducing benefits than those teeth which were still developing and maturing (canines, premolars and second molars) in the jawbones. This is expected since the later erupting teeth received more exposure to tissue fluids containing fluoride while in the jawbones.

C. The rate of extractions drops dramatically, especially in the anterior (front) teeth. Loss of first permanent molars is also reduced by more than half. These teeth are important in the development and maintenance of proper occlusion (bite). It should be emphasized that sound anterior teeth are most important from an appearance standpoint and that the dental restoration or replacement of anterior teeth can be difficult and expensive as a result of esthetic considerations.

4. In 1966, dental examinations were conducted on children of the same race (black) attending an elementary school in Georgia. The school had been opened in 1956 and was served by a deep well whose water naturally contained 3.5 ppm fluoride. This fluoride level is about 4.0 times the optimum level for community fluoridation in Georgia. A random sample of the home water supplies of children attending the school revealed only two samples with fluoride and these samples had minimum amounts. Children in another elementary school in the same county, served by a nonfluoridated public water supply, were examined and used as controls.

The findings of this study revealed that the children (ages 6-15) attending the naturally fluoridated school had experienced 1.37 decayed, missing and filled permanent teeth per child while children of the same age range attending a nearby school served by a non-fluoridated community water supply had experienced 2.26 DMF teeth per child. (See Table V and Graph # VII). The level of reduction in this natural study - 40.7 percent - is quite comaprable to the controlled study in Elk Lake, Pennsylvania.

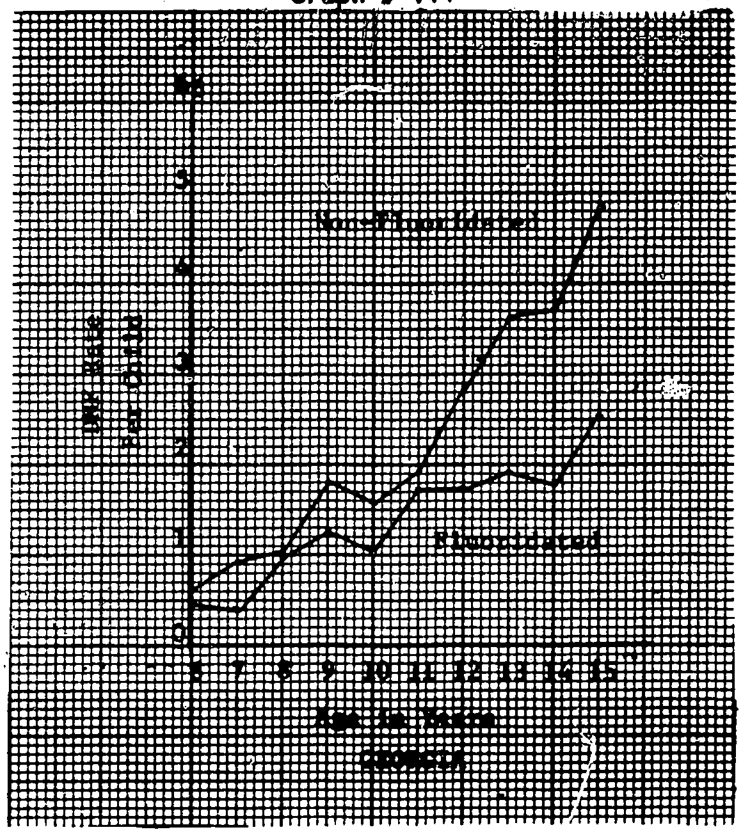
TABLE V

COMPARISON OF DMF TEETH IN TEST AND CONTROL GROUPS
BY AGE, GREENE COUNTY, GEORGIA
1966

AGE	TEST GROUP DMF RATE	CONTROL GROUP DMF RATE
6	0.46	0.62
7	0.40	0.93
8	0.97	1.04
9	1.26	1.80
10	1.02	1.59
11	1.72	1.91
12	1.73	2.87
13	1.92	3.63
14	1.79	3.73
15	2.54	4.89
Total	1.37	2.26

Adapted From: Barron, E.G., Lewis, J.F., Effect of a School's Naturally Fluoridated Water on the Prevalence of Carious Lesions. J. Public Health Dent., Vol. 28, No. 3, Summer 1968, p. 169.

Graph # VII



These studies unequivocally established that the fluoridation of school water supplies is effective in reducing the occurrence of dental decay in permanent teeth. This reduction occurs even though children do not begin to consume the fluoridated water until they reach school age. These studies also provided support to the hypothesis formulated during the Elk Lake study that part-time exposure to school fluoridation at elevated levels and full-time exposure to optimally fluoridated community water provided equivalent levels of daily fluoride intake. It was found that 16-year-olds who had not begun full-time consumption of optimally fluoridated community water on a full-time basis until they were of school age had experienced reductions in decay of approximately the same magnitude as 16-year-olds who had consumed school water fluoridated at elevated levels since the age of six. Both types of groups had experienced a reduction in decay of 26 - 41 percent when compared to baseline examinations.

SAFETY

Of primary concern in the elevated levels of school fluoridation was the possibility of fluorosis. As has been previously mentioned, the enamel-forming cells are the most sensitive tissues in the body to higher than optimum levels of fluoride. The eight-year results from Pike County and Elk Lake revealed that only 12 teeth of 13,304 teeth (.09 percent) examined could be positively diagnosed as having fluorosis. This fluorosis was of a very mild type, requiring the training eye of an experienced dental epidemiologist to detect. This extremely low level of occurrence of fluorosis is less than that expected in a fluoridated community supply. As mentioned in Section II, consumption of water containing a fluoride concentration as high as 14 ppm will not produce fluorosis of enamel that has already formed.

From the standpoint of general health, epidemiologic and case studies have indicated that long term consumption of water containing fluoride concentrations at levels used in school fluoridation has no harmful effects upon other body tissues.

OPTIMUM FLUORIDE CONCENTRATION FOR SCHOOL FLUORIDATION

The results of school fluoridation studies to date have indicated that the optimum fluoride concentration for school fluoridation is approximately 4.5 times the optimum fluoride concentration for community fluoridation in the same temperature zone. For example, if the optimum fluoride concentration in a particular area is 0.9 ppm, the optimum fluoride concentration for school fluoridation in the same area would be 4.0 ppm.

To accurately determine the optimum fluoride concentration for school fluoridation in a given area, the following guidelines can be used:

1. Using publications of the U.S. Weather Bureau, determine the mean maximum temperature for the previous five-year period for the area in question.

2. Refer to the table given below (Table VI) for the optimum fluoride concentration for community fluoridation.

TABLE VI

MEAN MAXIMUM TEMPERATURES AND
CORRESPONDING RECOMMENDED OPTIMUM FLUORIDE CONCENTRATIONS

Mean Maximum Temperature (Degrees Fahrenheit)	Recommended Optimum Fluoride Concentration (Parts Per Million)
50.0-53.7	1.2
53.8-58.3	1.1
58.4-63.8	1.0
63.9-70.6	.9
70.7-79.2	.8
79.3-90.5	.7

Source: Galagan, D.J., Vermillion, J.R. Determining Optimum Fluoride Concentration, p. 492, Pub. Health Reports 72: No. 6, June 1957.

3. Multiply times 4.5 the optimum figure for community fluoridation obtained from Table VI. The product will be the optimum fluoride concentration for school fluoridation.*

* Initial results from a study currently being conducted in Seagrove, North Carolina have indicated that the optimum fluoride concentration for school fluoridation may be as much as seven times or more the optimum concentration for community fluoridation in the same geographic area.

PART B

INTRODUCTION

This part of the manual will outline specific procedures that can be used to fluoridate a rural school water supply. These procedures include the assessment of school facilities, sampling of home water supplies, installation and calibration of fluoridation equipment, establishment of a surveillance system and maintenance of fluoridation equipment. It is realized, of course, that these procedures may have to be altered depending upon the circumstances surrounding any one individual rural school. However, in general these procedures should be adequate to fluoridate most rural schools.

The appendix included in this part of the manual contains sample forms, equipment lists and photographs of equipment that are used in school fluoridation. These materials may prove useful to agencies and schools interested in instituting a school fluoridation program.

PART B
Section I

INITIAL RURAL SCHOOL SURVEY PROCEDURES

The following procedures can be used to assess the feasibility of fluoridating a rural school:

A. Contact the Local Health Department

The local health department, particularly the sanitarian, can usually provide general information about rural school water supplies in his county. This information can serve as one initial screening procedure in the identification of rural school's potential eligibility for school fluoridation.

B. Contact the Local School Board Superintendent

Using information obtained from the local health department, the school fluoridation program is discussed with the local school board superintendent. If the superintendent decides to approve the program, written or verbal approval is secured to survey potential schools. The superintendent should also be requested to notify principals of potential schools that their schools will be surveyed.

C. Survey of Potential Schools

1. Contact principals of potential schools and discuss the school fluoridation program with them.

2. Assess school facilities using the criteria presented below to determine the feasibility for the installation of a school fluoridator. (See sample form A.)

3. Criteria for Rural School Assessment

The following criteria are used to assess the technical feasibility of fluoridation of a rural school water supply.

(a) The school must be the sole user of its water supply. The existence of any branch lines serving nonschool buildings or residences must be determined. If such branch lines exist, the feasibility of isolating these lines from that portion of the school's water system to be fluoridated must be determined. If isolation is not possible, the nonschool buildings must be provided with an alternate source of water or the school must be dropped from consideration.

(b) <u>The school water supply must contain a natural fluoride level less than the level considered optimal for school fluoridation</u>. At present, the optimum level for school fluoridation is 4.5 times the optimum fluoride level for a community located in the same geographic area as the school.

(c) <u>Children attending the school must not be served by a water supply at home that contains more than one-half the maximum fluoride level recommended for community fluoridation in the same geographic area</u>.

(d) <u>Neither the rural school nor the homes of children attending the school should be likely to be connected to a fluoridated public water supply within five years from the time a school fluoridator could be installed</u>.

(e) <u>Sufficient space and adequate plumbing and electrical facilities must be available for installation of fluoridation equipment</u>. A heated, dry, spacious, and separate pump house is ideal. An adequate location can be in the school near the pressure tank. In either case, the room should be secured by lock and key. If the school facilities require alteration, such alterations must occur before final approval of the school. In some cases, a separate, enclosed, heated and lockable shelter must be constructed to house the fluoridation equipment.

(f) <u>In general, the school should serve at least 150-200 students</u>. Smaller schools tend to have marginally adequate water systems with low flow rates (less than eight gallons per minute) that make the maintenance of steady fluoride levels in the system more difficult. Regardless of the size of the school, the principal or responsible maintenance personnel should be asked if any problems with the water supply exist. Occasionally, even a large school will be served by a very inadequate water system that should not be fluoridated. It is recommended that the school's pressure tank have a capacity of at least 300 gallons.

4. In those schools which have adequate facilities, a water sample is drawn and sent to the state health agency water laboratory for accurate analysis. An optional on-site reading can be obtained by the use of a portable electrode or colorimetric analyzer (of the SPADNS type).

5. If the school water supply contains a fluoride concentration within acceptable limits, a survey of home water supplies is conducted. The survey should be a representative sample of the different types of home water supplies. One sampling method is:

(a) Distribute a water supply questionnaire to each pupil in the school (See sample form B).

(b) Using this questionnaire, prepare a list of families to which the school children belong.

(c) Separate these families according to the type of water supply. In general, these types are:

- Deep well (drilled)
- Shallow well (dug)
- Creek or stream
- Spring
- Public or semi-public
- Unusual (such as slag pond)
- Other (cisterns, etc.)

(d) Since elevated levels of fluoride are most likely to be found in water drawn from deep wells, the sampling procedure should be weighted to include a higher proportion of deep wells than of most other types of water supplies. For example, one system of weighting proportions of water supplies to be sampled is:

Type of Supply	Percent of Home Water Supplies to be Sampled
Deep well (drilled)	50%
Shallow well (dug)	15%
Creek or stream	15%
Spring	15%
Public or semi-public	100%
Unusual (slag pond, etc.)	100%
* Other (cisterns, etc.)	Determined by source

* In some areas the use of cisterns is common. Since families may purchase water that has been drawn from a fluoridated supply (controlled or natural), it is important to sample cisterns and be informed of the water source used.

