NOISE STUDY FOR THE FINAL ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED I 475

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

NOISE STUDY FOR THE FINAL ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED I 475

Research Laboratory Section
Testing and Research Division
Research Project 72 TI-95
Research Report No. R-874

Michigan State Highway Commission
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INTRODUCTION

The proposed I 475, routed through urban Flint, is composed of two sections: the southern, from 5th to Stewart Streets, and the northern, from Stewart to Saginaw Streets, as shown in Figure 1. The report which follows considers the traffic noise effects of this project in terms of existing levels and predicted future levels. Noise levels that will exist at the roadway right-of-way and also at selected, potentially sensitive facilities are identified and considered separately.

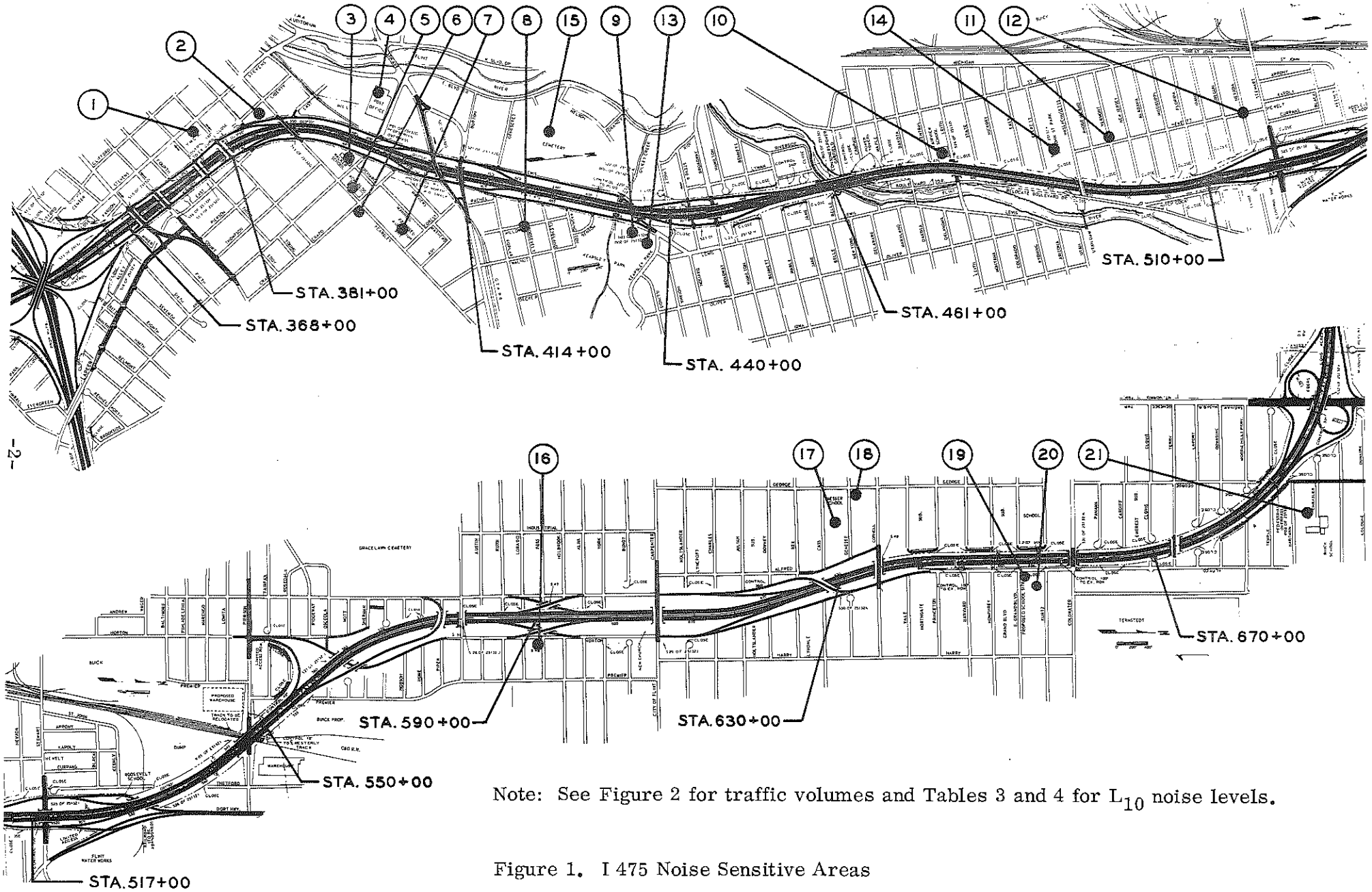
Acoustical noise is defined as "unwanted" sound. It is generally composed of combinations of discrete tone and random pressure fluctuations covering the entire audible frequency spectrum. An accurate physical description of noise requires a careful frequency analysis and a specification of the statistics of its randomness. Such an analysis is not only difficult and costly to obtain, but is more detailed than necessary for most applications.

The acoustical engineer often obtains a satisfactory description by analyzing sound to determine the sound pressure level (SPL) in each of a series of contiguous frequency bands covering the audible spectrum. Although the bandwidths of the filters used in frequency analyses can be varied as desired, the most common are either one octave or one-third octave in width. The frequency range of interest is generally between about 20 and 10,000 Hz and can be covered by a set of nine octave band filters.

Although the acoustical engineer cannot generally work with a description of sound more coarse than that provided by an octave band analysis, he is often asked to provide a specification using a single number rather than the series provided by frequency analysis. The sound level meter, a direct reading instrument which gives a single measure of the magnitude of a sound, has been developed for this purpose.

Because of the deficiencies in applying a single number descriptor to sounds of different character, several weighting networks have been provided in the sound level meter to alter meter response. The weighting networks have been designated A, B, and C. The A network provides the most emphasis for higher frequencies and has a frequency response roughly comparable to that of the human ear. The levels obtained from use of the A network are called A-weighted decibels, abbreviated as dbA.

Knowledge of average traffic noise levels is not, in itself, sufficient to define environmental acceptability. Some knowledge and measure of the sound peaks is also required. Most researchers have concluded that the noise aspects of the traffic environment are adequately characterized by the noise level which is exceeded 10 percent of the time. It is this level (designated L_{10}) which is specified in the FHWA Policy and Procedure Memorandum (PPM 90-2).



Note: See Figure 2 for traffic volumes and Tables 3 and 4 for L_{10} noise levels.

Figure 1. I 475 Noise Sensitive Areas

TABLE 1

I-475 NOISE SENSITIVE FACILITIES; THEIR PPM 90-2 LAND USE CATEGORY AND EXISTING, MEASURED NOISE LEVELS

Site No.	Noise Sensitive Facility	Proposed Land Use Category	Existing L_{10} dbA Noise Level	Figure No.
1.	Y. M. C. A.	E	62	3
2.	Riverside Assembly of God	E	60	4
3.	Walker School	E	57	5
4.	U. S. Post Office	E	59	6
5.	Board of Education Administration Building	B	70	7
6.	Flint Public Library	E	59	8
7.	Municipal Auditorium	B	60	9
8.	Roosevelt Free Methodist Church	B	56	10
9.	Michigan National Guard Armory	E	66	11
10.	Drug Rehabilitation Center	E	60	12
11.	Zion Hill Bible Church	B	56	13
12.	St. Marks Mission Church	B	59	14
13.	Kearsley Park	B	59	15
14.	St. John Street Park	B	56	16
15.	Avondale Cemetery	B	60	17
16.	Foss Avenue Baptist Church	B	52	18
17.	Joseph G. Messer Elementary School	B	52	19
18.	Emmanual Temple Apolstolic Church	B	51	20
19.	Marion Harrow Elementary School	B	50	21
20.	Kurtz Elementary School	B	54	22
21.	Buick Community School	B	53	23

Vehicle Noise Sources

There are two major sources of noise from motor vehicles in motion: the engine/exhaust system and the tire/roadway interaction system. Under certain conditions, carburetor intake noise and noise from cooling fans, superchargers, valve lifters, gear boxes and other parts is detectable. Most new passenger cars have good factory equipped mufflers; however, used cars, hot-rods, sport cars, motorcycles and trucks often have inadequate mufflers. The extreme case is the motorcycle or truck with a straight pipe and either no muffler or a rodded muffler.

Tire/roadway interaction noise is present for all motor vehicles in motion. For some vehicles and operating conditions, such as new passenger cars driven at high speeds on a freeway, it is the dominant noise source. Under some conditions, the sound from trucks is rich in tire/roadway interaction noise. Many characteristics of the tire, roadway, and vehicle suspension are important factors although the mechanisms are not well understood or measured. The tread depth and pattern, the roadway roughness, dryness, tire stiffness and loading and suspension coupling are known to affect the amount of noise radiated.

ANALYSIS PROCEDURES FOR PROPOSED I 475 FREEWAY

Since traffic conditions on this project will exceed level of Service C at opening, Service C volumes and speeds were used for the 1982 (two years after opening) and 2000 (design year) automobile data. The truck data were derived from the respective DHV peaks. Only p.m. predictions were made since they were consistently larger. This traffic information is contained in Figure 2.

The noise prediction method of NCHRP Report No. 117 has been computerized by the Department's Research Laboratory (recommended in PPM 90-2) and is used here for the predicted noise levels. Traffic data were supplied by the Transportation Survey and Analysis Section.

The noise predictions of Tables 2 and 3 are for the locations specified in Table 1, and are based on the conditions given below.

a. Dual 3-lane pavement with 26-ft median
b. At grade
c. Observer height 5 ft
d. No grade or shielding corrections
e. Infinite roadway length
f. Free flow traffic
g. Traffic volumes as tabulated in Figure 2.

For sites with L_{10} noise levels exceeding 70 dbA, the addition of a bituminous wear surface and noise barriers of the required height are indicated.

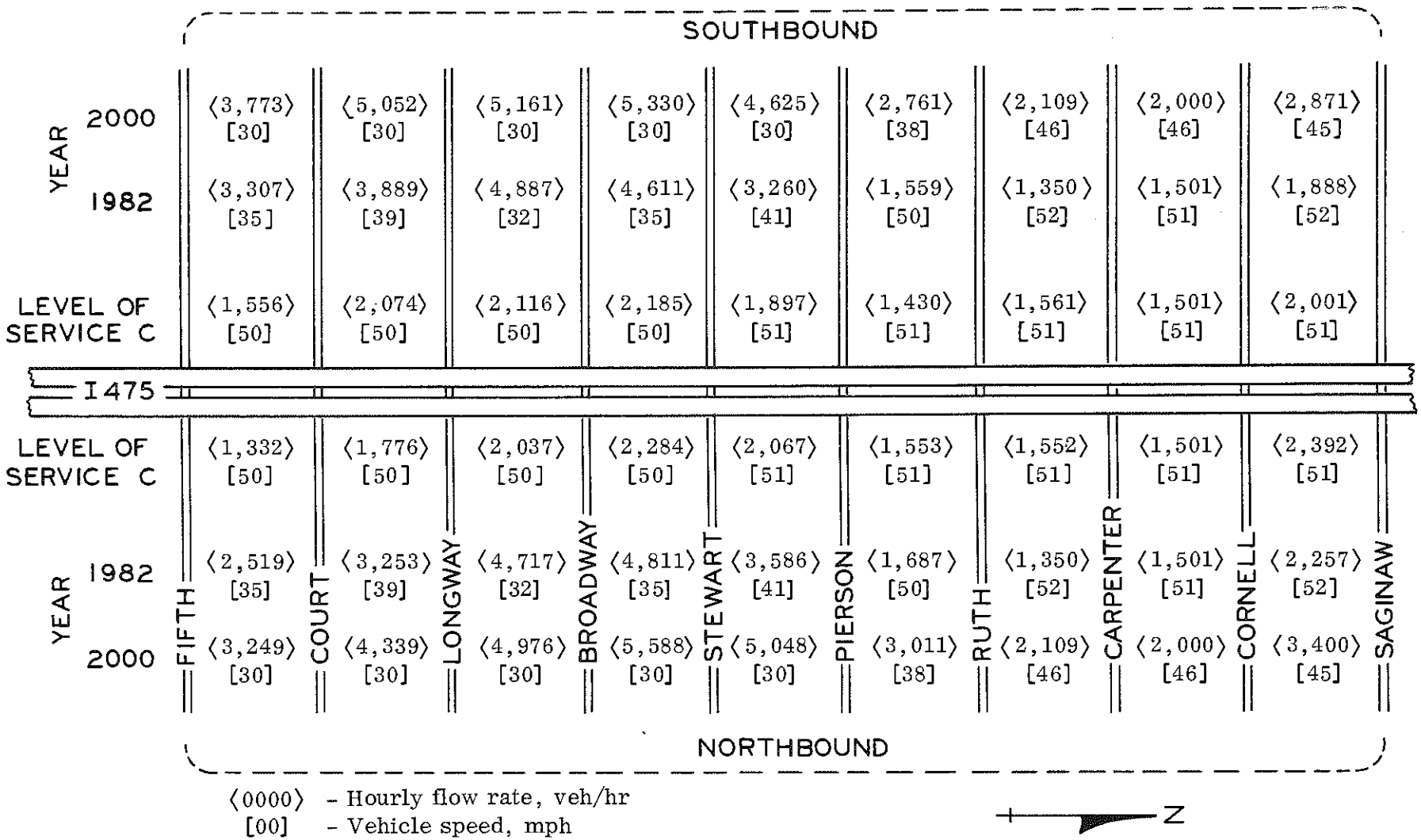


Figure 2. Traffic data for proposed I 475 including level of Service C and 3:30 to 4:30 p.m. peak volumes for years 1982 and 2000.