Supplies to be sampled are randomly selected. One example might be:

Type of Supply	Number	% to be Sampled	Number to be Sampled
Deep well	75	50%	37
Shallow well	32	15%	5
Spring	3	15%	1
	110	39%	43

(e) A county map may be utilized to help insure that each geographic area that the school served is represented in the water samples that are to be collected.

(f) One child (probably an older child) of each family's water supply selected for the sample is provided a plastic water bottle, water supply survey form (See sample form C) and a mailing tube in which the bottle and form can be placed. The child is instructed to:

- Take the sample bottle and form home.
- Have it filled with water.
- Have the parents complete the form.
- Place both bottle and form in the container.
- Return the sample to the school within three days.

(g) The school principal is instructed to place the samples in a box of sufficient size and mail them to the State health agency laboratory for fluoride analyses.

(h) Following analyses of the samples, if no samples contain more than one-half the optimum level for community fluoridation in that geographic area, the school is eligible for fluoridation.

(i) If one of the analyzed samples contain a fluoride concentration in excess of one-half the optimum level for community fluoridation in the area, all water supplies of families who have children attending the school should be sampled and analyzed for fluoride content. If the total sample reveals that only a few families have water supplies containing excessive amounts of fluoride, two courses of action can be taken (besides eliminating the school from consideration). These are:

- The children of these families can be provided bottled water while attending school. This is necessary only if these children are less than nine years of age.

- The family can be encouraged to obtain another source of home water. This will probably be practical only in those cases where an alternative water supply is available without increased cost or inconvenience to the family.

(j) If more than a few family water supplies contain excessive amounts of fluoride, the school should be dropped from consideration.

6. Following the determination of a school's eligibility for fluoridation, a contract is drawn up that includes the official health agency and the local board of education (See sample form D). In essence, this contract stipulates that the school will agree to use and maintain the school fluoridation equipment according to the direction of the supervising agency. The contract may also include provision for the school to provide electrical and plumbing personnel for installation of equipment and agreements to make modifications to existing plumbing and electrical equipment, if necessary. The equipment is then installed, under the supervision of State health agency personnel.

PART B
Section II

INSTALLATION OF SCHOOL FLUORIDATION EQUIPMENT

Following the signing of the required contractual agreements, arrangements are made with the school principals to install the fluoridation equipment. Under the supervision of the appropriate staff member of the supervising agency, equipment can be installed by a plumber and electrician furnished by the school or by a private firm, depending upon the terms of the contract.

Assuming that the criteria for school fluoridation have been met, the following outline can be utilized as a general model for the installation of a school fluoridator of the sodium fluoride, down-flow type. Although sodium fluoride is relatively expensive when compared to other fluoride compounds used in fluoridation, a sodium fluoride saturator is usually the fluoridation unit of choice. This is because it is simple in operation, relatively easy to maintain, and due to the constant solubility of sodium fluoride in water over a wide temperature range, produces a fluoride solution of stable concentration (4 percent or 18,000 ppm). The fluoride cost is a minor consideration in a school where the volume of water used is quite small when compared to community fluoridation. The specific design of the installation will depend, of course, upon the individual school.

Sequence of Installation

The sequence of events involved in the installation of school fluoridation equipment is discussed in detail below.

A. Location of the Injection and Flow Metering Point

The injection and flow metering point is that point in the school's water system where the water flow rate is uniform. This point will be located on the input side of the pressure tank (elevated or hydropneumatic) to insure the constant maintenance of the desired fluoride level.

NOTE: In some rural schools, the well pump provides water to a non-pressurized underground storage tank from which a pressure tank is filled by means of a secondary pump. In this type of system, the injection and flow metering point may be located between either the well pump and the underground storage tank or between the secondary pump and the pressure tank. The choice of the injection and metering point in this case will depend upon considerations such as space available, access to water lines, well pump capacity or branch lines serving other buildings. In either case, the output of the well pump or secondary pump will determine the capacity required of the saturator feeder pump and master flow meter.

If branch lines exist that supply residences or non-school buildings, the injection and flow metering point must be located so that fluoridated water is excluded from these branch lines. To be specific, these branch lines must leave the main water line in an area between the well pump (or secondary pump, according to the situation) and the injection and flow metering point. This may necessitate the relocation of the branch lines and/or the installation of check valves to allow water to be supplied to the branch lines only when the well pump is operating. In some cases, a residence may require the installation of a pressure tank. Occasionally a different water supply will have to be provided to a residence if the residence cannot be isolated from lines carrying the fluoridated water. Once the location of the injection and metering point has been decided upon, the well pump delivery rate must be determined.

B. Determination of the Well Pump Delivery Rate

The delivery rate of the well pump (or secondary pump in some instances) must be determined for the selection of:

1. The size saturator feeder pump required to fluoridate a designated volume of water at a specific fluoride concentration.

2. A master meter of sufficient capacity to accurately measure the flow rate of a particular water system at the point of maximum flow.

Determination of the well pump (or secondary pump) delivery rate can be made in one of the following ways:

1. Recorded specifications on data available at the school or from the pump manufacturer.

2. Estimation from the horsepower rating of the well pump, well depth and head loss.

3. If reliable data on the well pump capacity is not available, the water line at or near the planned injection and flow metering point can be opened, a flow meter inserted in the line, and the flow rate measured by means of a stopwatch. Another method is to use a bucket or calibrated drum and stopwatch to measure well pump output. (If the water line is too close to the floor, this method may not be feasible.) Since the second method measures the flow rate against zero pressure, it will be necessary to calculate the estimated flow rate that would occur against pressure produced by the system. A health department sanitarian may be able to provide assistance in this case.

   In many schools, if they have experienced no water supply problems, the master meter loop (See page DI, Part B, Section II) can be installed prior to the determination of the flow rate and without using either of the two methods outlined above. If the master meter is the same or slightly smaller diameter as the existing water supply line, it can usually be assured that the meter will be of sufficient capacity to accurately measure the flow rate. Once the master meter loop has been installed, the flow rate can be determined and the proper size saturator feeder pump selected. The vast majority of rural schools will require a saturator feeder pump capable of feeding 20 gallons/day or less to attain four to five ppm fluoride in the water supply.

Once the well pump delivery rate has been determined, the proper size of a saturator feeder pump and master flow meter can be selected.

C. Selection of the Saturator Feeder Pump and Master Flow Meter

1. Saturator Feeder Pump

The size of the saturator feeder pump to be utilized will depend upon the flow rate at the injection and flow metering point and the concentration of fluoride that is to be maintained in the school's water supply. The feeder pump selected should be of sufficient size so that the delivery rate required to maintain the desired fluoride concentration will fall in the mid-range of the feeder pump's capacity. For example, if a hypothetical school water system had the following characteristics:

Water flow rate	= 15 gallons/min.
Desired fluoride concentration in drinking water	= 4.5 ppm
Natural fluoride level	= nil
Saturator fluoride concentration	= 18,000 ppm

$$\frac{\text{Water flow rate x time}}{\text{Fluoride conc. of saturator}} \times \text{Desired conc.} = \text{Feeder pump rate required}$$

$$\frac{\text{20 gal./min. x 60 min./hr.}}{\text{18,000 ppm}} \times \text{4.5 ppm} = \text{0.30 gallons per hour}$$

For this system, a feeder pump would be selected that is capable of providing at least 0.60 gallons per hour or 14.4 gallons per day (24 hours).

Since rural schools have relatively low water flow rates, usually a small capacity feeder pump is used that has a fluoride-resistant diaphragm-type head with check valves. The feeder pump motor should be compatible with the existing electrical system.

2. Master Flow Meter

The master flow meter is used to accurately determine the flow rate of the water system near the injection point. This will permit the feeder pump to be calibrated so that the desired fluoride level in the system will be achieved. The master flow meter should be as small as practical. Considerations in the selection of the master flow meter are:

(a) Flow rate.
(b) Pipe size at the injection and flow metering point. The pipe size can be reduced at the metering point if some pressure loss can be tolerated.
(c) Capacity of the well pump.

D. Installation of Equipment

The school fluoridation unit consists of two primary sections - the master meter loop and the saturator tank loop. When space is available, these two sections should be placed in close proximity to facilitate installation and maintenance.

The amount of space available and position of existing water lines will determine the spatial configuration or "shape" of the plumbing required, especially for the master meter loop. If space is abundant, a simple linear arrangement may be used. However, the amount of space that is usually available and the position of the water lines will often dictate that the pipes be placed in a vertical or horizontal square shaped loop. The sequence of individual components will remain the same regardless of the plumbing design.

The amount of space available can be determined by visual inspection and by taking a few measurements. After the spatial configuration of the fluoridation unit has been decided upon, the unit can be installed as outlined below.

1. Master Meter Loop

The master meter loop includes the injection point and the master flow meter. It is always placed in the water supply line on the input side of the pressure tank. The loop consists of the following components, in sequence, from the well-pump side of the water line.

Component	Function
(a) Gate valve - usually $1\frac{1}{2}$"	Allows the water supply to be shut off for testing of check valves.
(b) Pipe union - usually $1\frac{1}{2}$"	Facilitates later repair, modification, or removal of the fluoridation unit.
(c) Strainer - usually $1\frac{1}{2}$"	Removes sand or gravel that has been siphoned into the system by the well pump. Must be installed in a horizontal plane.
(d) Test hose bibb	Used in testing of check valves.
(e) Check valve - usually $1\frac{1}{2}$"	Prevents back-flow when well pump is off. Must be installed in an upright position.
(f) Test hose bibb	Used in testing of check valves.

(g)	Check valve - usually 1½"	Prevents back-flow when well pump is off. Must be installed in an upright position.
(h)	Test hose bibb	Used in testing of check valves.
(i)	Surge chamber	Necessary only if the well pump is of the reciprocating type. Prevents damage to the master flow meter and flow switch.
(j)	Satruator supply tee - usually ½" x 1½" x ½"	Provides water to the saturator tank.
(k)	Master flow meter - usually 1½"; if 1" is used on 1½" pipe, two 1" x 1½" reducers are required	Measures the flow rate. Used in the calibration of the feeder pump. Can be used in combination with saturator supply line flow meter to estimate fluoride level in the water system. Must be installed in a horizontal plane. If located in an area subject to freezing, must be of frost-proof construction.
(l)	5" long pipe - 1" or 1½" depending upon master flow meter	Required for unrestricted flow to flow switch
(m)	Flow switch - usually 1½"	Connected electrically in series to feeder pump and well pump. Insures that feeder pump will operate only when water is flowing through the line and the well pump is operating. Has an adjustment screw that permits tension to be placed on the blades of the switch to prevent a minimal flow of water activating the feeder pump. Must be installed in a horizontal plane.
(n)	5" of pipe	Required for unrestricted water flow from flow switch.
(o)	Injection tee	Point at which feeder pump output is injected into the water system. Injection opening is placed at the bottom of the pipe to prevent air binding and crystal buildup.
(p)	Anti-siphon tee - usually 1½" x 1½" x 3/4"	Contains a vacuum breaker to prevent siphoning.

(q) Pipe union	Facilitates later repair, modification, or removal of the fluoridation unit.
(r) Gate valve - usually 1½"	Permits the fluoridation unit to be isolated for maintenance while allowing the school to use water contained in the pressure tank. Also allows for testing of check valves.

2. Saturator Tank Loop

The saturator tank loop is that portion of the fluoridation unit where the concentrated fluoride solution is formed and pumped into the school's water system. It consists of the following components listed <u>in sequence</u> from the <u>saturator supply tee</u>:

Component	Function
(a) Gate valve - usually ½"	Allows water supply to saturator tank to be shut off for maintenance purposes.
(b) Saturator supply line - usually ½" pipe	Supplies water to the saturator tank. Length and configuration of the line will depend upon the relative position of the saturator tank to the master meter loop. The line should be arranged so that it is supported by a floor or wall.
(c) Water softener - usually of the replaceable cartridge type	Prevents build-up of calcium fluoride deposits in the saturator tank. Recommended where the hardness of the water exceeds 75 ppm.
(d) Saturator supply line flow meter - usually ½"	Used to determine the amount of water supplied to the saturator tank. Allows the fluoride concentration in the school's water system to be estimated as a check against the results of fluoride analyses. Must be installed in a horizontal plane.
(e) Water control valve	Maintains water level in saturator tank. Activated by float device. Positioned so that an air gap exists between water supply line and water surface.

(f) Saturator tank - 55 gallons

Where the concentrated fluoride solution is prepared - composed of four primary parts:

1. 55 gallon molded translucent polyethylene drum - must have an over-flow outlet and a drain outlet.

2. Molded polyethylene (or polyester) cover - must fit the drum tightly and be of sufficient strength if it is to support a feeder pump. Must have openings for the float valve assembly, suction manifold and water inlet.

3. Float valve - may be solenoid or mechanically operated. Maintains a constant water level in the saturator tank by opening and closing the water control valve in the saturator supply line.

4. Suction manifold (or cone) - provides an unobstructed path through gravel, sand and fluoride for the suction line of the feeder pump. The concentrated fluoride solution is drawn from the manifold (or cone) by the feeder pump.

(g) Feeder pump - usually of the diaphragm type

Pumps concentrated fluoride solution (18,000 ppm) from the saturator tank to the injection tee in the master meter loop. Size of the feeder pump will be determined by the output expected of it. Can be placed on the cover of the saturator tank (if the cover is of sufficient strength or on a small shelf directly above the saturator tank). The feeder pump consists of three primary parts:

1. Feeder pump solution line - a plastic line which extends from the bottom of the saturator tank to the feeder pump head by passing through the suction manifold (or cone) and saturator tank cover. A strainer and foot valve are placed on the saturator tank end of the line which terminates 2" above the bottom of the

saturator. The strainer and foot valve prevent suction of sand or grit into the line, weigh the line and prevent loss of prime. The line should be as straight and short as practical.

2. Feeder pump - consists of the pump motor and feeder head (usually of the diaphragm type). The feeder head must be made of a material that will resist attack by sodium fluoride, such as styrene. The feeder head should also contain check valves to prevent back-siphonage. The feeder pump must be electrically wired in series to the well pump and the flow switch in the master meter loop. This means the feeder pump will not feed fluoride solution into the system unless the well pump is operating and the flow switch has been activated by water flow in the master meter loop line.

3. Feeder pump discharge line - delivers concentrated fluoride solution from the feeder pump to the injection tee. A check valve is placed in the line at the point where it is connected to the injection tee. It is constructed of plastic. Length of the line will depend upon the relative position of the feeder pump and the injection tee in the master meter loop. The line should be kept as straight as possible without kinks or small loops that might permit air binding to occur.

Once the saturator tank loop has been installed, the fluoridation unit is ready for charging and calibration.

PART B
Section III

CHARGING AND CALIBRATION

Following installation of the fluoridation unit, the saturator tank is charged with sodium fluoride and the feeder pump is calibrated to achieve the desired rate of feed.

A. Charging the Saturator Tank

Prior to charging the saturator tank, it should be inspected to insure freedom from defects or debris. (If the tank is not of the type manufactured specifically for fluoridation, it may have been necessary to prepare openings in the tank or its cover for drainage, overflow, suction manifold, etc.) Following inspection, the tank is charged in the following manner:

1. With the suction manifold (or cone) in position, place 2" of coarse, clean gravel (1" - 2" size) on the floor of the tank. Place another 3" layer of smaller gravel (½" - 1" in size) on top of the layer of coarse gravel.

2. Place a 6" layer of clean torpedo (filter) sand over the gravel.

   NOTE: Ordinary sand or soil <u>must</u> not be used.

3. Place 200 pounds of clean, <u>coarse crystalline</u> sodium fluoride (40 - 60 mesh) on top of the sand.

   NOTE: Fine crystal or powered sodium fluoride must <u>not</u> be used since it can be drawn through the filter sand and gravel in an undissolved state and pumped as a slurry. This will elevate the concentration of fluoride in the water system and may foul the feeder pump head or the check valve in the injection point in the master meter loop.

4. Note the position of the float and insure that it has sufficient space to operate properly. A depression in the surface of the fluoride may be necessary to provide room for operation.

5. Open the gate valve on the saturator tank water supply line and allow the water tank to fill.

6. Adjust the float position so that the low water level is at least 2" above the surface of the fluoride and the high water level is ¼" below the overflow outlet.

7. Lower the feeder pump suction line down through the suction manifold (or cone) until the strainer and foot valve are 2" above the floor of the tank. Adjust the line to this length and attach

the free end to the input side of the feeder pump head. The line should be as straight as practical and without kinks or sharp loops. The feeder pump discharge line should have previously been installed and should also be free of kinks or sharp loops that might cause air binding.

8. Prime the feeder pump. It may be necessary to loosen the fittings around the discharge line at the feeder pump head and jiggle the feeder pump suction line up and down. The discharge fitting is then retightened.

The feeder pump is now ready for calibration.

B. Calibration of the Feeder Pump

To achieve the desired level of fluoride in the school water system requires that the feeder pump rate be accurately set. The following steps outline one method of calibration.

Supplies Required

- Stopwatch
- Graduated cylinder, 100 ml.
- Regular graph paper
- Note pad
- Pencil

Procedure

1. Accurately determine the water flow rate per minute by using the master flow meter and stopwatch. The well pump should be allowed to operate for about thirty seconds before timing begins. During non-school hours, it may be necessary to open several faucets to insure continuous operation of the well pump. The timing procedure should be repeated several times to assure accuracy.

2. After determing the flow rate, calculate the volume of concentrated fluoride solution that must be injected into the school's water system to attain the desired fluoride level. The concentrated fluoride solution contains 18,000 ppm fluoride. As an example, the following hypothetical school water system had these characteristics:

   R_1 = feeder pump rate = to be determined

   C_1 = concentration of fluoride solution = 18,000 ppm

   R_2 = well pump rate = 18 gallons/minute

   C_2 = desired conc. of fluoride in school's drinking water = 4.5

   Natural fluoride content of water = 0.4

$R_1 \times C_1 = R_2 \times C_2$

$R_1 \times 18{,}000 \text{ ppm} = 18 \text{ gals./min.} \times 4.1 \text{ ppm}$

$R_1 = \dfrac{18 \text{ gal./min.} \times 4.1 \text{ ppm}}{18{,}000 \text{ ppm}}$ (one gallon = 3784 ml.)

$R_1 = .0041 \text{ gal./min.}$

$R_1 = 15.5 \text{ ml./min.}$

The feeder pump must deliver 15.5 ml./min. at the injection point in the master meter loop to attain a fluoride level of 4.5 ppm in the water supply (4.1 ppm + 0.4 ppm naturally present).

* 3. Turn the feeder pump off by means of a switch or by unplugging. Pull the feeder pump suction line up and out of the saturator tank, being careful not to lose prime. Place the end of the feeder pump suction line in a 100 ml. graduated cylinder that contains 80 ml. of water. (It may be necessary to remove the strainer - foot valve.)

4. Place the feeder pump stroke adjustment on the lowest setting.

5. Start the well pump. (It may be necessary to have several faucets opened to insure continuous operation.)

6. Turn the feeder pump on.

7. Measure the amount of water drawn out of the graduated cylinder during a one minute interval.

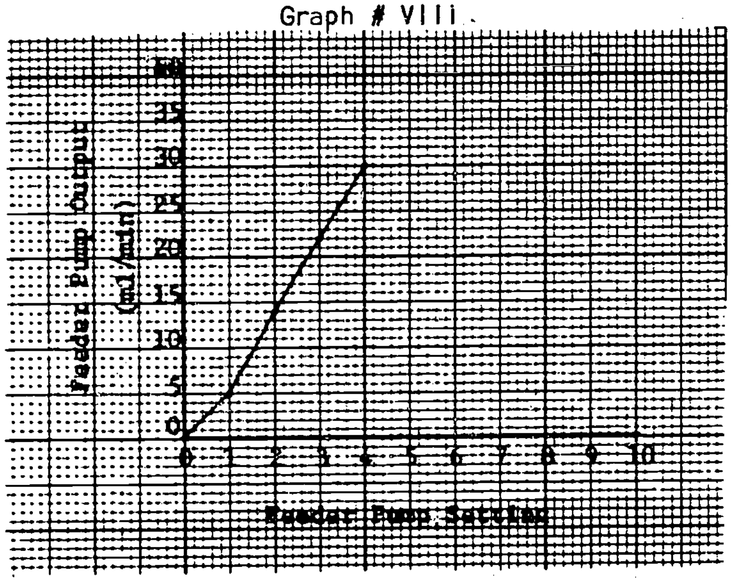
8. Turn the feeder pump off and record the volume of water pumped by the feeder pump on a note pad.

9. Repeat steps 4 - 8 using progressively higher feeder pump stroke settings until the volume of water being pumped is in excess of the volume required as determined by the calculations performed in Step 2.

10. Using regular graph paper, plot the volume pumped by the feeder pump against the stroke settings. For example:

Feeder Pump Stroke Setting	Output (Ml./Min.)
1	5
2	14
3	22
4	30

Graph # VIII



Using this graph, it can be determined that a feeder pump stroke setting of about 2.2 will be required to attain an output of 15.5 ml./min.

11. Place the feeder pump stroke setting on the desired number and check the feeder pump's output to assure accuracy. Some minor adjustment to the stroke setting may be necessary.

12. After replacing the strainer and foot valve on the feeder pump suction line, being careful not to lose prime, place the line back in the saturator tank.

13. Important: Test the flow switch for proper wiring. This can be accomplished by the following procedures:

    - The power supply to the fluoridation unit must be on.

    - Remove the cover of the top portion of the flow switch.

    - First, while the well pump is not operating and no water is flowing trhough the master meter loop, activate the flow switch by depressing the spring mechanism of the flow switch blade (can be reached on the input side of the top portion of the flow switch, see appendix).

    - This will cause the electrical contacts in the flow switch to touch. However, since the well pump is not operating, the feeder pump should not begin to operate and pump the concentrated fluoride solution into the water line. If the feeder pump does begin to operate, the flow switch and feeder pump are not properly wired in series with the well pump. The wiring must be corrected.

    - Secondly, with the well pump operating, water flowing through the master meter loop and the feeder pump operating, lifting up on the spring mechanism of the flow switch blade will separate the electrical contacts in the flow switch and the feeder pump should cease to operate.

Proper wiring will insure that the feeder pump will inject the concentrated fluoride solution into the school's water system only when the well pump is operating and water is actually flowing past the flow switch.

14. Pertinent information concerning the installation is recorded (See sample form E) for use by the supervising agency.

Charging and calibration of the fluoridation unit are now complete.

* NOTE: It is also possible to calibrate the feeder pump by disconnecting the discharge line at the injection tee and measuring feeder pump output at various settings. However, since the feeder pump output is not being measured against operating pressure, this calibration method tends to be more inaccurate than the method outlined above.

PART B
Section IV

SURVEILLANCE

Following the charging and calibration of the fluoridation unit, the fluoride level of the schools' water system will gradually rise until equilibrium is reached. To assure that the desired level of fluoride is achieved and maintained throughout the school year, a surveillance system must be established.

NOTE: As soon as the school fluoridator becomes operative, all physicians, dentists and druggists in the area must be notified that children attending the fluoridated school are not to be provided prescriptions for supplemental fluorides (See sample form F)

The surveillance system should consist of two componenets, on-site surveillance and surveillance by the supervising agency. These two components should be designed to be complementary and to provide:

- regular, accurate and reliable analysis of the fluoride level in the system.
- provisions for performance records of the system over time.
- a means of rapidly reacting to excessively high or low fluoride levels.

The functions of the two components are:

A. On-site Surveillance

On-site fluoride analyses are conducted by responsible school personnel (usually classroom teachers) designated by the school principal. School personnel are trained in the operation of portable equipment used in fluoride analysis by the supervising agency. On-site surveillance includes:

1. Establishment of a schedule for sample collection and testing. The schedule is separated into two phases. During the first phase, usually a period of a few months, at least two water samples per week (usually Monday and Wednesday) are collected with one-half of each sample analyzed on-site, and one-half forwarded to the supervising agency for testing (split sampling). After the system has stabilized and the variability of fluoride test results are no more than 0.5 ppm, a second phase requiring the on-site testing of two samples per week, and only one split sample per week be tested by the supervising agency will be adequate.