TABLE 2

L_{10} NOISE LEVELS PREDICTED FOR THE YEAR 2000 AT THE R.O.W., AT INDICATED STATIONINGS

Station	D_N	Distance, ft		Elevation or Depression, ft	L_{10}	
		D_C	D_S		East	West
670+00	65,70	39,44		-5	76.3	75.9
663+00	65	5		-22	64.8	65.2
649+50	65	0	0	0	77.3	77.3
630+00	205,260	149,204		-20	63.4	61.1
620+00	264,240	240,216		-4	65.9	66.8
612+00	260,285	204,229		-7	65.6	64.7
604+50	247,248	193,194		-18	62.4	62.4
592+00	249	217		-8	64.9	64.9
571+00	167,187	0	0	0	74.1	73.2
564+00	186,159		170,143	+14	72.9	73.9
550+00	284,107		268,91	+25	68.7	67.5
538+00	86,120		70,104	+42	73.3	72.5
529+00	184,273		168,257	+17	76.4	73.4
521+00	164,238		148,222	+28	75.3	73.7
517+00	115,160		99,144	+11	80.3	77.8
510+00	85		69	+20	79.3	79.2
480+00	105,82		89,66	+22	78.3	78.4
461+00	102,75		86,59	+13	81.0	82.9
440+00	145,182		129,166	+13	78.2	76.6
431+50	132,124	0	0	0	79.1	79.6
414+00	124,160	62,98		-18	76.4	73.4
399+00	118,125	96,103		-3	79.1	78.9
391+00	130,138	78,86		-18	74.6	74.0
381+50	124	68		-20	75.0	75.0
371+00	103	49		-19	77.5	77.5
368+50	103	43		-22	76.2	76.3

DN = Distance between observer and center of the near lane of roadway.

D_S = Distance parameter measured between observer and shoulder of roadway.

D_C = Distance measured between observer and cut of roadway.

TABLE 3

PEAK NOISE PREDICTIONS FOR
NOISE SENSITIVE SITES ADJACENT TO I-475

Site No.	Relative Roadway to Site Elevation (ft)	Distance from Roadway to Site Property Line	L_{10} dbA Peak Noise Level, year		
			1982	2000	2000(2)
1	-17	125	75	78	73
2	-20	100	77	79	74
3	-7	150	76	78	73
4	-7	300	69	71	66
5	-10	400	64	67	(1)
6	-13	780	57	60	(1)
7	-13	600	59	62	(1)
8	-8	375	68	69	(1)
9	25	135	74	75	70
10	22	75	78	79	74
11	18	1025	63	64	(1)
12	13	700	66	67	(1)
13	28	175	73	74	69
14	8	75	82	83	78
15	-3	150	77	77	72
16	-7	110	70	72	67
17	-20	820	50	53	(1)
18	-20	925	49	52	(1)
19	-2	200	70	72	67
20	-5	350	64	66	(1)
21	3	600	62	64	(1)

(1) A bituminous cap is not required at these sites to meet the requirements of PPM 90-2.

(2) L_{10} dbA noise level prediction for the year 2000 with a bituminous wear surface on the roadway.

TABLE 4
DOT-FHWA PPM 90-2 NOISE STANDARDS

Land Use Category	Design Noise Level - L_{10}	Description of Land Use Category
A	60 dbA (Exterior)	Tracts of lands in which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parks, or open spaces which are dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B	70 dbA (Exterior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, picnic areas, recreation areas, playgrounds, active sports areas, and parks.
C	75 dbA (Exterior)	Developed lands, properties or activities not included in categories A and B above.
D	---	Undeveloped lands
E	55 dbA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

These barriers are assumed to be placed at the cut (D_C) or shoulder (D_S) distance for depressed or elevated pavements, respectively. The barrier length should extend four-times this cut or shoulder distance on each end of the length of property to be shielded.

Existing noise levels were determined by actual field measurement at selected sites along the proposed route for comparison purposes.

Noise Sensitive Areas Along I 475

L_{10} noise level predictions at the right-of-way on both sides of the roadway are given in Table 2 for the year 2000; and identified as to location by the stationing numbers in both Figure 1 and Table 2.

Noise sensitive sites along the proposed I 475 expressway between 5th and Saginaw Streets were identified and categorized per PPM 90-2 into the various land uses. These noise sensitive areas are identified in Table 1 and located in Figure 1 of this report. Present 1972-73 noise level measurements and 1982 and 2000 predicted levels at corresponding locations are also given for comparison purposes in the text. Suggestions for noise reduction at individual sites are included for these areas where the noise level standards would be exceeded.

DETAILED ANALYSIS OF SENSITIVE AREAS

All levels referred to in this section are L_{10} levels. The standards and categories refer to those of DOT-FHWA PPM 90-2 'Noise Standards" (Table 4).

Young Men's Christian Association (Fig. 3)

The Y.M.C.A. is located between Second and Third Street west of Liberty Street. Present noise level measurements indicated 62 dbA at 46 ft from the north side of the building. Predicted noise levels at the same location for the years 1982 and 2000 were 75 dbA and 78 dbA, respectively.

Since the level for 2000 is over the 70 dbA limit for Category B, some treatment is required. A bituminous cap would reduce the 2000 year level to 73 dbA. To further reduce the predicted level to 70 dbA would require a 9-ft high solid barrier located just inside the right-of-way line.

Since activities are confined to the inside of this building, land use Category E, which has a 55 dbA interior level maximum, would be appropriate also. There are no windows on the building side facing the freeway. For this reason, since the building is of masonry construction, a noise reduction factor of 35 dbA due to the structure would be appropriate permitting a maximum exterior noise level of 90 dbA. The predicted exterior level for the year 2000 is below this level and hence no treatment is required in this instance.

Riverside Assembly of God (Fig. 4)

The Riverside Assembly of God Church is located at the end of First Street and east of East Street near the proposed I 475. Present measured level is 60 dbA. The predicted 1982 level is 77 dbA and for the year 2000 it will be 79 dbA.

In order to meet Category B standards, the pavement surface will require a bituminous cap and a solid barrier 10-ft high at the right-of-way boundary.

Predicted values were based on a worst case condition of a noise peak between 3:30 to 4:30 p.m. with a level of Service C. Most activity would occur in the church in the evenings and on Sunday when the noise level would be much lower. The building is of masonry construction and probably single glazed windows, with windows normally closed. Using a noise reduction factor of 25 dbA would allow an exterior noise level of 80 dbA in Category E. Some visual screening should be provided. A further investigation is recommended if it is required to meet Category B.

Walker School (Fig. 5)

This school is located near the proposed I 475 between Thompson and Avon. The measured level is 57 dbA. In 1982 the predicted level would be 76 dbA and 78 dbA in the year 2000.

In front of the school, the road surface should be capped with bituminous concrete and a 10-ft high barrier installed to meet the Category B level in the year 2000.

Sound-proofing should be considered as provided in PPM 90-2, to reduce the interior noise level to a Category E maximum of 55 dbA if necessary. Since most school activities would be over before the predicted 3:30 to 4:30 p.m. peak, no soundproofing should be necessary.

U.S. Post Office (Fig. 6)

The U.S. Post Office is located at the end of Mill Street. The measured level in 1972 is 59 dbA. The predicted levels for 1982 and 2000 are 69 dbA and 71 dbA, respectively.

A bituminous capping of the concrete surfaces near the post office would reduce the level below 70 dbA as required for Category B.

This facility has no windows facing the proposed I 475 freeway. Since activity is confined to the inside of the building, land use Category E is appropriate. Being of masonry construction, a 90 dbA exterior level would meet the Category E, 55 dbA, requirement. Since the predicted level for the year 2000 is 71 dbA, no special treatment is required.

Board of Education Administration Building (Fig. 7)

A building located on Kearsley between Crapo and Avon called the Administration Building is about one and one-half blocks from the proposed I 475 expressway. The measured value is 70 dbA in 1972. The 1982 and 2000 predicted values are respectively, 64 dbA and 67 dbA.

Since these values are below the standard for Category B use in PPM 90-2, no special treatment is required.

Flint Public Library (Fig. 8)

The Flint Public Library is located at the corner of Kearsley and Crapo, about two blocks from the proposed I 475 expressway. The measured 1972 value is 59 dbA. In 1982 and 2000 the predicted values are, respectively, 57 dbA and 60 dbA.

Therefore the section of I 475 in this area will not require special treatment to meet the standards.

Municipal Auditorium (Fig. 9)

The auditorium is located about two and one half blocks from the proposed expressway at the corner of Kearsley and Forest. The measured 1972 value is 60 dbA. The predicted values for the years 1982 and 2000 are 59 and 62 dbA.

Since these are below the maximum as set for this land use Category B, no special treatment of the expressway is required in this area.

Roosevelt Free Methodist Church (Fig. 10)

This church is located less than one block from the right-of-way at the corner of Willow and Roosevelt. The microphone was located 50 ft from the corner of the church on the sidewalk facing toward the new road. The measured L_{10} value is 56 dbA. The 1982 and 2000 predicted L_{10} values are 68 dbA and 69 dbA, respectively.

Since these values are below 70 dbA, which is the standard for land use Category B, no special treatment of the roadway is required.

Michigan National Guard Armory (Fig. 11)

The armory is located on the westerly edge near the roadway between Kearsley Park and a Cemetery. The measured L_{10} value is 66 dbA. The predicted values for 1982 and 2000 are 74 dbA and 75 dbA, respectively.

A bituminous capping of the surface in this area would bring the 2000 level down to 70 dbA, which would meet the standard for land use Category B.

The armory is constructed of masonry and has several windows on the side facing the proposed freeway. Most activities associated with the armory occur inside the building and do not coincide with freeway traffic peaks. Therefore, a maximum exterior noise level of 80 dbA would be permitted for Category E. No special treatment appears necessary.

Drug Rehabilitation Center (Fig. 12)

This center was formerly the Fairview School. It is located just west of the roadway between Leith and Central. The measured value is 60 dbA. The predicted values for 1982 and 2000 are, respectively, 78 dbA and 79 dbA.

Since these exceed the standards for Category B, treatment is required. A bituminous cap will reduce the year 2000 level to 74 dbA. In addition an 8-ft high, solid barrier would have to be installed at the right-of-way line to bring the level down to the required 70 dbA.

The drug rehabilitation center is used only internally and, therefore, Category E land use, with a maximum interior noise level of 55 dbA is applicable. Sealing of windows and installation of air conditioning would bring the facility into compliance with PPM 90-2, and would preclude the necessity for capping the roadway, or building a barrier.

Zion Hill Bible Church (Fig. 13)

This church is located on Vermont west of Hewelt approximately one and one-half blocks from the expressway. The measured value is 56 dbA. For the years 1982 and 2000, the predicted values would be 63 and 64 dbA, respectively.

These values are below the 70 dbA standard set forth in PPM 90-2 for land use Category B and therefore no special treatment would be needed.

St. Marks Mission Church (Fig. 14)

This church is located at the corner of Nevada and Hewelt Streets approximately one block west of the proposed I 475. The measured 1972 level is 59 dbA. The predicted 1982 and 2000 values are 66 and 67 dbA, respectively.

These are below the 70 dbA level and therefore no special treatment is required.

Kearsley Park (Fig. 15)

Kearsley Park is crossed by the proposed roadway at Kearsley Park Street. The measured value is 59 dbA. The predicted values for 1982 and 2000 are 73 and 74 dbA, respectively.

A bituminous capping would reduce the level for the year 2000 to 69 dbA. This would be below the 70 dbA standard required for Category B land use. Alternately, if instead of a bituminous cap, a 9-ft high barrier were to be placed 2 ft outside the shoulder of the bridge, a level of 70 dbA would be achieved for the year 2000.

St. John Street Park (Fig. 16)

This park abuts on the proposed roadway between Everett and Massachusetts and fronts on St. John Street. The measured value is 56.5 dbA. The predicted values for 1982 and 2000 are 82 and 83 dbA.

This would require bituminous capping to bring the year 2000 level down to 78 dbA, and in addition a 13-ft high barrier along the right-of-way to bring the level down to 70 dbA.

Avondale Cemetery (Fig. 17)

This cemetery adjoins the proposed I 475 expressway north of Geneseret Street. The measured level is 60 dbA. The predicted levels for the years 1982 and 2000 are, respectively, 77 and 77 dbA.

To reduce the noise to the 70 dbA standard will require a bituminous cap and a solid barrier. The capping would give a year 2000 value of 72 dbA and addition of a 9-ft barrier would bring the level down to the 70 dbA limit.