2. The sampling procedure is as follows:

    (a) The sample (50 cc) is drawn from a drinking fountain regularly used by the children.

(b) One-half of the sample is used for on-site fluoride analysis (See appendix for analytic techniques).

(c) The other half of the sample is forwarded to the State supervisory agency for testing with the results of the on-site testing (See sample form G).

3. A surveillance chart is used to record the results of on-site tests (See sample form H). Supervising agency fluoride test results of the split samples should be returned and also recorded on this chart.

4. In the event of excessively high fluoride readings (more than twice the optimal level), responsible school personnel are instructed to immediately turn the feeder pump off and shut off the water flow to the saturator. The supervising agency is immediately contacted. Low readings are not critical, of course, but the supervising agency should be promptly notified.

5. In those cases where only minor adjustment in the feeder pump settings are required, the supervising agency can instruct school personnel by phone to make the necessary corrections.

6. As a back-up procedure to analytic procedures used at the school, school personnel can estimate the fluoride level by determining the volume of water used by the water system and the volume of water used by the saturator over a given period of time. To make the necessary calculations, the master flow meter and the saturator supply flow meter are utilized. For example, if during a ten day period the master meter indicated that 35,600 gallons of water had been used and the saturator supply flow meter indicated that 10 gallons of water had been used by the saturator, the estimated fluoride level in the water system would be calculated as follows:

	Master Flow Meter	Saturator Supply Meter
Present reading	1,565,735	456
Previous reading	1,530,135	446
Difference	35.600	10

$$\frac{\text{Vol. used by saturator}}{\text{Vol. used by water system}} \times \text{fluoride conc.} = \text{ppm fluoride in system}$$

$$\frac{10}{35,600} \times 18,000 = 5.0 \text{ ppm}$$

This method is useful as a generalized surveillance technique. The calculated fluoride level will seldom agree with any one analytic test result but can serve as a check on these analytic procedures over an extended period of time.

43

NOTE: The school fluoridation unit should be turned off during those periods of time when the school is not being used for more than two or three days (such as long holidays or vacation periods).

B. Surveillance by the Supervising Agency

The supervisory agency must assume primary responsibility for the surveillance system. This is essential to insure that long-term functioning of the surveillance system and for the provision of a back-up system for fluoride level determination. In general, the supervising agency will usually be the State Health or Environmental Department. However, if large numbers of school fluoridators are to be placed into operation, it may become necessary to involve district or regional health or environmental deprartments in surveillance and maintenance procedures.

The surveillance functions of the supervisory agency are:

1. Training of designated school personnel in the use of on-site fluoride analytic equipment.

2. Determination of the fluoride level in split samples from the school. The results are compared to those obtained by school personnel (See sample form G) and copies of the reports are returned to the school for use by school personnel in quality control. If the results obtained by the school and the supervising agency are quite different (more than 1.0 ppm), the analytic technique of school personnel may be deficient or the testing equipment may be malfunctioning.

   NOTE: Most supervisory agencies will use the highly accurate electrode method for fluoride analysis. If on-site surveillance uses a less accurate method (usually the SPADNS photometric, colorimetric procedure), noticeable variations in test results between on-site and the supervisory agency can be expected. This will especially be true where the presence of interfering ions is high enough to affect the SPADNS procedure. In some states, rural schools having their own water supply are required to chlorinate. If this is true, the chlorine must be neutralized by the addition of sodium arsenite to the sample before analysis using the SPADNS procedure.

3. Maintenance of the records of fluoride analyses by both on-site and supervising agency. These records should be kept in a readily available form (See sample form H). Quality control charts can be prepared which allow visualization of system fluctuation over time and will indicate unstable systems (See sample form I).

4. A plan of action to deal with high or low fluoride levels, especially excessively high levels. One plan would be:

(a) If the fluoride levels are only slightly outside the desired range, school personnel can be instructed by phone to make minor adjustments in the feeder pump settings.

(b) In the event of readings 2 ppm or more outside the desired range, a phone call is promptly made to the school. In the case of excessive high readings of more than twice the optimal level, the responsible school person is instructed to <u>immediately</u> turn off the feeder pump and shut off the water supply to the saturator. A staff member will promptly make an on-site visit to inspect the unit and determine the cause of malfunction. If necessary, arrangements are made to have the unit repaired. Following repair, the unit is recalibrated and placed back into operation. Information concerning the malfunction should be recorded for future references (See sample form E).

C. Reasons for Fluoride Levels Outside the Desired Range

The following list outlines some of the possible causes of fluoride levels outside the desired range and actions that can be taken to correct them.

HIGH FLUORIDE READINGS

Possible Cause:	Corrective Action:
1. Analytic technique	
(a) Faulty technique	Meticulous attention to analytic technique, especially the use of clean glassware
(b) Presence of interfering ions when using a photometric, colorimetric method of analysis, such as SPADNS, polyphosphates and chlorine can be especially troublesome	Distillation of sample - Chlorine can be eliminated
2. Feeder Pump	
(a) Incorrect setting	Readjustment or recalibration of pump
(b) Continued operation of feeder pump when well pump is not operating	Test for faulty electrical connections, rewire if necessary. Check electrical connections of flow switch.
3. Saturator Tank	
(a) Failure of saturator suction manifold (or cone)	Have sample of fluoride solution from manifold analyzed. (Should be 17,000 - 18,000.) Inspect manifold for defects and replace, if necessary.

(b) Formation of a fluoride slurry due to sodium fluoride sifting through sand layer — Inspect to see that the layer of sand is of adequate depth (6") and that only torpedo (filter) sand has been used. Remove fluoride and add or replace sand. Insure that coarse crystalline sodium fluoride has been used, not fine crystal or powdered sodium fluoride.

4. Water Supply

(a) Lowered water flow rate due to failure of well pump or leak in water supply line combined with too little tension on the blade of the flow switch — Repair well pump; repair leak; increase tension on flow switch blade.

(b) Installation of a new well pump; change in source of water supply — Determination of the new flow rate and recalibration of the feeder pump; testing of new water supply for natural fluoride content.

(c) Failure of foot valve on well pump and check valves in water line — Test check valves by using test hose bibb procedures.

LOW FLUORIDE READINGS

Possible Cause:	Corrective Action:
1. Analytic technique	
(a) Faulty technique	Meticulous attention to analytic techniques
(b) Presence of interfering ions (especially when using SPADNS photometric, colorimetric method of analysis, aluminum and iron can be particularly troublesome.	Distillation of sample
2. Feeder Pump	
(a) Incorrect setting	Readjustment or recalibration of pump

(b) Air binding or leaks in feeder pump discharge line	Remove kinks from line; tighten connections to head and injection tee; replace line, if defective.
(c) Leaks, air binding or foot valve failure in feeder pump suction line	Tighten line connections; remove kinks, check foot valve; replace line and/or foot valve, if defective.
(d) Malfunction of check valve in feeder pump head	Repair or replace valve.
(e) Failure of feeder pump to operate	Test feeder switch and electrical connections, especially electrical connections of flow switch; replace feeder pump if motor has failed.
(f) Loss of feeder-pump prime	Reprime feeder pump. Inspect for a cracked diaphragm in feeder pump head.
3. Saturator Tank	
(a) Insufficient quantity of sodium fluoride (less than 2")	Add sodium fluoride until layer is at least 6" deep.
(b) Lack of water supply to saturator	Test valve on saturator supply line; test float adjustment.
(c) Inability of water to filter through fluoride layer due to formation of dense film of calcium fluoride on surface of fluoride	Remove layer of calcium fluoride; install water softener in saturator water supply line.
(d) Slowed filtration of fluoride solution due to use of beach sand or soil	Recharge saturator, being sure to use torpedo sand in the layer required.
4. Master Meter Loop	
(a) Malfunction of check valve at injection tee	Repair or replace check valve.
5. Water System	
(a) Samples collected before system has reached equilibrium	Level should continue to rise with time.

(b) Installation of a new well pump; change in source of water supply	Determination of the new flow rate and recalibration of the feeder pump; testing of new water supply for natural fluoride content.

PART B
Section V

MAINTENANCE

Routine maintenance is essential for reliable and trouble-free operation of school fluoridation equipment. Although the supervising agency should assume the overall responsibility for maintenance, the school can and should be assigned some maintenance functions. The cost of maintenance is usually borne by the school after the first year or so of operation.

Maintenance can be separated into two primary components. They are:

A. Maintenance Provided by School Personnel

School personnel should perform the following minor maintenance functions on a routine basis, usually once per week.

1. Keep the area around the fluoride installation free of clutter.

2. Check plumbing connections for leaks.

3. If the equipment is located in an area subject to freezing, the infra-red lamp or radiant panel and the thermostat that controls them must be checked for proper functioning during cold weather to prevent freezing of equipment.

4. Check the feeder pump head for cracks or leaks.

5. If a thick layer of calcium fluoride builds up on the surface of the fluoride, the supervising agency should be notified. The installation of a water softener in the saturator tank supply line may be required to control this condition.

6. The level of fluoride in the saturator tank should be noted. If the layer drops to less than 2", the supervising agency should be notified that additional fluoride compound is needed.

7. If the school decides to install a new well pump or change the source of the water supply, the supervising agency must be promptly notified. As a result of the change in flow rates that will be caused by a new well pump, the feeder pump will require calibration. The feeder pump and saturator should be turned off during the installation period. A new water supply will require testing to determine the natural fluoride content and also, possibly recalibration of the feeder pump.

8. If another building is connected to the school water supply at any time following the installation of fluoridation equipment, the supervising agency must be notifed immediately. In the case where a residence is connected to the water supply, the installation of a separate pressure tank that is supplied by nonfluoridated water will be necessary. Nonfluoridated water for the residence can be drawn from a point in the school water

supply located on the well pump side of the fluoride injection point. In some instances it may be necessary to locate another source of water for such a residence.

B. Maintenance Provided by the Supervising Agency (usually once per year)

1. Master Meter Loop

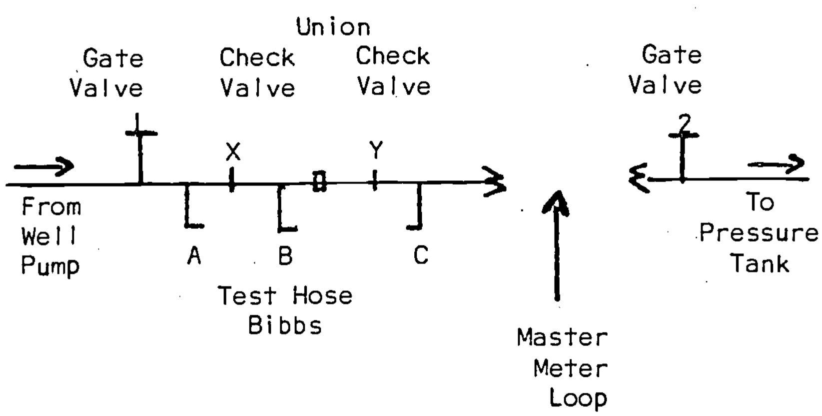
(a) Inspection of plumbing connectors for leaks.

(b) Clean strainer.

(c) Removal, inspection (including electrical connections), and lubrication (if necessary) of flow switch.

(d) Inspection of injection tee and connection of the feed pump discharge line.

(e) Test check valves. Through the use of test hose bibbs, the adquate functioning of the check valves can be determined. The procedure is:



- Open test hose bibbs separately to flush out any sediment or scale.
- Close gate valves 1 and 2.
- Open test hose bibbs A and C in succession. If leakage occurs, gate valve (s) 1 and/or 2 are leaking and must be repaired before continuing test.
- If no leakage at test hose bibbs A and C with gate valves 1 and 2 closed, proceed as follows:

  a. Open gate valve 2 and test hose bibb B. If leakage does not stop, check valve Y is leaking and must be repaired. If leakage stops, check valve Y is tight.

  b. Connect a hose between test hose bibbs B and C and open these hose bibbs. Open test hose bibb A. If leakage does not stop, check valve X is leaking and must be repaired. If leakage stops, check valve X is tight.

c. Necessary repairs to check valves should be made and the test series repeated.