Foss Avenue Baptist Church (Fig. 18)

This church is located on the northeast corner of Foss and Horton near the expressway. The measured sound level in 1973 is 52 dbA. The predicted levels for 1982 and 2000 are 70 and 72, respectively.

A bituminous capping will reduce the year 2000 to 67 dbA.

Joseph G. Messer Elementary School (Fig. 19)

This school is located on the east side of George Street between Cass and Genesee, and is about two blocks from the expressway. The measured level in 1973 is 52 dbA. The predicted values for the years 1982 and 2000 respectively, are 50 and 53 dbA.

This location will not require any additional treatment.

Emmanual Temple Apostolic Church (Fig. 20)

This church is located on the northeast corner of Genesee and George facing Genesee across the street from the Messer School. The measured level is 51 dbA. The predicted 1982 and 2000 L_{10} values are 49 and 52 dbA, respectively.

These are below the PPM 90-2 standard values and therefore the roadway will require no additional treatment.

Marion Harrow Elementary School (Fig. 21)

This school is located east of the Alfred and East Grand Boulevard intersection. The school is less than a block from the proposed I 475 expressway. The measured value in 1973 is 50 dbA. The predicted values in 1982 and 2000 are 70 and 72 dbA, respectively.

In order to meet Category B a bituminous cap will be required. This would bring the level down to 67 dbA.

Kurtz Elementary School (Fig. 22)

This school is located west of Alfred between East Grand Boulevard and Kurtz Street. The measured level in 1973 is 54 dbA. The predicted levels for this area in 1982 and 2000, respectively, are 64 and 66 dbA.

Since these values are below the 70 dbA level of Category B, no special treatment is required.

Buick Community School (Fig. 23)

This school is located north of Hartman at the east end of Chrysler Street. The measured level in 1973 is 53 dbA. The predicted values for 1982 and 2000 are, respectively, 62 and 64 dbA.

These are below the 70 dbA standard and therefore no special treatment is required.

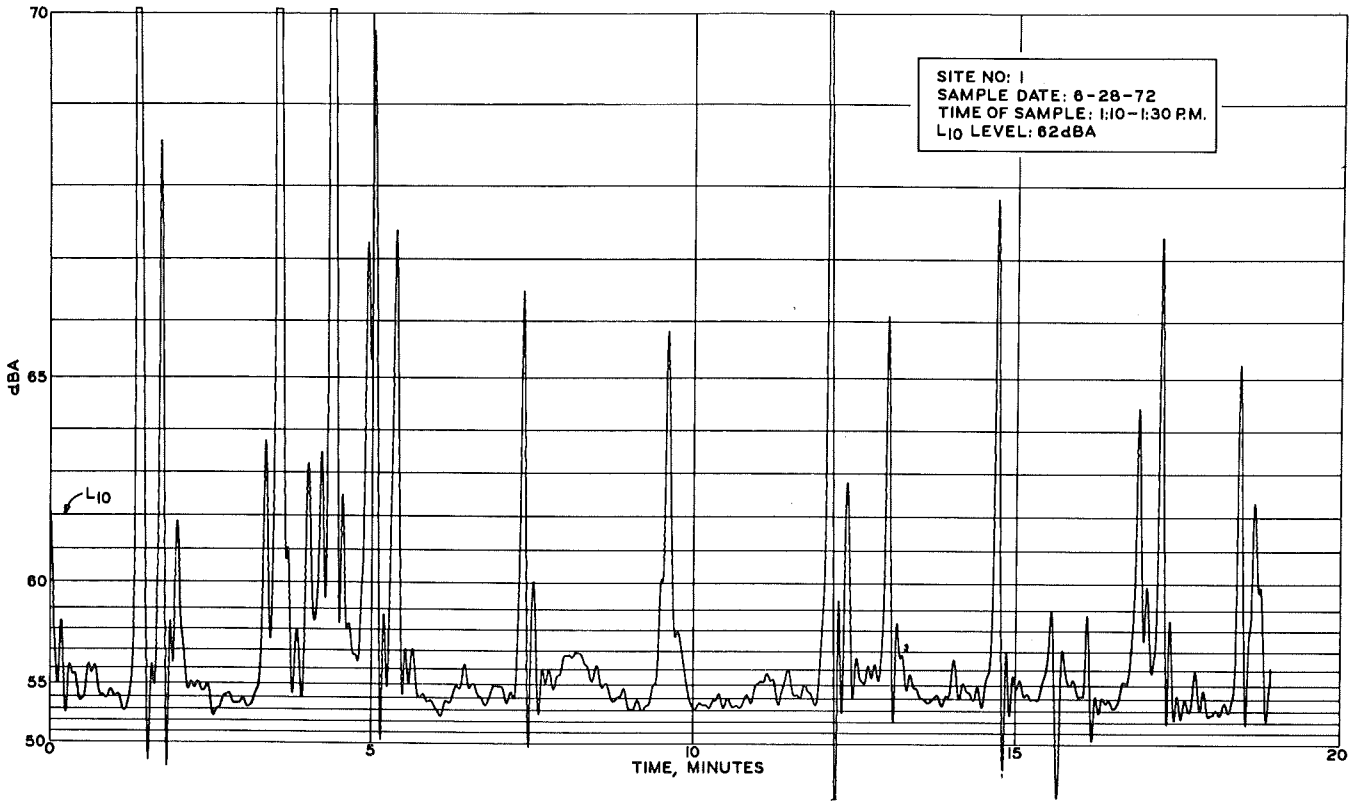
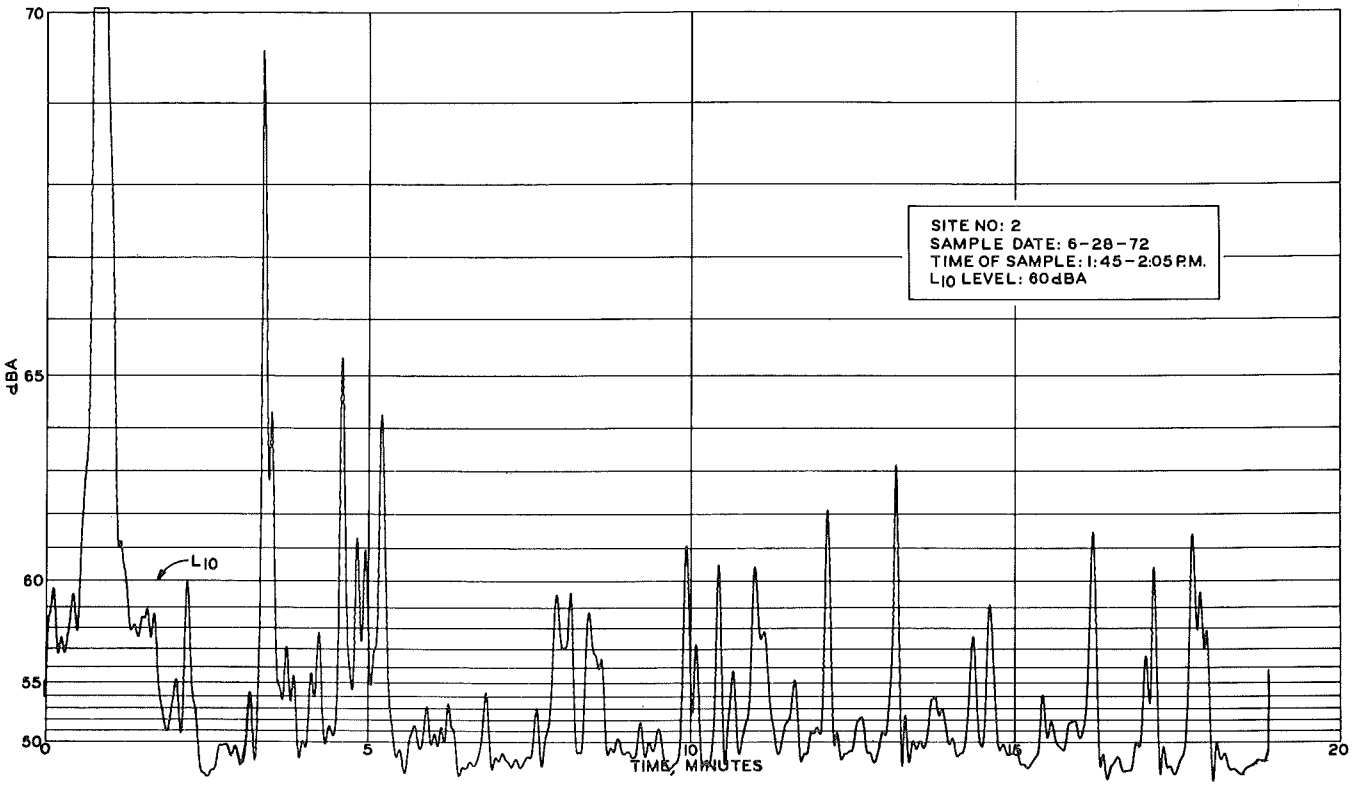


Figure 3. Microphone located on E side of Flint Branch Y.M.C.A. Observer looking NW. Sta. 379.



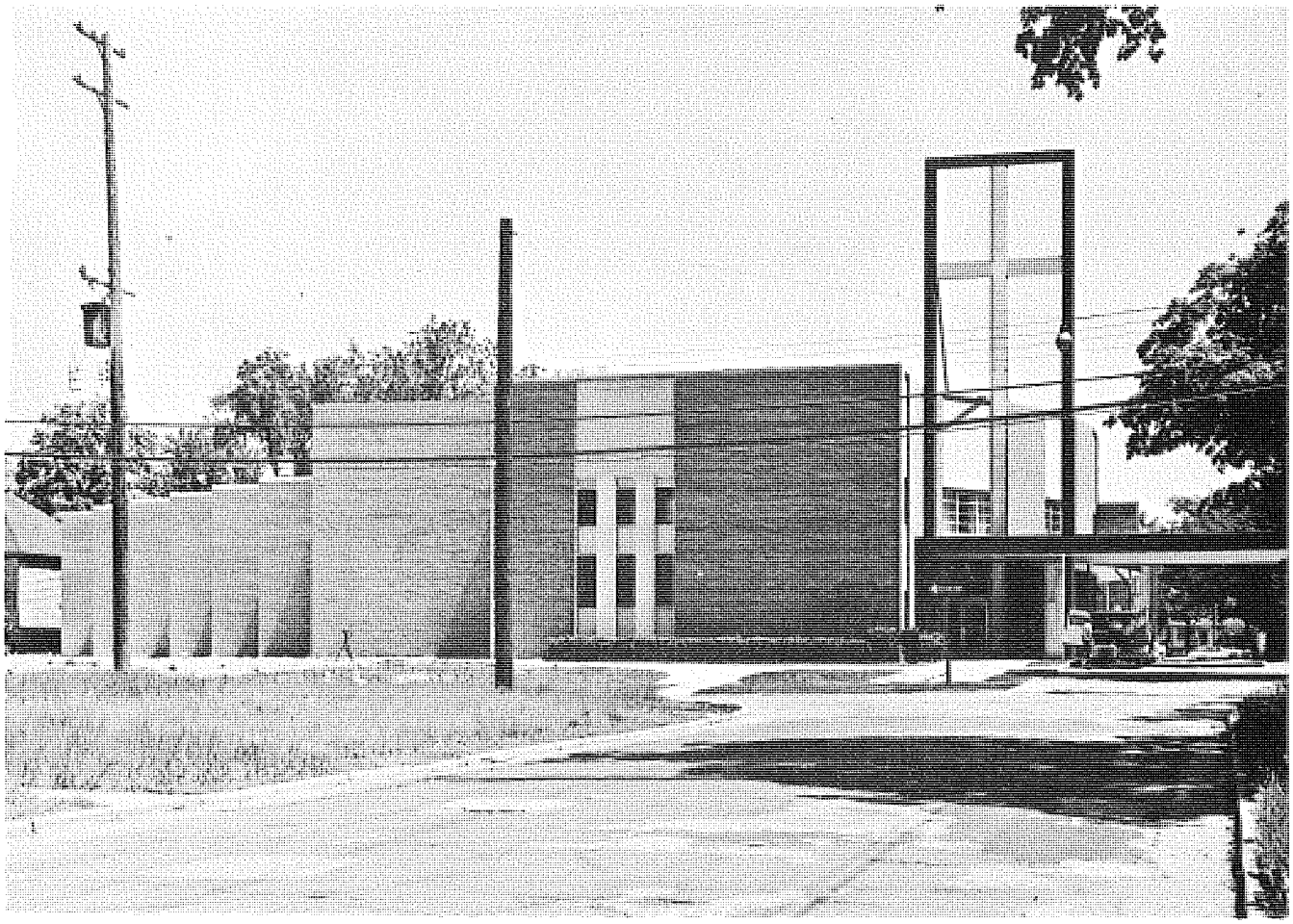


Figure 4. Microphone located on W side of Riverside Assembly of God Church at proposed right-of-way. Observer looking E. Sta. 386+50.