- When the test is complete, close all test hose bibbs and remove the hose between test hose bibbs B and C. Place gate valves 1 and 2 in their proper operating position.

2. Saturator Tank Loop

(a) Inspection of saturator tank supply line and flow meter for leaks and proper operation.

(b) Replace or clean the filter in the water softener (if present).

(c) Inspection of float valve for ease of operation and freedom from corrosion.

(d) Inspection of saturator tank for leaks around drain outlet or defects in the tank.

(e) Recharging the saturator. Approximately once per school year, the saturator tank must be cleaned and recharged. This is accomplished by:

(1) Using the saturator tank shut-off valve, turn off the saturator's water supply, and open the drain outlet.

(2) Remove the saturator tank cover, and pull the feeder pump suction line up and out of the suction manifold (or cone).

(3) Remove the old sodium fluoride, sand and gravel. If the sand and gravel are to be reused, they can be placed in separate buckets and washed with water until all of the old fluoride and dirt have been cleaned off. If the old sand and gravel are not to be reused, they should be buried. The old sodium fluoride must be buried or flushed down a drain.

(4) Remove and clean the suction manifold (or cone), and clean with water. Clean out the inside of the saturator tank.

(5) Replace the suction manifold (or cone).

(6) Recharge the saturator.

NOTE: Fluoride compounds <u>must not</u> be stored on school premises.

(f) Inspect the foot valve and strainer (if present) on the feeder pump suction line before it is placed back into the suction manifold (or cone).

(g) Inspect the feeder pump head for defects and proper operation of the check valves.

(h) Lubricate the feeder pump (if required).

(i) Inspect the electrical connections and plug of the feeder pump.

General information on the maintenance that has been performed should be recorded for future reference (See sample form E).

C. Safety Considerations When Handling Sodium Fluoride

Crystalline sodium fluoride is a dangerous chemical and can be a health hazard if improperly handled. Since fluoride <u>must not</u> be stored at the school, the primary danger will occur when personnel from the supervising agency charge the saturators. This will be especially important if these personnel are responsible for more than a few school fluoridators, and are likely to come into frequent contact with fluoride in the installation and maintenance of school fluoridators.

Recommended procedures when charging saturators are:

1. Wear dust masks, safety glasses, gloves and a protective apron.

2. Handle bags or boxes of fluoride carefully to minimize the production of dust. The contents of fluoride containers should be poured gently into the saturator.

3. Open a window or door to assure good ventilation in the work area.

4. Rinse empty fluoride bags or boxes with water and have them buried or burned.

5. Make sure that fluoride containers are properly and clearly identified.

Since the supervising agency is responsible for the storage of fluoride, the material must be stored in such a way that it will not present a hazard to other personnel when they are engaged in normal duties or during mealtime. (It is possible to mistake sodium fluoride for salt if it is not tinted blue.)

In the event fluoride exposure does occur, the following symptoms may occur and are indicative of acute poisoning. If these symptoms occur, it is imperative that the listed first aid measures be instituted until medical assistance arrives.

Condition	Symptoms	First Aid
Acute poisoning by mouth	Vomiting, stomach cramps and diarrhea. If large amounts of fluoride are involved, the vomitus may be the same color as the fluoride. The individual becomes very weak, is thirsty, has trouble speaking, and may have disturbed color vision.	1. Remove from fluoride exposure and keep warm. 2. Give 3 teaspoonsful of table salt in a glass of warm water. 3. Induce vomiting. Tickle back of throat with spoon or finger if necessary. 4. Administer a glass of milk. 5. Repeat steps 2-4 several times.
Acute poisoning by inhalation	Sharp, biting pain in the nose, followed by nasal discharge or nose-bleed	1. Remove from fluoride exposure. 2. Place individual's head back and put absorbent material (cotton or tissue paper) in nasal passages. Change material frequently.

PART B
Section VI

IMPORTANT ADMINISTRATIVE CONSIDERATIONS

It is essential that an administrative system be established that can effectively control the school fluoridation program. The initial steps of assessment and selection of rural schools, home water supply sampling and installation of fluoridation equipment are relatively minor tasks when compared to the long term requirements of strict surveillance, routine maintenance and problem maintenance. Although the configuration of the administrative structure to conduct a school fluoridation program will undoubtedly vary depending upon the structure of the supervising agency, the following considerations are important.

(1) Staff Selection

The initial rural school fluoridation staff will usually consist of a fluoridation technician and a secretary under the direct supervision of a public health dentist. This staff will probably be placed within the dental program at the central level of the supervising agency.

The trouble-free operation and safety of a rural school fluoridator depends directly upon the selection of the school, proper installation of the fluoridation equipment and maintenance. As a result, the staff person primarily responsible for this phase of the school fluoridation program, the fluoridation technician, should be carefully selected.

Ideally, the fluoridation technician should have a background in dealing with public water supplies, such as a sanitarian. However, a capable person who has a general knowledge of plumbing and electrical techniques can certainly be trained in the mechanical aspects of school fluoridation. It is very important that this staff member receive training from someone knowledgeable and experienced in school fluoridation. If possible, arrangements should also be made with with sanitary engineering staff of the supervising agency to provide this person with at least a brief training session in the general principles of water supply engineering. A well trained staff person can provide valuable assistance in the fluoridation of small community water supplies since the fluoridation equipment utilized is essentially the same as that used in rural schools.

Initially, one staff person trained in the mechanical aspects of rural school fluoridation will be sufficient. However, once the number of fluoridated rural schools exceeds 30 - 40 schools, additional fluoridation technicians and secretarial support will become desirable. Placing these additional personnel in multi-county areas (regions or districts) that contain sufficient numbers of fluoridated rural schools (about forty schools) will permit a more effective program to be accomplished.

(2) Surveillance

Careful surveillance of fluoridated rural school water supplies is essential. One staff person (such as a secretary) should be given the direct responsibility of monitoring the fluoride analyses of fluoridated schools and posting these readings in a school fluoridation ledger. Readings outside the desired range must be promptly brought to the attention of the administrator of the program. Excessively high fluoride readings (more than twice the recommended level) require immediate notification of the affected school to shut down its fluoridator until the problem can be corrected.

If more than a few rural schools are fluoridated, problems with some schools not submitting water samples to the supervising agency on schedule and/or not conducting on-site analyses properly will undoubtedly arise. These schools must be dealt with promptly to insure the safety of school fluoridation. One system of dealing with such a school is:

a. Contact the person responsible for on-site surveillance by phone and explain the necessity of adhering to the surveillance method and schedule.

b. If (a) does not produce satisfactory results, a staff member should visit the school and reemphasize the importance of surveillance to the person responsible for on-site surveillance.

c. If (b) does not produce satisfactory results, the principal of the school should be notified by phone and by correspondence (See sample forms J and K).

d. If (c) does not produce satisfactory results, the school superintendent should be contacted and informed of the situation. It should be emphasized that the school fluoridator cannot be allowed to operate without adequate surveillance.

e. If none of the above steps produce satisfactory results, the school fluoridator must be removed from the uncooperative school.

(3) Maintenance

As increasing numbers of rural schools are fluoridated, the provision of routine and problem maintenance will become formidable tasks. If possible, fluoridation technicians, as mentioned in (1), should be placed in multi-county areas (regions or districts) close to concentration of fluoridated rural schools. In addition, a close working relationship should be established with local and multi-county health departments. Staff members of these health departments, especially sanitarians, can be extremely helpful in providing assistance in case of minor surveillance and maintenance problems of fluoridated rural schools in their county (s).

(4) Maximizing the Beneficial Effects of Rural School Fluoridation

The benefits of rural school fluoridation are real but depend upon two important factors:

- that the school child consume the school's fluoridated water

- that cariogenic foods are not made available to the child, especially as in-between meal snacks

The following recommendations should be made to school officials:

a. That regular times be scheduled each day for children to be directed to the water fountain. Once in the morning and once in the afternoon are recommended.

b. That school lunches should be prepared that are low in sugar containing, cariogenic foods.

c. That vending machines that dispense sweets not be allowed in the school. If any are already present, they should be removed or at least replaced with machines that dispense nutritious foods such as peanuts, corn chips, popcorn, whole milk and unsweetened fruit juices.

   At a minimum, if vending machines dispensing sweets cannot be removed, children should be allowed to purchase and consume sweets only during lunch hours. If a school permits children to consume sweet snacks other than at mealtime, the rationale of fluoridating the school is at least partly defeated.

d. In some schools, the water supply has an objectional taste as a result of dissolved minerals such as iron or sulfur. To help overcome this problem and make the water more palatable, cold water fountains can be installed and/or a water softener of sufficient capacity can be installed on the main water line (on the well pump side of the master meter loop).

(5) Important Cost Factors in Rural School Fluoridation

The basic cost of equipment used to fluoridate a rural school will be approximately $1,000 - $1,100 including materials used to charge the unit and the on-site fluoride analyzer. In addition to this cost, the salary and travel of the fluoridation technician in the assessment of rural schools must be added.

The cost of installation of school fluoridation equipment will depend upon the agreement reached with the local board of education. If the board agrees to furnish a plumber and electrician, the school fluoridation program will be responsible only for the cost of the fluoridation technician to supervise the installation. If the program must contract with a private plumber and electrician to install the equipment, installation costs will probably fall between $200 - $400 per unit. The cost of installation could be higher if branch lines exist that require isolation and if an auxiliary pressure tank must be installed because the school's water supply serves a private residence. Another additional cost could be the installation of a large water softener on the main water supply line where the mineral content of the water imparts an unpleasant taste to the water.

Although the plumbing and electrical requirements in school fluoridation are relatively simple, licensed, competent persons should be used by a school fluoridation program to install equipment under the direct supervision of the fluoridation technician. The reasons are twofold: First, the safety of operation of the fluoridation unit depends upon proper installation; second, if damage to school water supply equipment or property resulted from improper installation, a school fluoridation program could be placed in an uncomfortable legal position if unlicensed personnel were utilized to install the equipment.

The cost of operating the surveillance system will become significant as the school fluoridation program expands. For example, for each rural school fluoridated, a minimum of 35 home water samples must be analyzed plus two samples per week for at least the first month of operation and one sample per week during the remainder of the school year. Assuming a school year of 36 weeks, a minimum of 75 water samples per school would have to be analyzed during the first year of operation and 36 samples would have to be analyzed during each subsequent year. This will certainly place an additional load upon the water laboratory of the supervising agency and as a result the school fluoridation program may very well be requested pay for the cost of fluoride analyses for schools, about \$0.50 - \$1.00 per sample. If the water laboratory does not possess an ion-electrode type fluoride analyzer, the school fluoridation program may also consider furnishing such an instrument to the laboratory in the interest of accuracy and speed of analysis. Such an instrument will cost \$500 - \$800.

Another cost factor which will become significant will be the cost of maintenance. Since at a minimum each unit must be recharged once a year, after 30-40 schools have been fluoridated it may become practical to place a fluoride technician on a multi-county level (region or district). At this level the technician could be made responsible not only for the rural school fluoridators but could also provide assistance in the fluoridation and surveillance of community water systems in the area.

PART B
Section VII

A P P E N D I X

58

SCHOOL FLUORIDATION

Form Listing

The following forms can be utilized in a school fluoridation program. These forms are referred to in Part B of the manual. A sample of each form is included in the following pages of this appendix.

Sample Form	Function
A	Used to record information as to the adequacy of a school's water supply system.
B	Used in a general survey of the type of pupil's home drinking water supply.
C	Specific survey of pupil's home drinking water supply. This form is accompanied by a small bottle for a sample of the home water supply.
D	Contract between the school and supervising agency concerning the installation, surveillance and maintenance of the school fluoridation equipment.
E	Used to record pertinent information concerning the feeder pump setting and person (s) responsible for on-site surveillance of each school. Also used to record maintenance and repairs performed on the fluoridation equipment.
F	Letter to local dentists, physicians and pharmacists notifying them that a certain school (s) has been fluoridated in their county or area.
G	Laboratory form used to indicate the results of fluoride analysis of school water samples by both on-site and supervising agency tests.