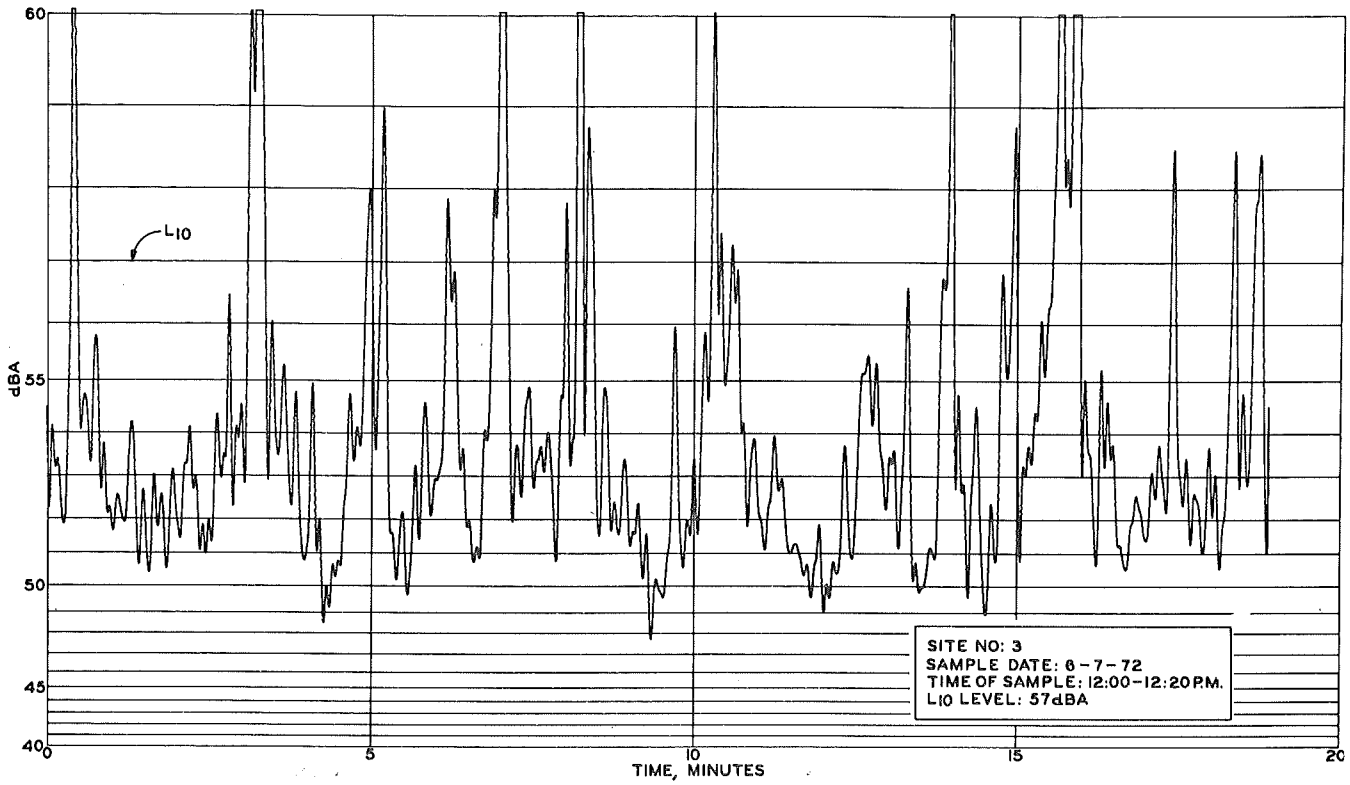


Figure 5. Microphone located on N side of Walker School at the right-of-way. Observer looking SE. Sta. 398.

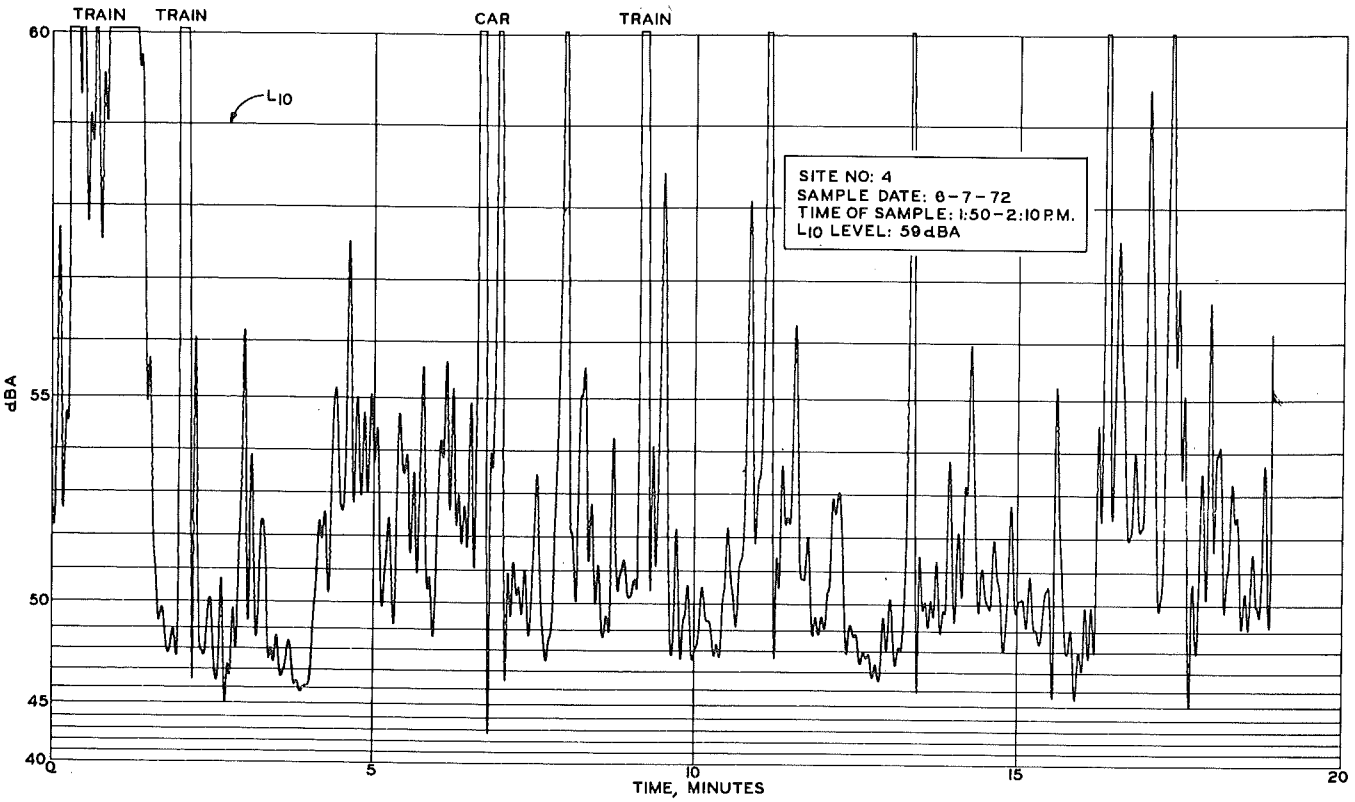
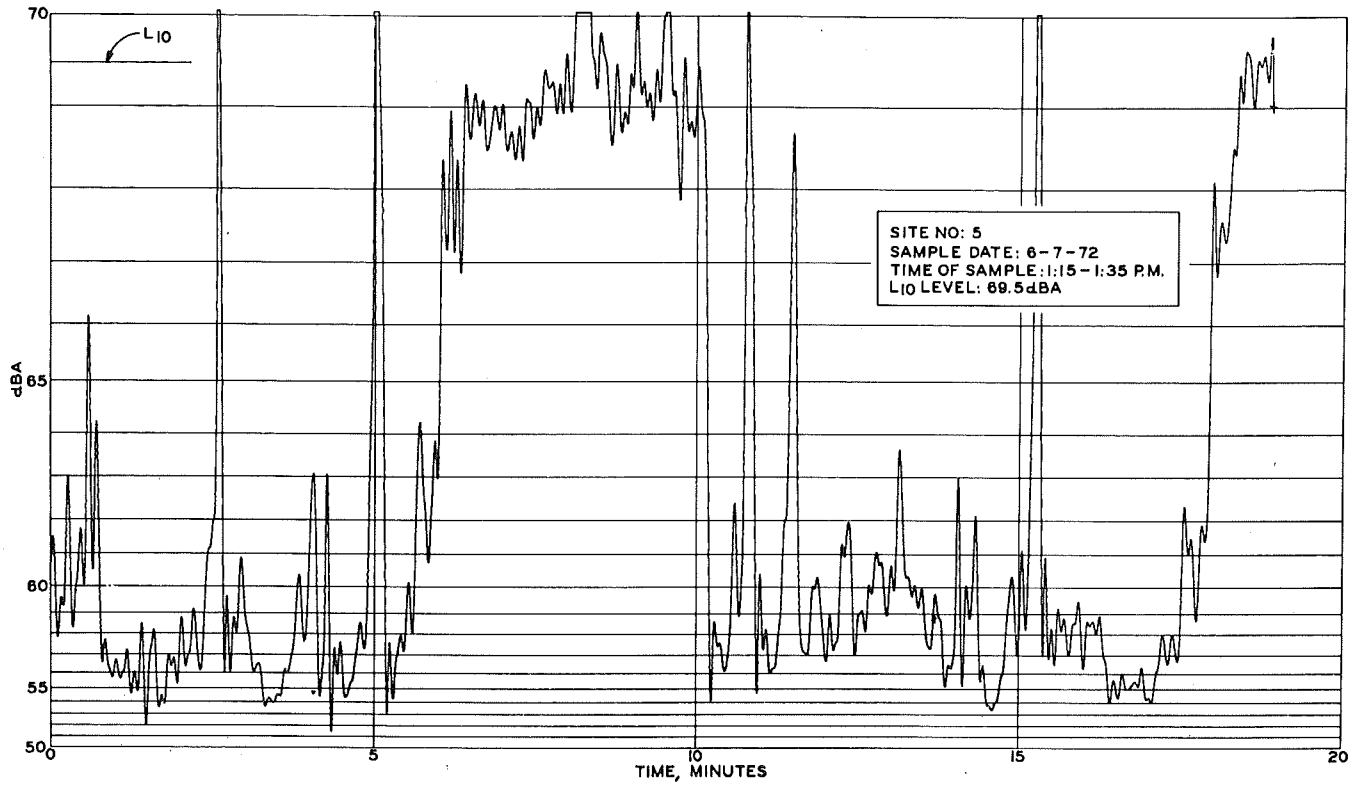


Figure 6. Microphone located 50 ft S of post office in parking lot. Observer looking NW. Sta. 400.



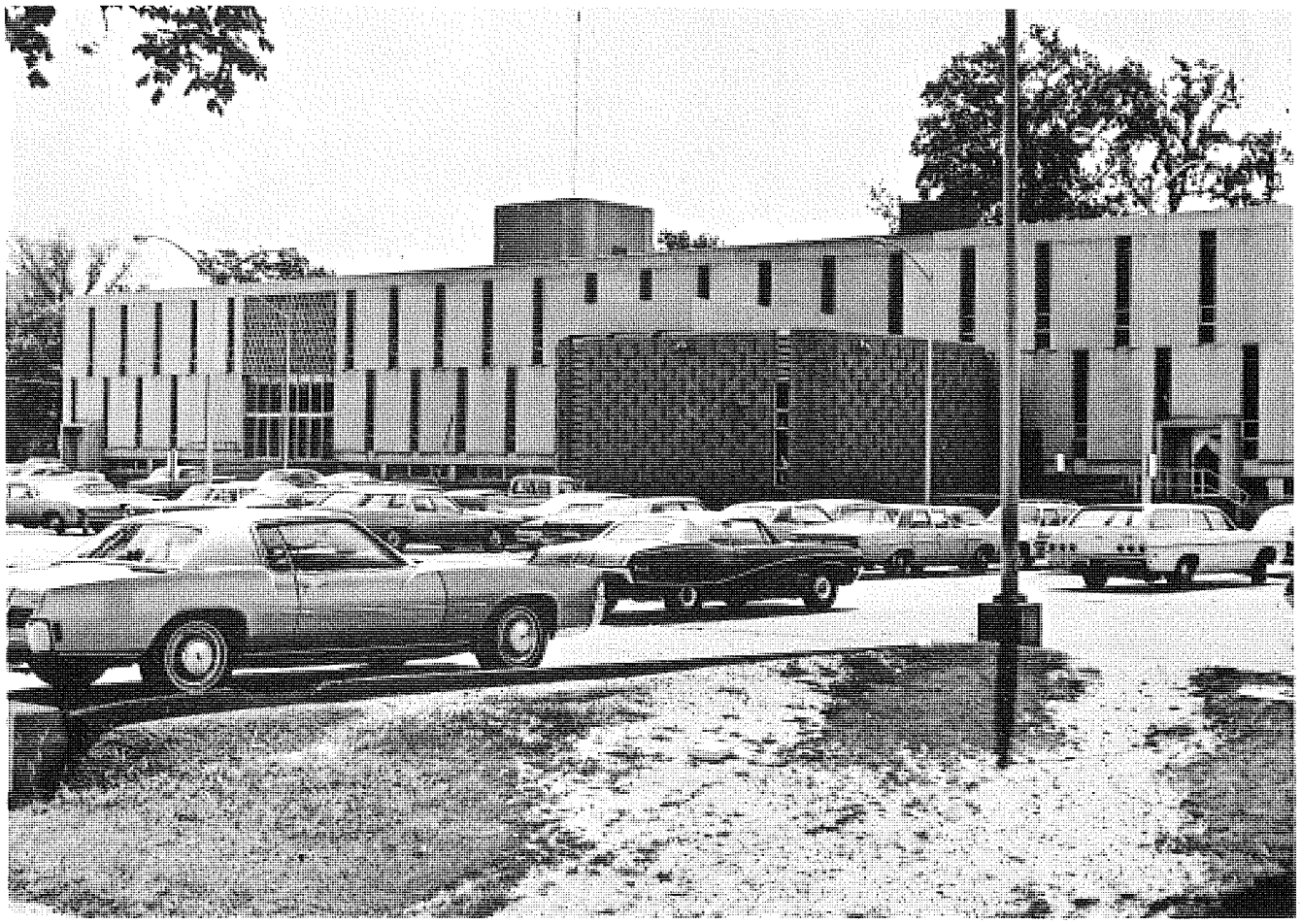


Figure 7. Microphone located on NW side of Board of Education Administration building at 50 ft in parking lot. Observer looking SE. Sta. 400+50.

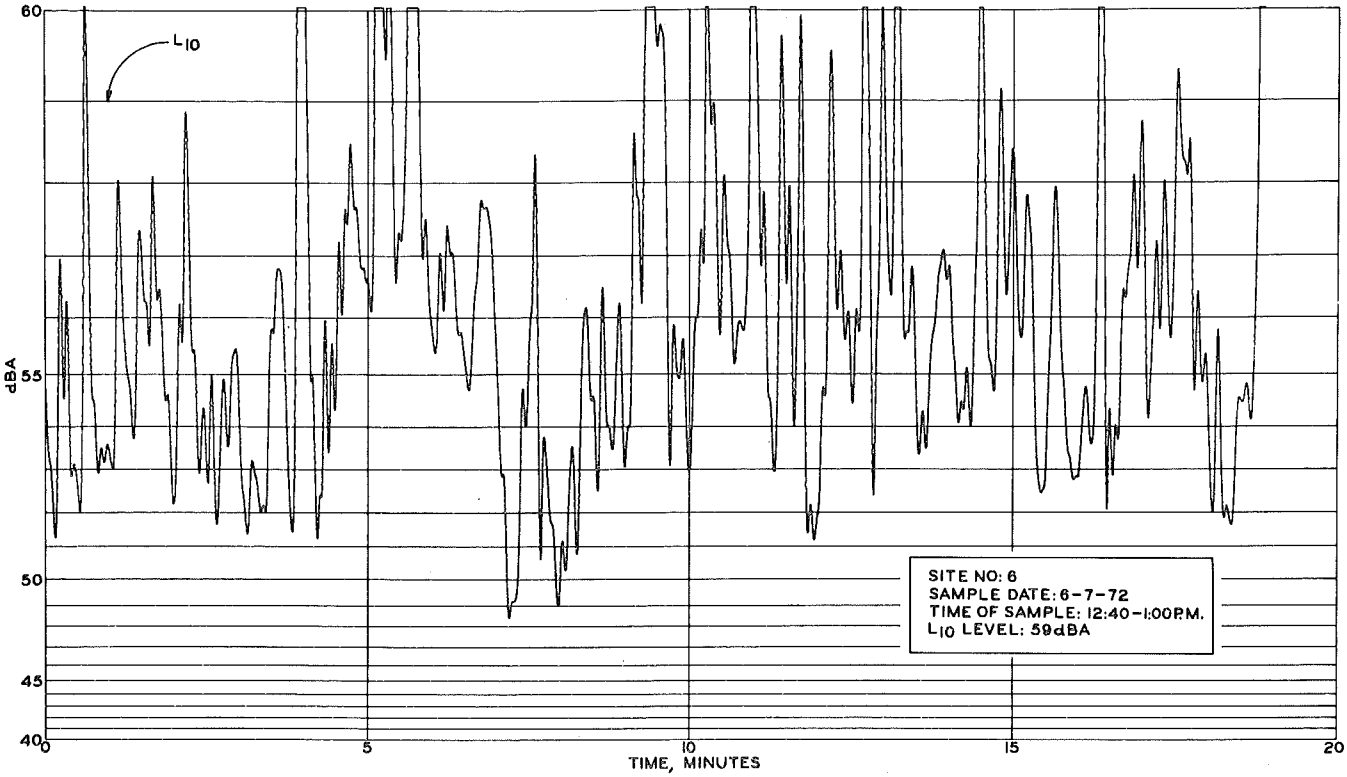


Figure 8. Microphone located on NW side of Flint Public Library at Kearsley St. Observer looking NE. Sta. 402.

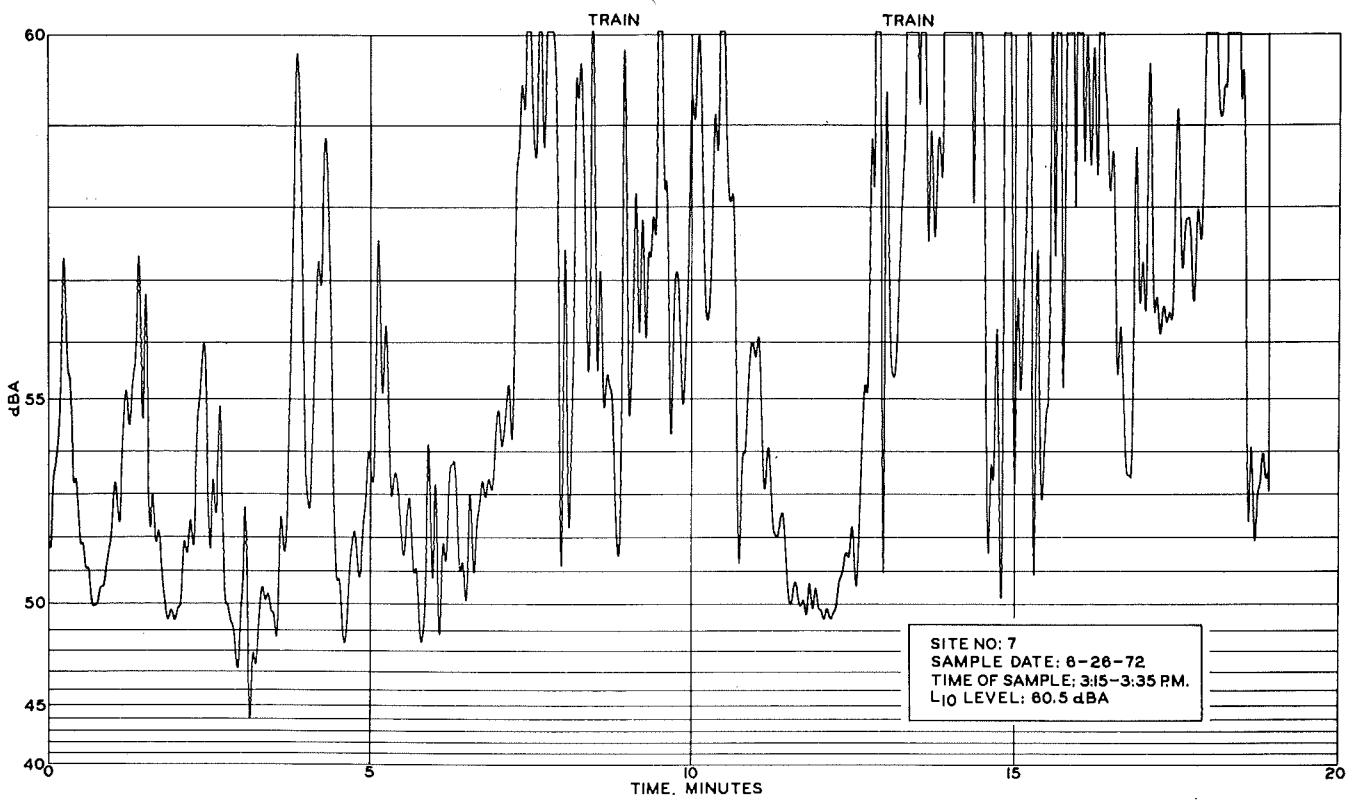
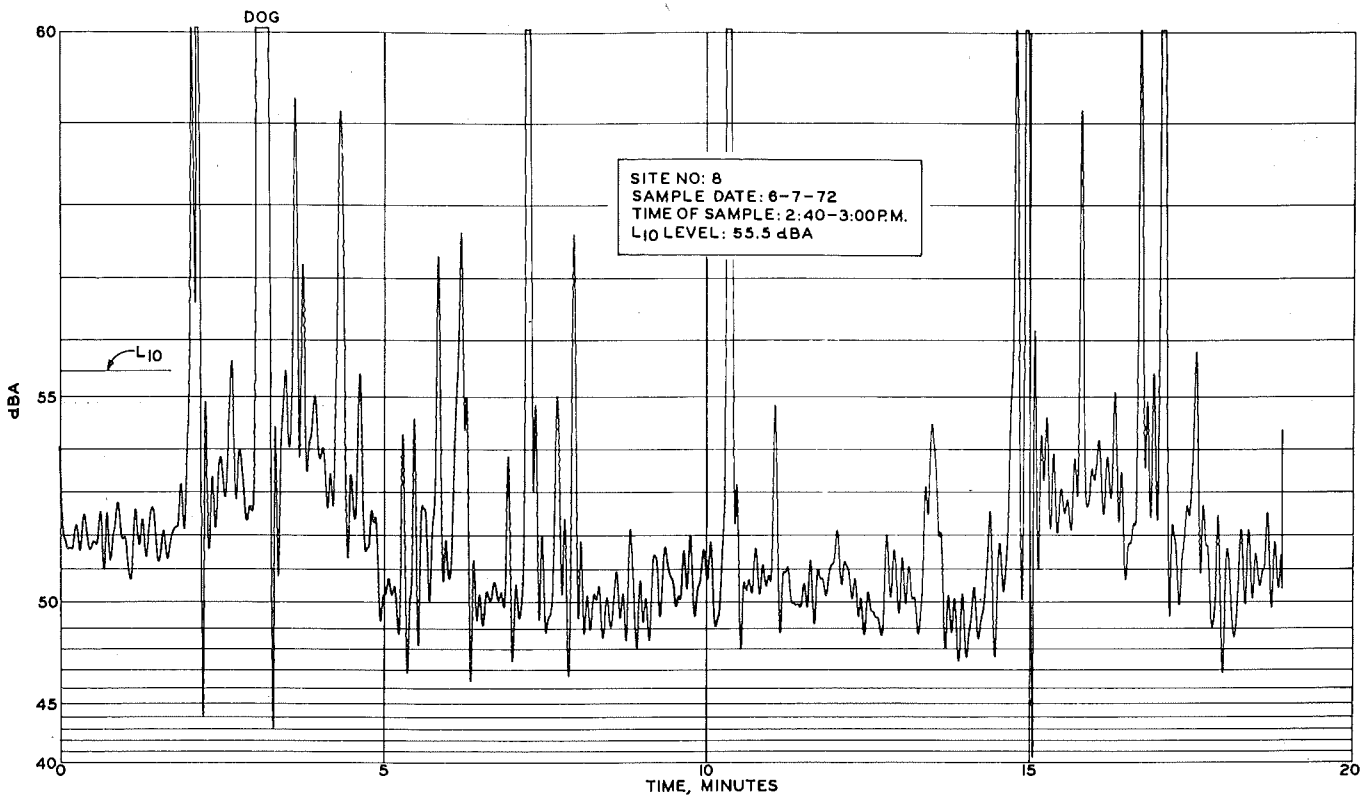


Figure 9. Microphone located on NW side of Municipal Auditorium at Manning St. Observer looking NW. Sta. 407+50.