H	Used to record the results of local and supervising agency analyses for one fluoridated school during the year. This form is used in quality control of the fluoride levels in each school.
I	Quality control chart that can be used for the visualization of the stability of a fluoridated school water supply.
J	Used to notify a fluoridated rural school that the required regular water samples are not being submitted to the supervising agency for testing.
K	Used to notify a fluoridated rural school that the on-site analyses are either not being conducted or are being conducted inaccurately.

SCHOOL FLUORIDATION

INITIAL SCHOOL WATER SUPPLY SURVEY

SCHOOL____________________ TELEPHONE NUMBER____________________

ADDRESS____________________ COUNTY____________________

PRINCIPAL____________________ SUPERINTENDENT____________________

ENROLLMENT__________ GRADE__________ SUPERINTENDENT'S PHONE NUMBER__________

Source of Water Supply____________________

If well, depth____________________

Location____________________
Pump Capacity____________________
Chlorinated: Yes____ No____
Is school only user:
Yes____ No____
(show janitor's residence as a separate user)

Drinking Fountain
Cooled____ Uncooled____
Pressure Tank: Yes____ No____
Size (gal.)____________________

Natural Fluoride Content ________________PPM

If there are other users, list____

Space available for fluoridation equipment

Where available:

Pumphouse____________________ Adequate: Yes____ No____
Boiler Room____________________
Other____________________

Adequacy of facilities and comments:
(Sketch proposed installation site on back of page)

SAMPLE FORM B

CHILD'S NAME ______________________

PARENT'S NAME ______________________

SCHOOL ______________________

GRADE ______________ AGE ______

Dear Parent or Guardian:

The County Health Department and the Dental Health Branch of the Kentucky Department for Human Resources are conducting a survey of drinking water supplies.

PLEASE ANSWER THE FOLLOWING AND RETURN THIS FORM TO YOUR CHILD'S SCHOOL.

1. CHECK THE SOURCE OF YOUR HOME DRINKING WATER.

   A. City water system ____
   B. Deep well (drilled) ____
   C. Shallow well (dug) ____
   D. Cistern ____
   E. Spring ____
   F. Mine ____
   G. Creek or Stream ____
   H. Other (please explain) ____

2. How long have you lived in your present home? ______________________

3. Ages of other children in the family who live at home? __________ ______

____

Thank you.

Your County Health Department and the Dental Health Branch of the Kentucky Department for Human Resources, Bureau for Health Services

SAMPLE FORM C

CHILD'S NAME______________________________ SCHOOL__________________________

GRADE & TEACHER___________________________ COUNTY__________________________

Dear Parent or Guardian:

As part of our survey of drinking water supplies, we would appreciate a sample of your drinking water.

1. Please check one of the following as the source of your home drinking water:

____ City Water *

____ Deep well (drilled)

____ Shallow Well (dug)

____ Cistern **

____ Spring

____ Mine

____ Creek or Stream

____ Other ______________________

* If you have city water, what city? ______________________________

** If you buy water, where is it delivered from? ____________________

2. How many years have you lived in your present home? ______________

3. Ages of other children in the family who live at home? ____________

____

Note: It is very important to fill the water bottle completely in order to have enough water to do the survey. Please have your child return the water sample to school as promptly as possible.

Thank you.

Your County Health Department and the Dental Health Branch of the Kentucky Department for Human Resources, Bureau for Health Services

AGREEMENT TO USE FLUORIDATION EQUIPMENT IN SCHOOLS

This Agreement made and entered into this ________ day of ____________, 197__, by and between the Commonwealth of Kentucky Department for Human Resources, Bureau for Health Services, hereinafter called the DEPARTMENT, and the _________ County Board of Education ___________, Kentucky, ____________, hereinafter called the BOARD.

WITNESSETH:

WHEREAS, the DEPARTMENT desires to improve the general level of oral health in Kentucky through implementation of school fluoridation in certain qualified school (s) to assist such school (s) in initiating fluoridation for the prevention and control of oral disease.

NOW, THEREFORE, the parties hereto in consideration of the promises and agreements hereinafter made convenant and agree as follows:

(1) The following school (s) shall be included in this agreement:

(2) The subject matter of this agreement is the following described fluoridation equipment:

NECESSARY PARTS FOR SCHOOL FLUORIDATORS

QUANTITY	PARTS
1	Drum, Polyethylene, 55 gallon, with cover
200 lbs.	Sodium Fluoride Crystaline (20-60 mesh) in 100 lb. bags
1	Chemical Metering Pump with Anti-siphon Valve PRECISION BIF WALLACE & TIERNAN
1	Water Meter, Disc-type, Unsealed, Straight reading, 100 GPM, U.S. gals. including couplings
1	Flow switch - Usually for 1" to 1½" pipe
1	Delta Scientific Colorimeter (with reagents)
1	16 oz. bottle SPADNS Reagent R-67
1	16 oz. bottle Fluoride Standard Solution (0.8 ppm) R-68
* 1	Pall Guard Water Softener, Model # 30H
1	Refill Cartridge for Model # 30H Water Softener
2	Unions
1	Horizontal Dirt Y Strainer
2	Horizontal Check Valve
3	Test Hose Bibbs
1	Gate Valve for "make-up" water line
1	Stock Tank Float Assembly
200 lbs.	Filter or Torpedo Sand

QUANTITY	PARTS
50 lbs.	Filter or River Stone
1	3/4" Vacuum Breaker
2	Gate Valve for Main Water Line
1	Heat Lamp with bulb (if needed)
1	Funnel, Polyethylene
1	PVC Tube from funnel to top of Saturator Tank for removal of Foot Valve

All necessary reducers, bushings, tees, elbows, nipples, etc. for proper installation.

* Necessary only if water exceeds 75 p.p.m. hardness or if school does not already have a softener.

(3) The DEPARTMENT agrees:

A. To cause to be installed, the above described fluoridation equipment.

B. To provide, for one year from the beginning of operation of the fluoridator, all necessary maintenance (including parts), fluoride compound, surveillance chemicals and equipment, sample bottles and mailing containers to the school (s) at no cost.

C. To train appropriate school personnel in the technique of on-site surveillance using testing equipment furnished by the DEPARTMENT.

(4) In consideration whereof, the BOARD agrees:

A. To provide a suitable location for the fluoridation equipment in each school.

B. To provide modifications to the existing water and/or electrical systems and facilities as recommended by Sanitary Engineering, Division of Licensing and Regulations, Bureau for Administration and Operations, Commonwealth of Kentucky Department for Human Resources, prior to the installation of the fluoridation equipment and to make available personnel to install the equipment.

C. To designate two appropriate school personnel in each school fluoridated to be trained in and responsible for surveillance procedures, who will also be responsible for the weekly inspection of the fluoridation equipment to insure continuous operation and for keeping the equipment area neat and free of other materials and/or equipment.

D. To not alter in any way, disconnect or remove fluoridation equipment from a school without prior approval of the DEPARTMENT.

E. To properly maintain the fluoridation equipment and replacements necessary after the first year of operation.

F. To pay for mailing two school water samples per week to the Division of Laboratory Services, Kentucky Department for Human Resources.

G. To use and maintain, during and after the contract support, the above described equipment for the purposes set forth herein and to return to the DEPARTMENT, through the local health department concerned, the school fluoridation equipment whenever the BOARD ceases to use same or the school water supply is connected to a fluoridated community water supply.

(5) The period of agreement is from ________________, 197__, until terminated by either party with 30 days written notice.

(6) The parties hereby agree to comply and state that they are in compliance with Title VI of the Civil Rights Act of 1964, and all requirements imposed by or pursuant to the regulation of the Department of Health, Education, and Welfare (45 CFR Part 80) of that Title.

FIRST PARTY:

SECOND PARTY:

____
Authorized Official
Department for Human Resources

____
Superintendent
______________ Board of Education

____
Lorman W. Sprouse, D.D.S.
Director, Dental Health Branch

Examined as to Form and Legality:

____
Attorney
Department for Human Resources

SAMPLE FORM E

INFORMATION ON FLUORIDATED SCHOOL WATER SUPPLY

SCHOOL____________________ DATE FLUORIDATED____________________

COUNTY____________________ FEEDER-TYPE____________________

ENROLLMENT__________ GRADE__________ MANUFACTURER____________________

SETTING____________________

PRINCIPAL____________________ SUPERINTENDENT____________________

PHONE NUMBER OF SCHOOL____________________ SUPERINTENDENT'S PHONE NUMBER__________

Teacher (s) assigned for surveillance ______________________________

Source of water supply______________________________

Treatment (other than fluoridation)______________________________

MAINTENANCE PERFORMED (ROUTINE AND PROBLEM)

Date	Task	Initials

DEPARTMENT FOR HUMAN RESOURCES
COMMONWEALTH OF KENTUCKY
FRANKFORT 40601

SAMPLE FORM F

BUREAU FOR HEALTH SERVICES
275 East Main Street

Beginning this year, the local school board, local health department and the Dental Health Branch, Kentucky State Department for Human Resources, have joined in a cooperative effort to provide fluoridated water for some of the rural school children in your county. As of   , we expect the following schools to be fluoridated:

This will be accomplished by placing a fluoridation unit on the school water system.

Although the children will only drink the fluoridated water during school hours, studies have shown that this will reduce the incidence of dental decay by 40 percent.

We wanted to make you aware of this new health service as it is a factor if you prescribe fluoride tablets or drops to young child patients. If the child attends one of the fluoridated schools, you should not prescribe supplemental fluoride as the optimum level of fluoride will be provided.

If you have questions, please feel free to call our office for any clarification you may need.

Best regards,

Dental Health Branch

jd

BUREAU FOR HEALTH SERVICES
LABORATORY SERVICES
Please print with BLACK MEDIUM SOFT lead pencil only

WATER BACTERIOLOGY 05 AND/OR FLUORIDES

NAME OF WATER SUPPLY SYSTEM OR ESTABLISHMENT

ADDRESS

NAME OF OWNER

ADDRESS

☐ SURVEILLANCE
SUPPLY NUMBER
COUNTY NUMBER
CLASSIFICATION

SANITARIAN OR AUTHORIZED COLLECTOR (SIGNATURE AND TITLE)

MAIL REPORT TO:

TYPE OF SAMPLE
☐ 1 PUBLIC WATER SUPPLY
☐ 2 SEMIPUBLIC WATER SUPPLY
☐ 3 PRIVATE WATER SUPPLY ☐ 4 BEACH
☐ 5 SWIMMING POOL ☐ 6 SCHOOL
☐ 7 OTHER (SPECIFY)

TEST DESIRED	TIME COLLECTED	DATE COLLECTED	COUNTY
☐ BACTERIOLOGICAL ☐ FLUORIDE			

CHLORINE RESIDUAL AT COLLECTION: TOTAL PPM FREE PPM

SOURCE OF SUPPLY
☐ 1 STREAM ☐ 2 IMPOUNDED ☐ 3 WELL ☐ 4 SPRING ☐ 5 CISTERN

TREATMENT OF SUPPLY
☐ 1 NONE ☐ 2 COAGULATED ☐ 3 SETTLED ☐ 4 FILTERED ☐ 5 CHLORINATED ☐ 6 FLUORIDATED
☐ 7 OTHER (SPECIFY)

☐ SPECIMEN UNSATISFACTORY ☐ FLUORIDE ☐ BACTERIOLOGY
☐ 1 BROKEN ☐ 2 SAMPLE LEAKED ☐ 3 SAMPLE NOT DATED ☐ 4 RECEIVED LATER THAN 30 HOURS AFTER SPECIMEN WAS COLLECTED ☐ 5 INSUFFICIENT QUANTITY

LABORATORY REPORT OF FLUORIDE TEST LABORATORY NO. ________

FLUORIDES: BY LOCAL ANALYSIS PPM. BY STATE LAB. PPM.

LABORATORY REPORT OF BACTERIOLOGICAL TEST TEST STARTED ________

VOLUME FILTERED (ML) ________ COLIFORM COLONIES PER FILTER ________

FECAL COLIFORM COLONIES PER 100 ML ________ COLIFORM COLONIES PER 100 ML ________

☐ 1 RESULTS INDICATE THAT THIS WATER SUPPLY WAS FREE FROM COLIFORM POLLUTION AT THE TIME THIS SAMPLE WAS TAKEN.