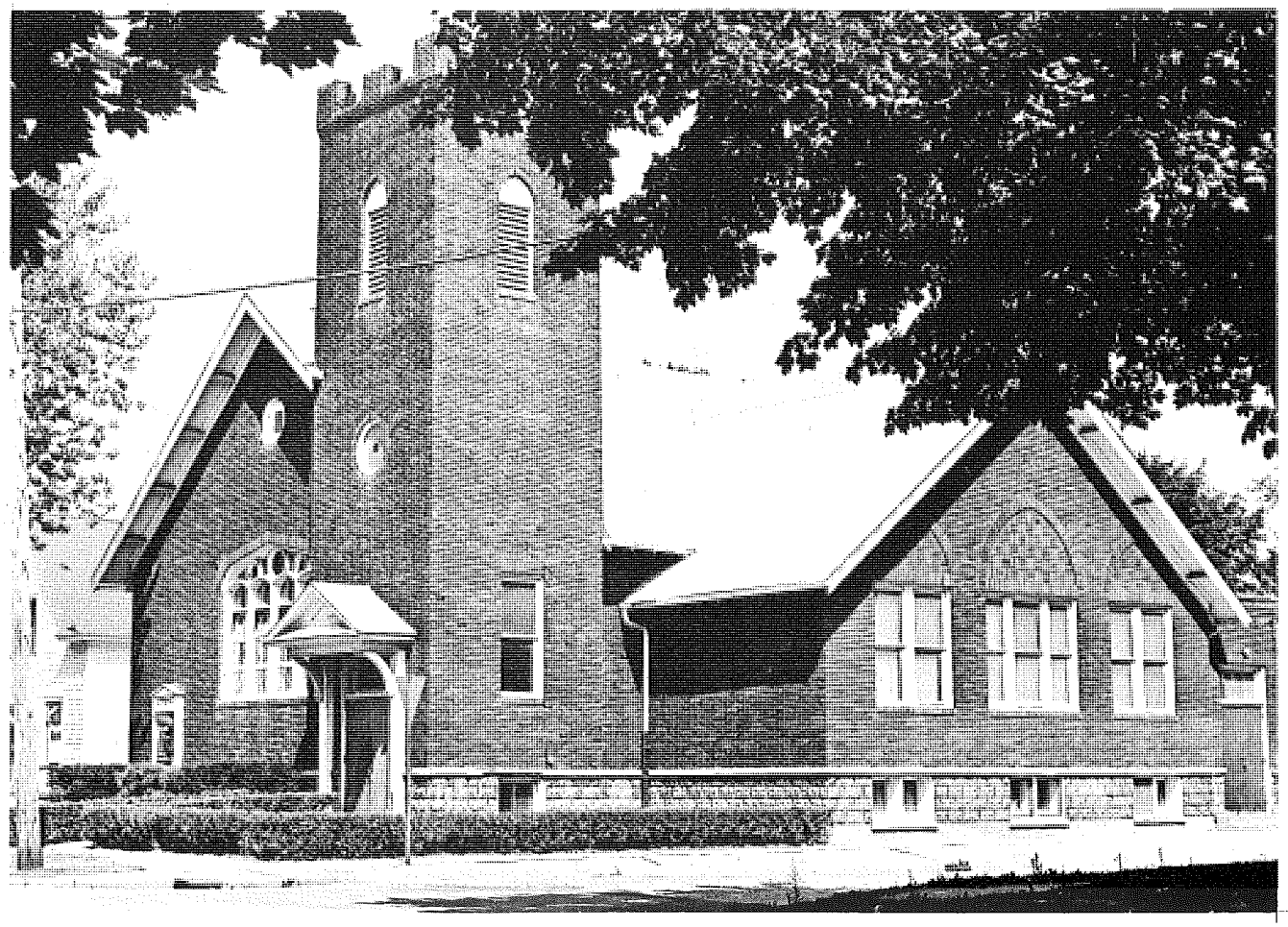
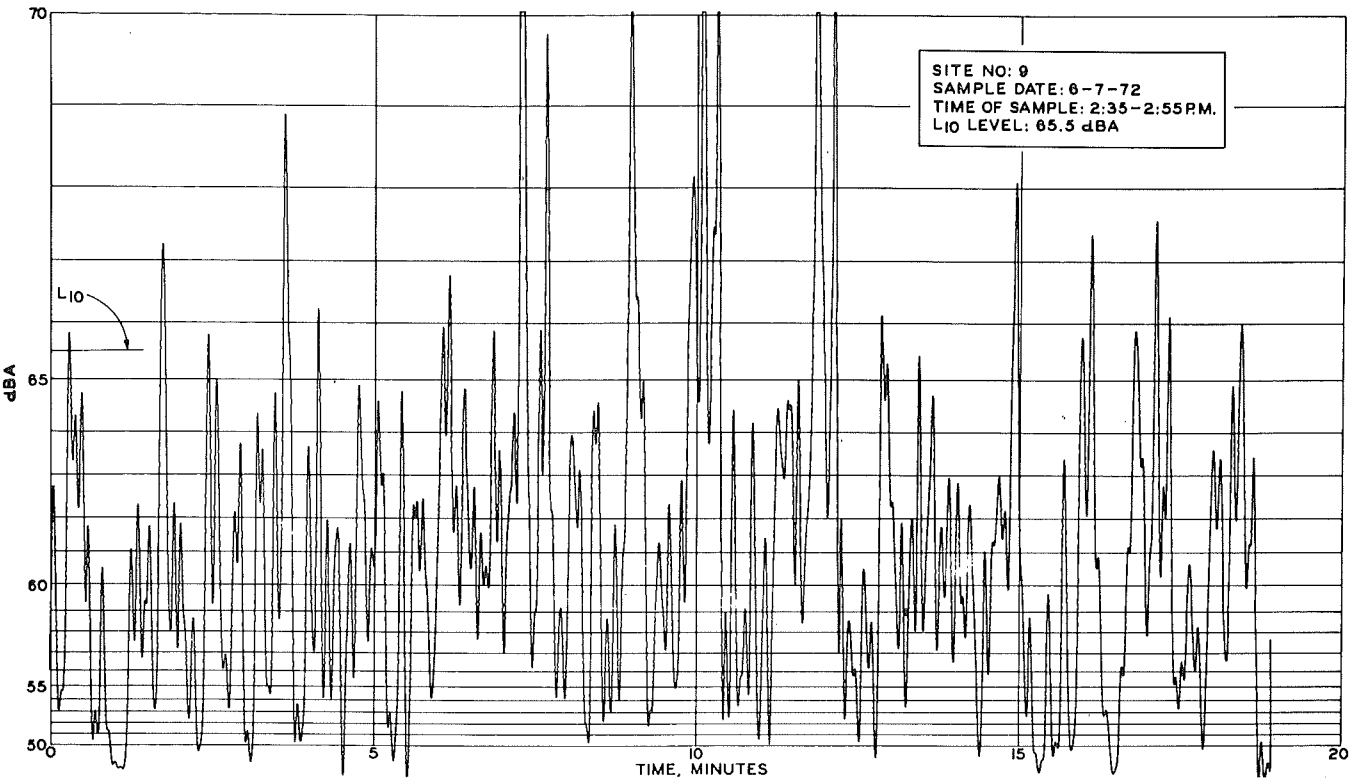


Figure 10. Microphone located 50 ft W of Roosevelt Free Methodist Church. Observer looking NW. Sta. 422.



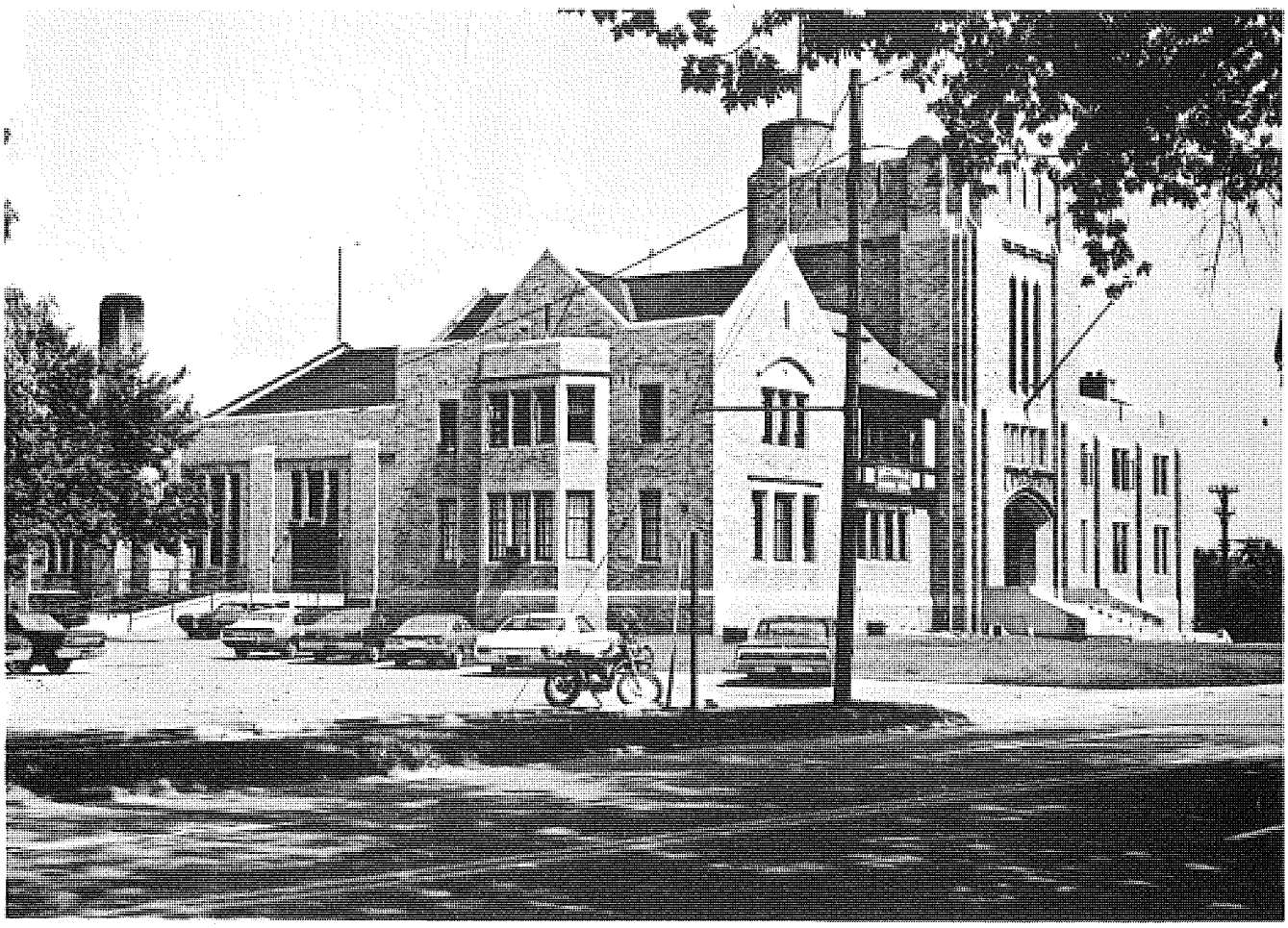
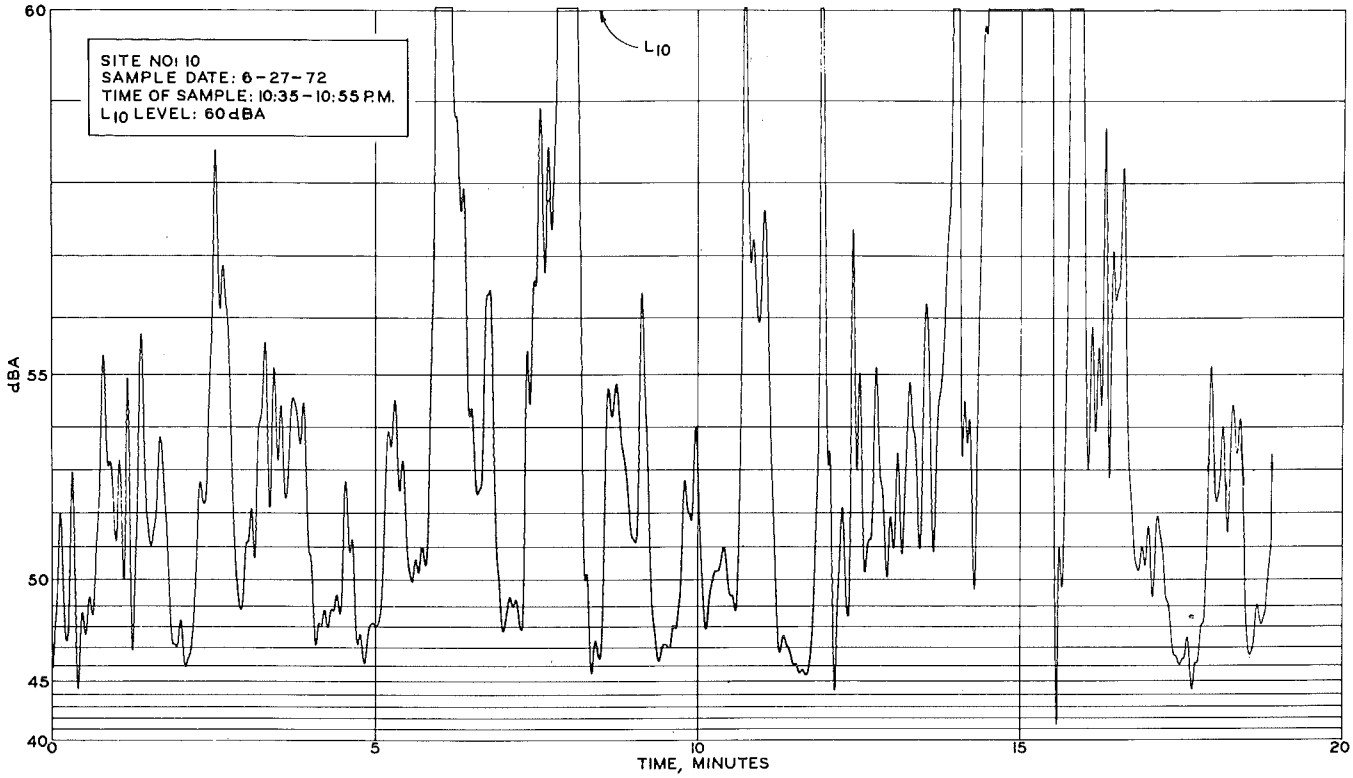


Figure 11. Microphone located 50 ft E of Michigan National Guard Armory. Observer looking NW. Sta. 439.



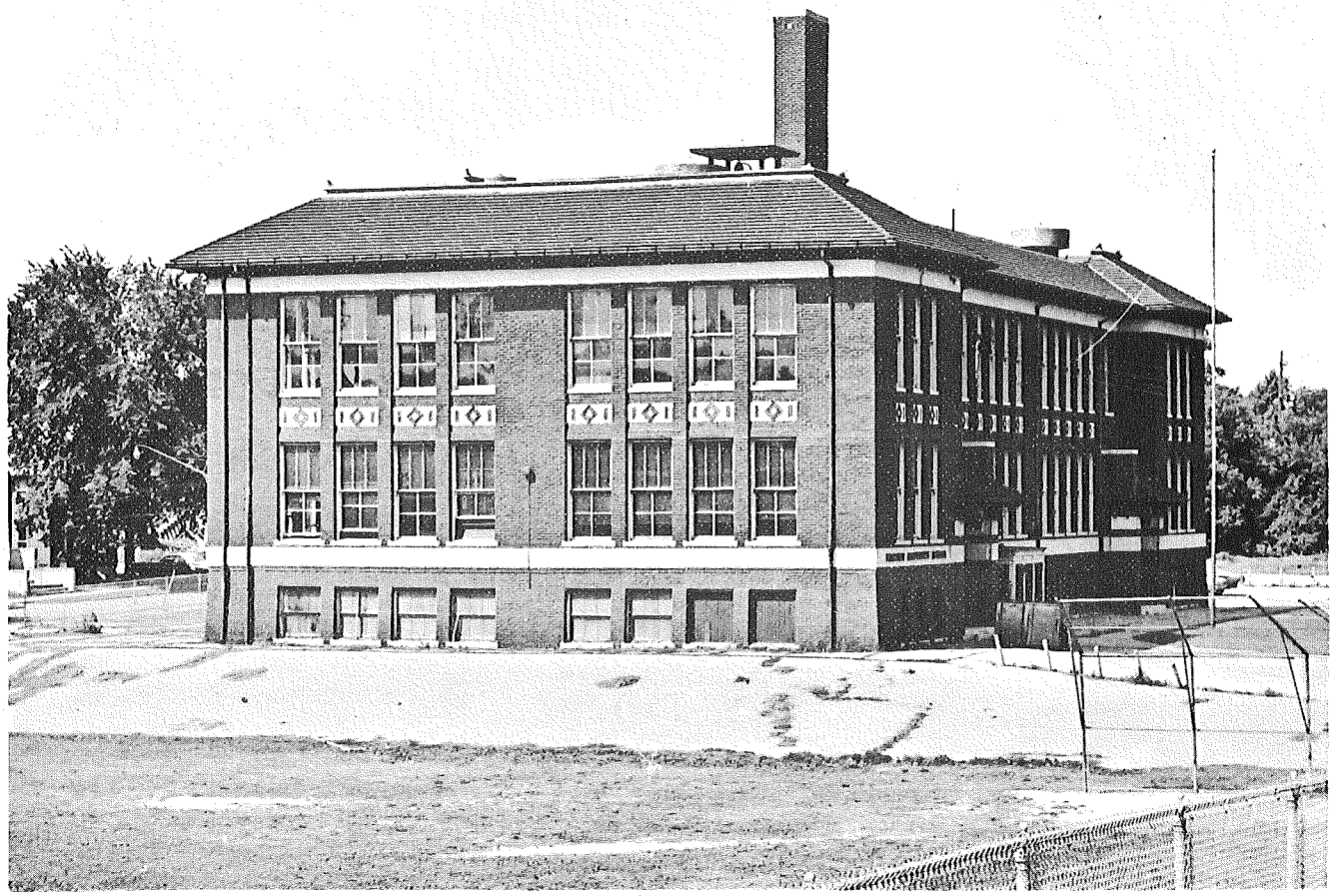


Figure 12. Microphone located 50 ft E of Drug Rehabilitation Center. Observer looking W. Sta. 475.

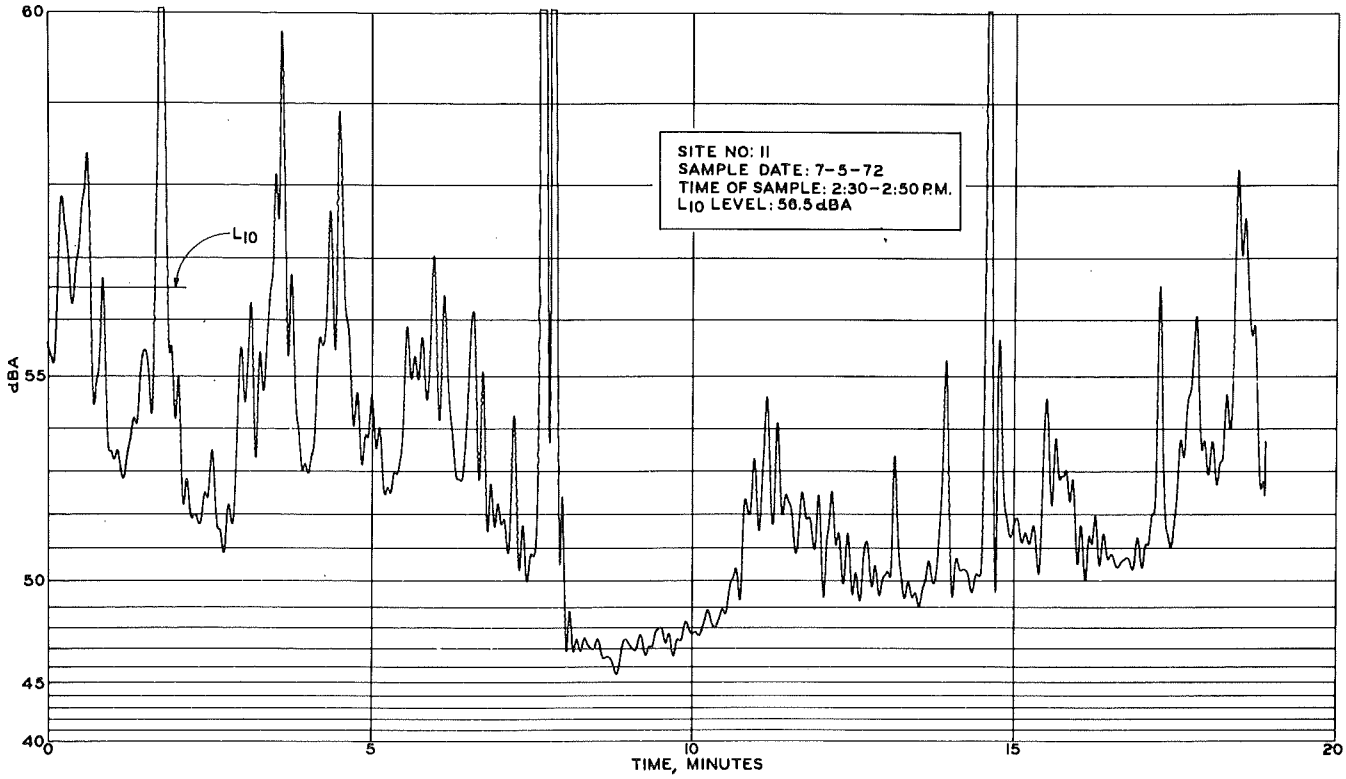
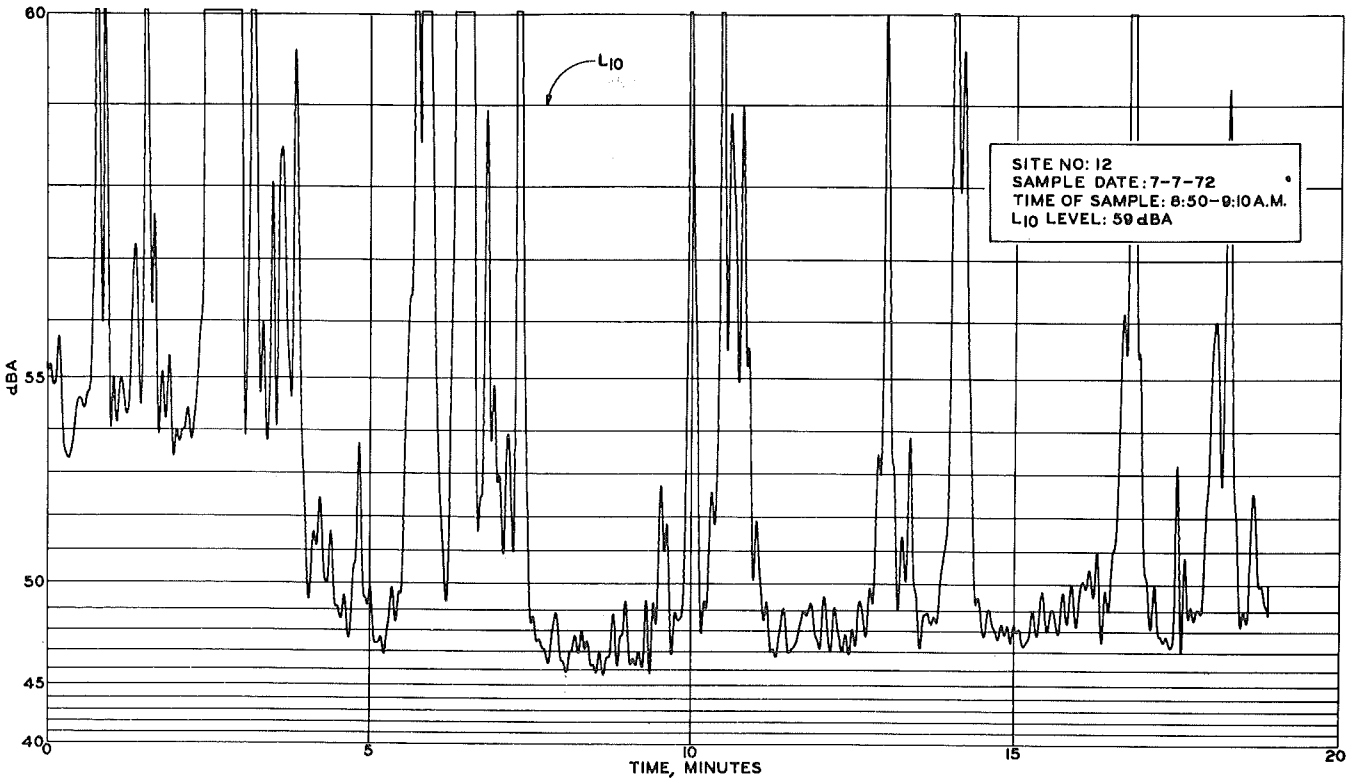


Figure 13. Microphone located 50 ft E of Zion Hill Bible Church. Observer looking NW. Sta. 500.