☐ 2 HEAVY GROWTH NEGATIVE FOR COLIFORM

☐ 3 RESULTS SHOW PRESENCE OF COLIFORM ORGANISMS, INDICATING SEWAGE OR OTHER FECAL CONTAMINATION. FOR INFORMATION REGARDING TREATMENT OF WATER, CONTACT YOUR LOCAL HEALTH DEPARTMENT.

DATE RECEIVED	LABORATORY NO.	DATE REPORTED

____
Analyst

LAB. 507 (Rev. 10/73)

69

SAMPLE FORM H

SCHOOL FLUORIDATION SURVEILLANCE

Code:

D = date sample collected
L = result of local analysis
S = result of supervising agency analysis

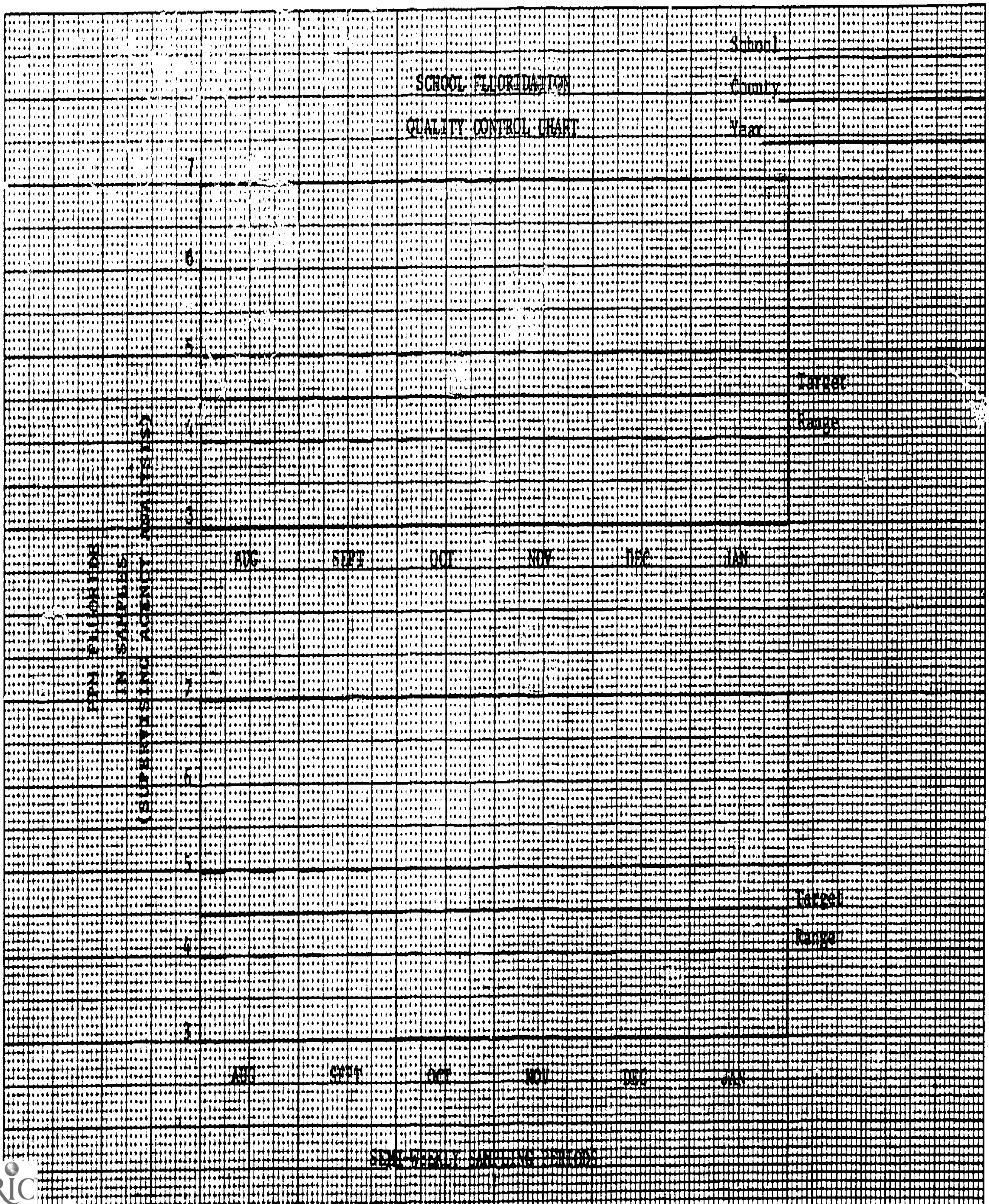
TELEPHONE__________
SCHOOL__________
COUNTY__________
YEAR__________

Month	Readings D	L	S	Month	Readings D	L	S	Month	Readings D	L	S
AUG				DEC				APR			
SEPT				JAN				MAY			
OCT				FEB				JUNE			
NOV				MAR				JULY			

NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

SAMPLE FORM I



SAMPLE FORM J

DEPARTMENT FOR HUMAN RESOURCES
COMMONWEALTH OF KENTUCKY
FRANKFORT 40601

BUREAU FOR HEALTH SERVICES
275 East Main Street

M E M O R A N D U M

TO:

FROM: Dental Health Branch

SUBJECT: Fluoridation

According to our records, we have not been receiving any fluoride samples from your school.

Our contract with the ________________ County Board of Education was that if we furnished the fluoridation equipment to the school, at no cost to them, they in turn would designate two appropriate school personnel in your school to be responsible for surveillance procedures. The school is also responsible for the weekly inspection of the fluoridation equipment to insure continuous operation and to take two water samples per week, Monday and Wednesday, and mail them to the Division of Laboratory Services for fluoride testing.

In order that we maintain an accurate record in our office as to how the equipment is operating, we must have the fluoride samples.

Enclosed you will find some sample bottles and when these are gone, let us know and we will send you some more.

Larman W. Sprouse, D.D.S., M.P.H.
Director, Dental Health Branch

Enclosure

SAMPLE FORM K

DEPARTMENT FOR HUMAN RESOURCES
COMMONWEALTH OF KENTUCKY
FRANKFORT 40601

BUREAU FOR HEALTH SERVICES
275 East Main Street

M E M O R A N D U M

TO:

FROM: Dental Health Branch

SUBJECT: Insufficient Fluoride Analyses

According to our fluoride records in this office, your school has:

- [ ] Not been making a local analysis of the fluoride samples before sending them to us.
- [ ] Making the fluoride analysis, but the level has been at least 1.0 or more different from the State laboratory.

Our contract with the ____________ County Board of Education was that we were to train appropriate school personnel in the technique of on-site surveillance using the testing equipment furnished by the Department for Human Resources (which we did about two weeks after we started the fluoridator). They were to be responsible for the surveillance procedures and were to take two water samples per week making an on-site analysis and marking the results in the proper place on the form furnished by us.

The water samples are to be taken on Monday and Wednesday of each week until the desired level is established. Part of the water from the sample bottle is for your own local analysis and the remaining portion of the water sample is to be sent to the Division of Laboratory Services, Kentucky Department for Human Resources for testing. After the desired level has been established, the appropriate school personnel will be responsible for taking two water samples per week as usual, but only part of the sample takin on Monday will be sent to the State laboratory for testing.

If you have any questions, please contact us. Our telephone number is: (502, 564-3246).

Larman W. Sprouse, D.D.S., M.P.H.
Director, Dental Health Branch

SCHOOL FLUORIDATION PROJECT

DEPARTMENT FOR HUMAN RESOURCES

School Surveillance Procedure

Delta Scientific Meter

1. Check fluoride feeder operation and infra-red light (if applicable) in the pumphouse at least twice per week noting pump setting.

2. Collect a water sample in the plastic bottles provided for that purpose on Monday and Wednesday of each week. Fill each bottle approximatel half full for mailing.

3. Rinse glassware with distilled water before each fluoride analysis.

4. Perform a fluoride analysis of these water samples by using the (Delta Scientific) colorimeter.

   (a) Combine 25 ml. of 0.8 p.p.m. Standard Solution with 5 ml. of Fluoride Reagent (SPADNS). Place in colorimeter and adjust the indicator to reading shown on calibration chart for 0.8 p.p.m. F.

   (b) Combine 5 ml. of collected water sample with 20 ml. of distilled water and 5 ml. of Fluoride Reagent (SPADNS). Place in colorimeter - note reading. From the calibration chart, find the corresponding p.p.m. F. for that reading from the chart and multiply indicated p.p.m. F. by five (Example: 0.8 p.p.m. x 5 = 4.0 actual parts per million). Record result on reporting form provided.

   (c) Wash glassware.

5. After analysis has been run and report form completed, mail the remaining portion of each sample on the day collected to the Division of Laboratory Services, Department for Human Resources, Frankfort, Kentucky. Important: If the analysis indicates a reading of twice or more (9 to 10 ppm fluoride or a reading off the high end of the meter scale), immediately disconnect the power supply to the fluoride unit by turning the feeder pump switch off and contact the Dental Health Branch.

6. Report any irregularities in the fluoride feeding equipment to the Dental Health Branch, Department for Human Resources, Frankfort, Kentucky. (Telephone: 502, 564-3246)

7. To shut down fluoridation unit operation, cut the feeder pump switch off. Record time feeder equipment was cut off and make note of master meter reading at that time.

8. The fluoridation unit should be shut down during long holidays or vacation periods (more than three days).

SCHOOL FLUORIDATION PROJECT

DEPARTMENT FOR HUMAN RESOURCES

School Surveillance Procedure

Orion Research Model 409

1. Check fluoride feeder operation and infra-red light (if applicable) in the pumphouse at least twice per week noting pump setting.

2. Collect a water sample in the plastic bottles provided for that purpose on Monday and Wednesday of each week.

3. Rinse cups with distilled water before each fluoride analysis.

4. Perform a fluoride analysis of these water samples by using the (Orion Research) fluoride electrode:

   (a) before measuring

   Be sure reference electrode is at least half filled with filling solution.

   calibrating the system

   Pour about 10 ml of 2 ppm standard into a cup. (Standards are ready to use - never mix with TISAB.) Set switch to 0.5-2.0

   Place electrodes in 2 ppm standard. Set pointer to read 2 ppm on upper meter scale, using knob marked "SET 2 ppm".

   (b) running the test

   Mix equal parts of TISAB and water to be tested, as follows:

   Pour about 20 ml of TISAB into second cup. Draw up one syringe of TISAB. (Fill syringe completely - no air bubbles - plunger all the way back.) Empty syringe-full of TISAB into third cup and add one syringe-full of water sample.

   Set switch to 0.1-10 ppm scale. Place electrodes in water/TISAB mixture and read fluoride level on lower meter scale.

   (c) after measuring

   Turn switch to "OFF" to conserve batteries. Leave electrodes with tips in water. Do not let reference electrode dry out.

   (d) Wash cups.

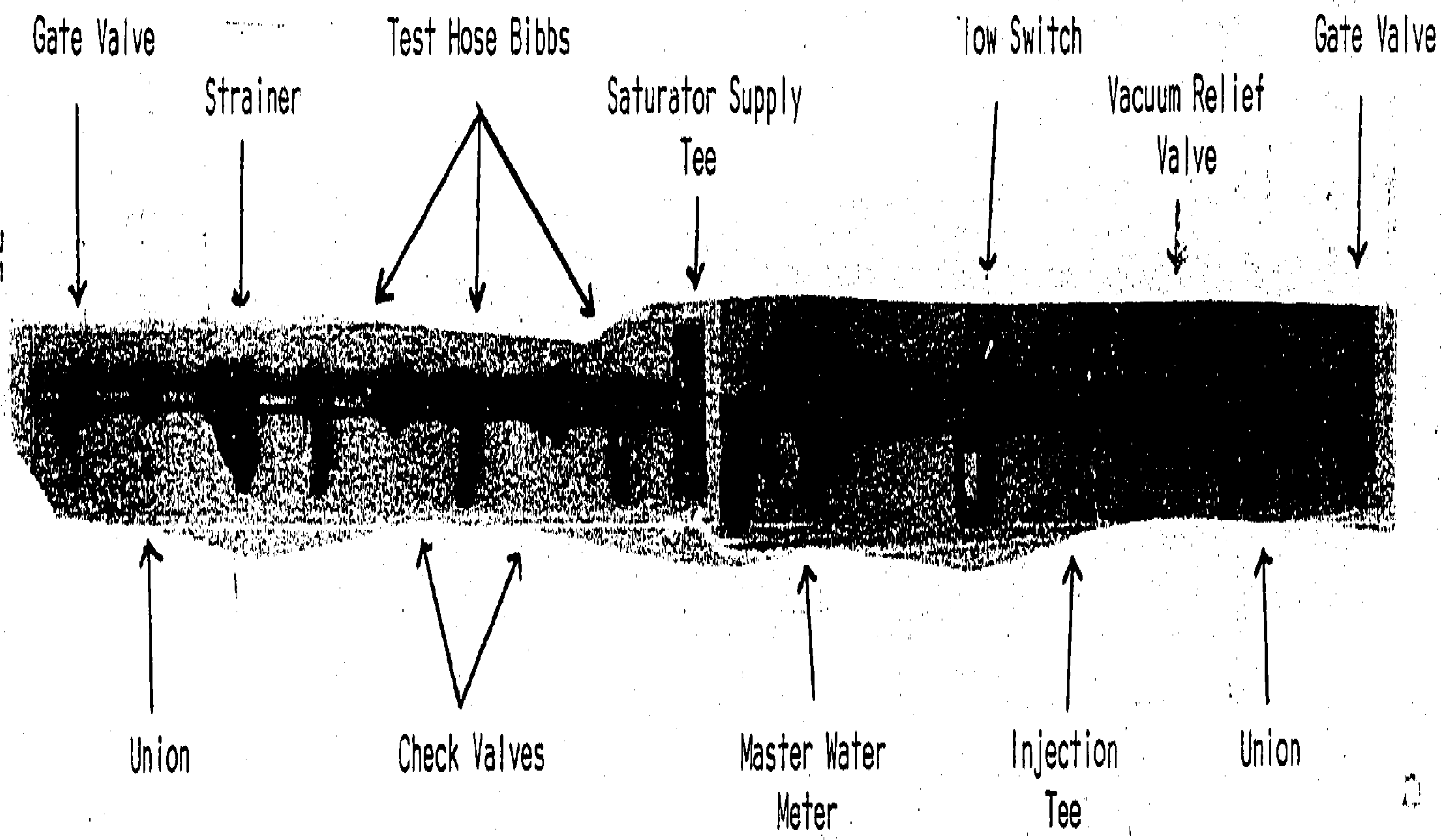
5. After analysis has been run and report form completed, mail the remaining portion of each sample (at least 20 ml.) on the day collected to the Division of Laboratory Services, Department for Human Resources, Frankfort, Kentucky. Important: If the analysis indicates a reading of twice or more (9 to 10 ppm fluoride or a reading off the high end of the meter scale), immediately disconnect the power supply to the fluoride unit by turning the feeder pump switch off and contact the Dental Health Branch.

6. Report any irregularities in the fluoride feeding equipment to the Dental Health Branch, Department for Human Resources, Frankfort, Kentucky. (Telephone: 502, 564-3246)

7. To shut down fluoridation unit operation, cut the feeder pump switch off. Record time feeder equipment was cut off and make note of master meter reading at that time.

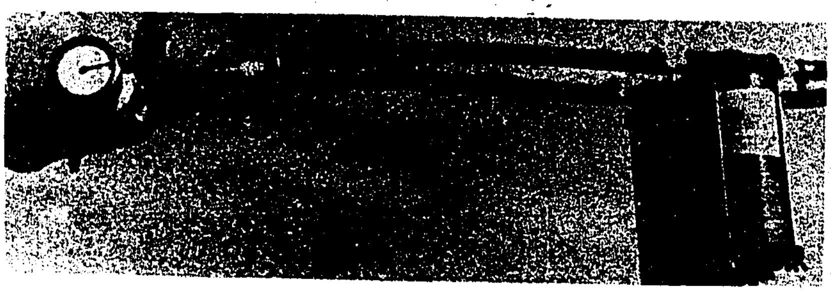
8. The fluoridation unit should be shut down during long holidays or vacation periods (more than three days).

MASTER METER LOOP



From Well Pump

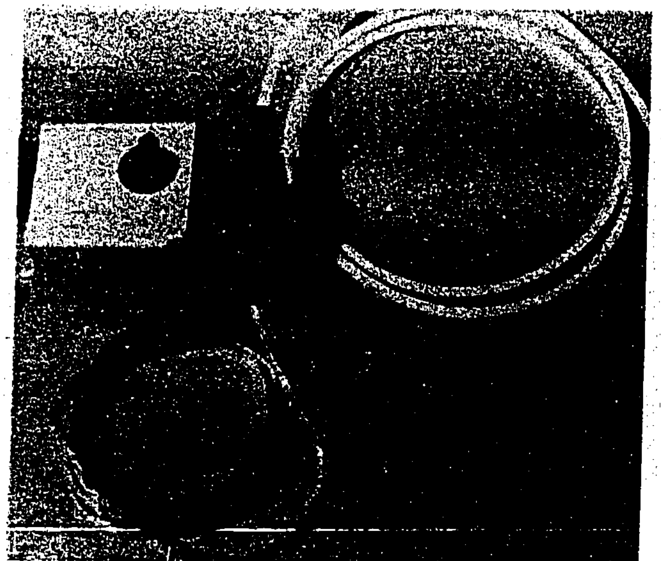
To Pressure Tank



From Main Water Line

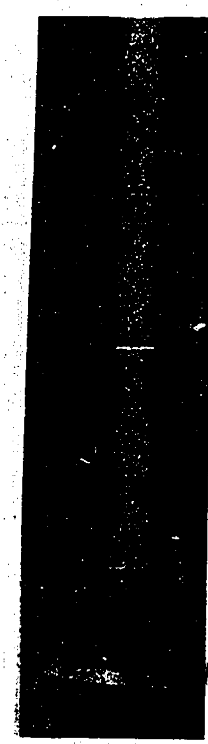
Water Meter

Water Softener



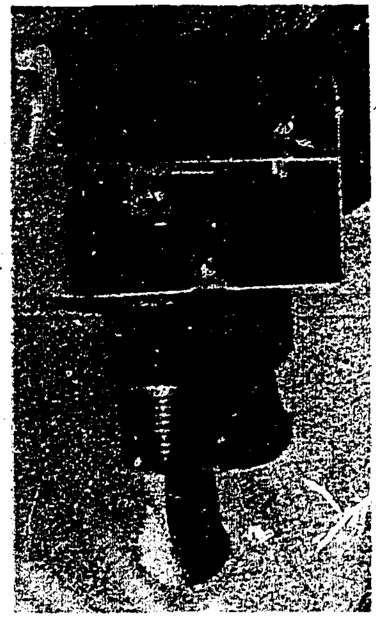
Feeder Pump with solution line (clear and discharge line (white)

Saturator Tank with feeder pump and float valve (not shown)



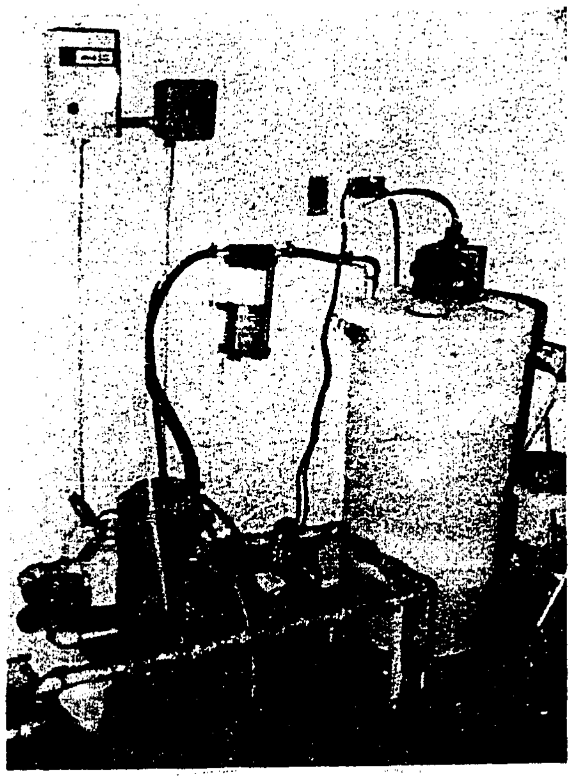
Suction Manifold

82



Flow Switch with cover removed. Viewed from the intake side. The tensioning screw and spring mechanism for the blade can be seen.

Position of thumb for testing electrical wiring of flow switch to feeder pump and well pump.



INSTALLED SCHOOL FLUORIDATION UNIT

84

NECESSARY PARTS FOR SCHOOL FLUORIDATORS

PARTS	PRICE
Drum, Polyethylene, 55 gallon, with cover	$ 33.00
Vendor: Brock-McVey Company P. O. Box 598 Frankfort, Kentucky 40601	
Sodium Fluoride Crystaline (20-60 mesh) in 100 lb. bags	$ 30.00
Chemical Metering Pump with Anti-siphon Valve (approx. 20 gals. per day)	
BIF (or)	$260.00
PRECISION (or)	$138.62
WALLACE & TIERNAN	$160.52
Vendor: Brock-McVey Company P. O. Box 598 Frankfort, Kentucky 40601	
Water Meter, Disc-type, Unsealed, Straight reading, 100 GPM, U.S. Gallons including couplings	$ 96.80
Vendor: Brock-McVey Company P. O. Box 598 Frankfort, Kentucky 40601	
Flow switch - Usually for 1" X 1½" pipe	$ 22.20
Vendor: Brock-McVey Company P. O. Box 598 Frankfort, Kentucky 40601	
Delta Scientific Colorimeter, with reagents	$387.50
Vendor: Brock-McVey Company P. O. Box 598 Frankfort, Kentucky 40601	
16 oz. bottle SPADNS Reagent R-67	$ 2.50
16 oz. bottle Fluoride Standard Solution (0.8 ppm) R-68	$ 2.50
Pall Guard Water Purifier, Model #30H and one (1) refill cartridge	$ 22.20
Vendor: Brock-McVey Company P. O. Box 598 Frankfort, Kentucky 40601	
Horizontal Dirt Y Strainer	$ 5.92
Horizontal Check Valve	$ 10.00
Unions	$ 2.16
Test Hose Bibbs	$ 3.44
Gate Valve for "make-up" water line	$ 10.50
Stock Tank Float	$ 18.00
Filter or Torpedo Sand in 100 lb. bags	$ 6.00
1½" Galv. Union	$ 1.63
Float Valve, #AA-10 with Adapter for ½" line	$ 9.35
3/4" Hoffman Vacuum Breaker	$ 7.50
Reducing Tee, Galv., 1½" X 1½" X 3/4"	$ 1.37
Reducing Tee, Galv., 1½" X 1½" X ½"	$ 1.37
Galv. ½" Union	$ .63
½" Gate Valve	$ 3.44
1½" Gate Valve	$ 10.50

85

PARTS	PRICE
½" Elbows, Galv.,	$ .15
6' of 1½" Pipe Galv.,	$ 6.90
1½" Elbows, Galv.,	$ .89
1½" Galv., nipples, 5" long	$ .60
1½" nipples, all thread	$ .40
8' of 1½" pipe	$ 7.00
Set of assorted 1½" Nipples, Galv.,	$ 4.60
1½" X 1" Hex Bushing, Galv.,	$ .25
220 Electric Box, Amps and Circuit Breaker	$ 7.70
30' of 14-2 Insulated Electric Wire, with ground	$ 4.50
Heat Lamp Bulb (if needed)	$ 2.30
If line is not 1½" - Reducers are required	$ 1.66
Set of assorted ½" Nipples, Galv.,	$ 4.00
Polyethylene Funnels	$ .80
Pipettes, #94185, as follows:	
5 - ml.	$ 2.80
20 - ml.	$ 3.70
25 - ml.	$ 4.00
15" X 15" Wooden Shelf, with wall brackets	$ 12.00
Filter Stone - 1¼" River Gravel (500 - 1200 lbs.)	$ 2.75
½" Check Valve	$ 4.25
1½" X 1½" Elbows	$ .39

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☆ U.S. GOVERNMENT PRINTING OFFICE: 1976— 210-821/1065