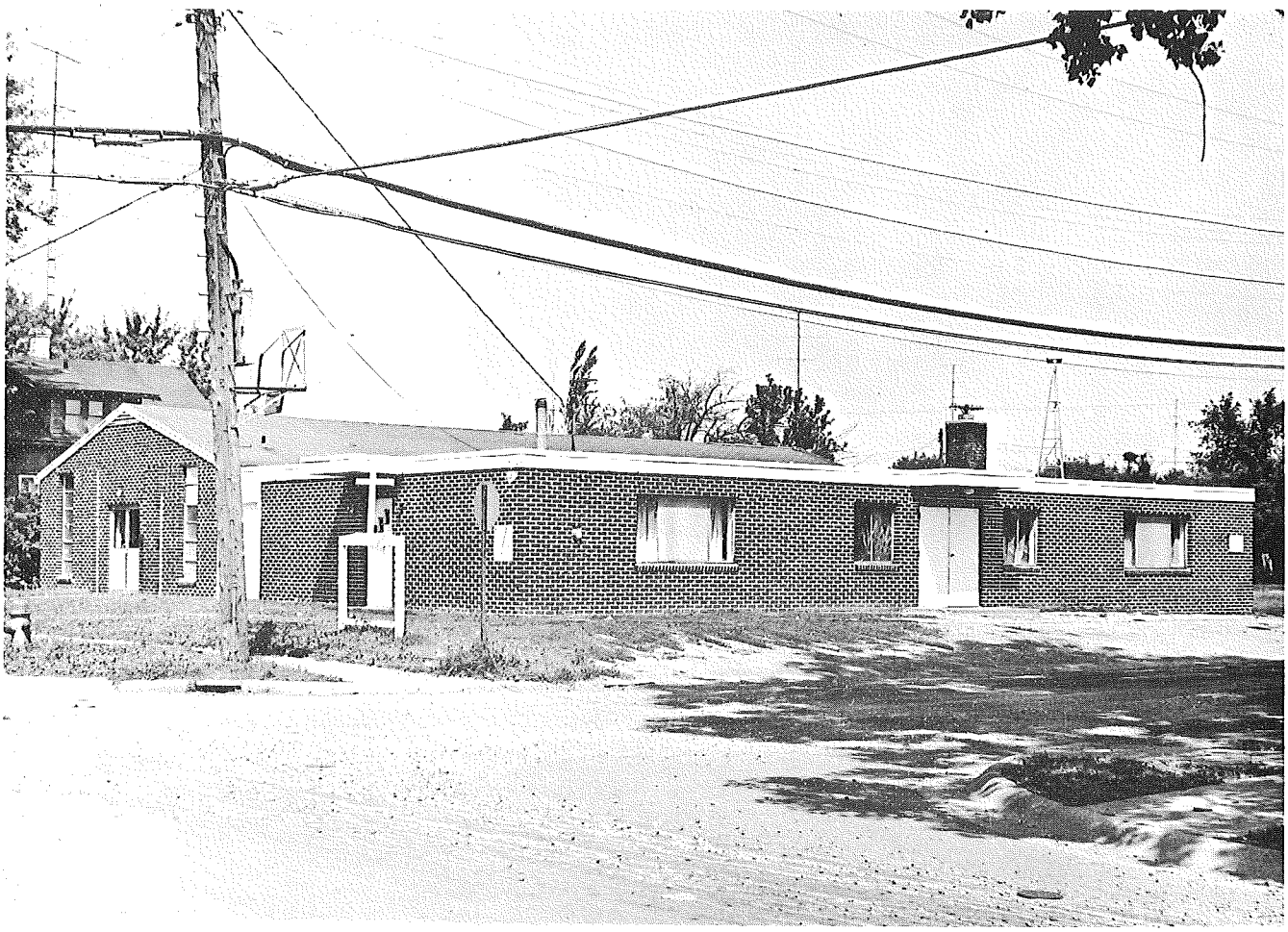


Figure 14. Microphone located 50 ft from St. Marks Mission Church at Nevada and Hewelt Sts. Observer looking NW. Sta. 517.

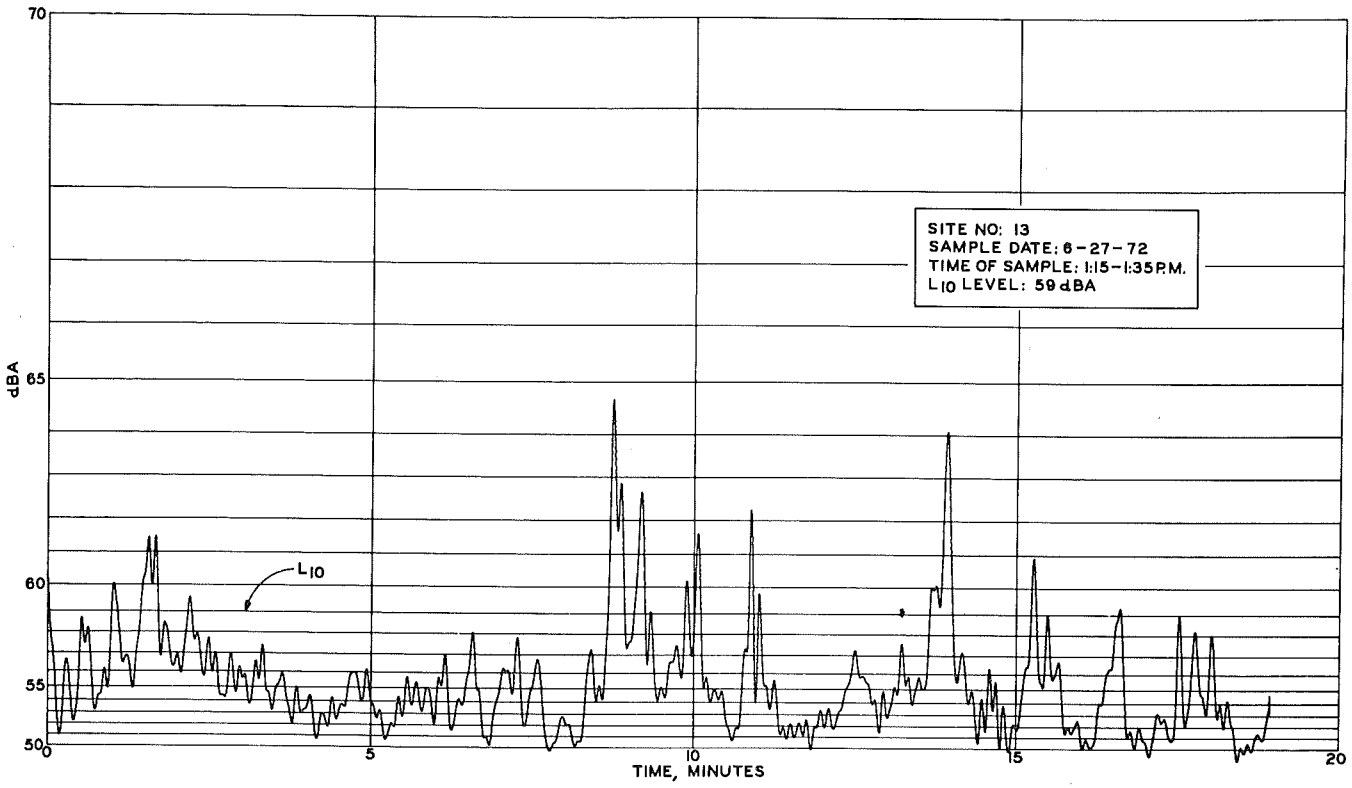


Figure 15. Microphone located in Kearsley Park. Observer looking E. Sta. 437.

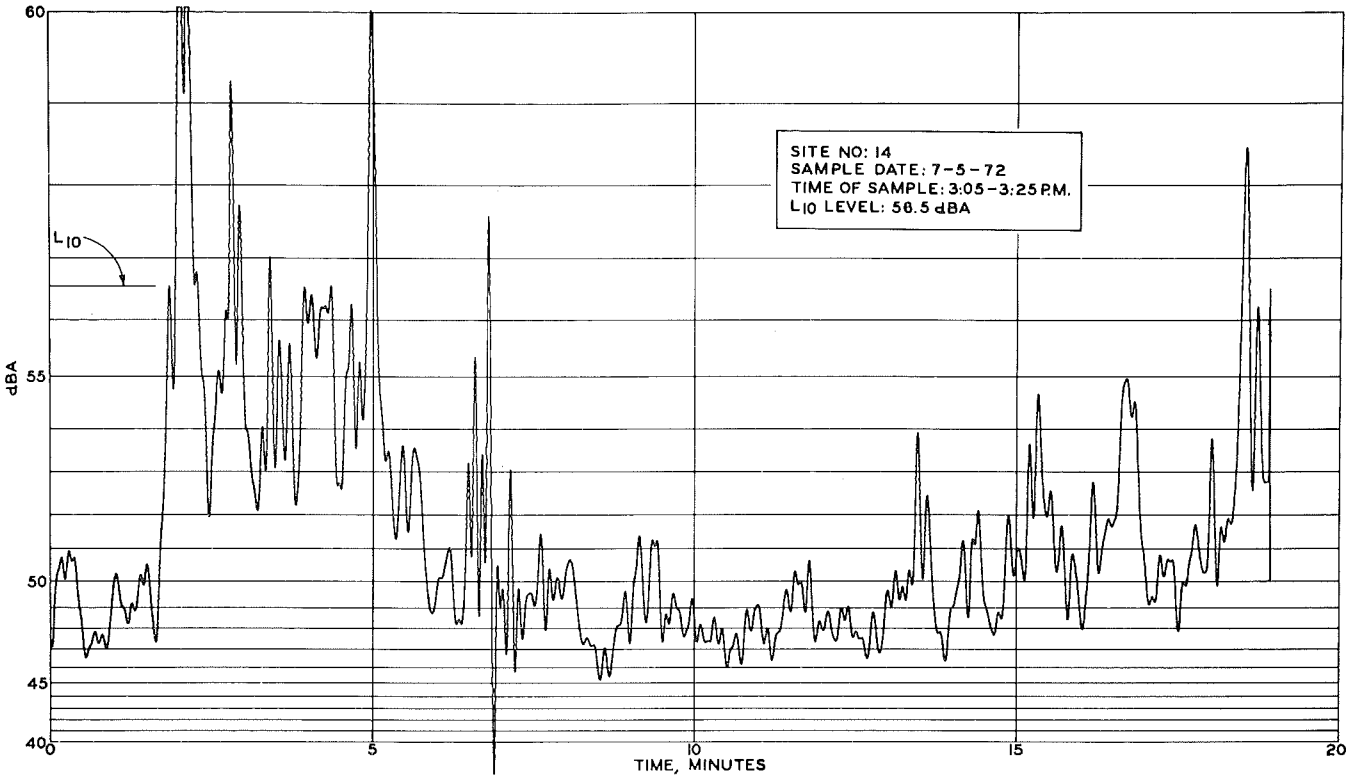


Figure 16. Microphone located 50 ft W of right-of-way in St. John Street Park. Observer looking W. Sta. 491+50.

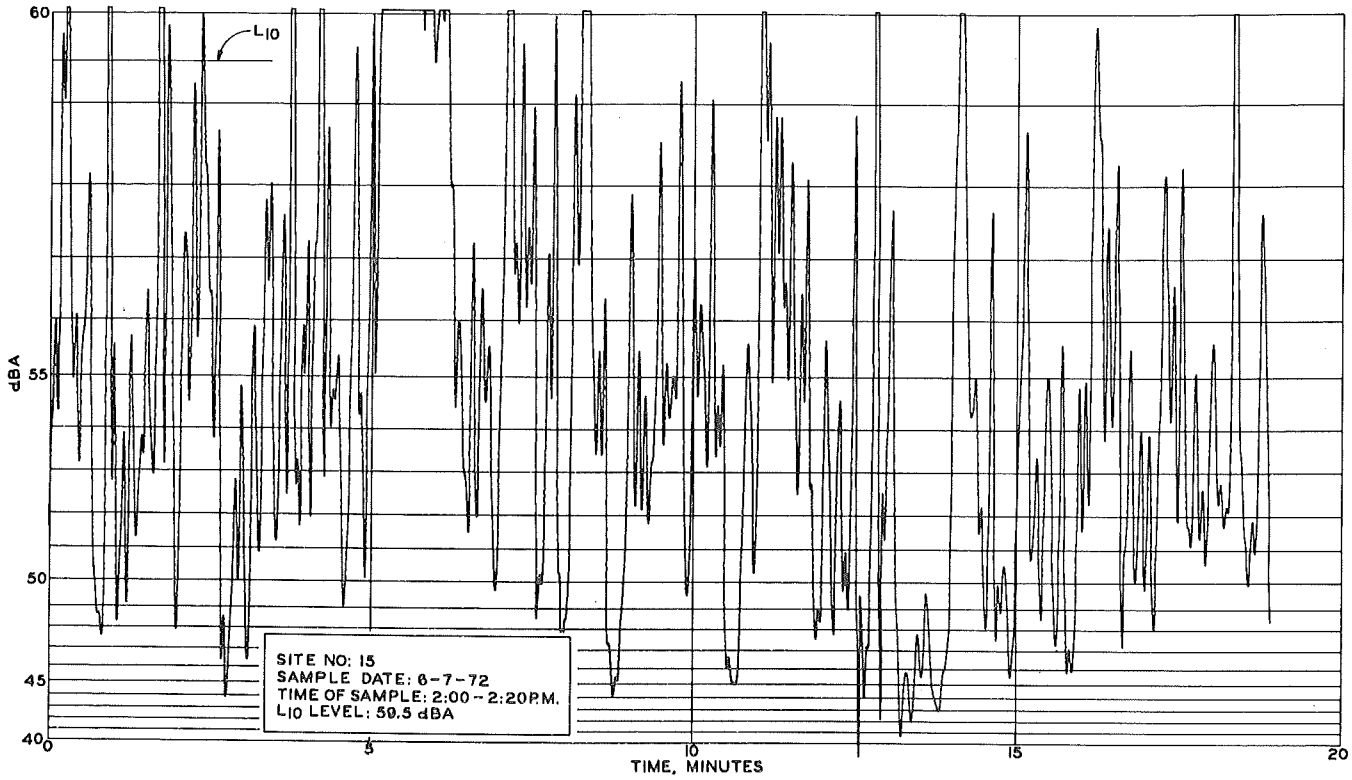


Figure 17. Microphone located at right-of-way at E side of Avondale Cemetery. Observer looking W. Sta. 427.

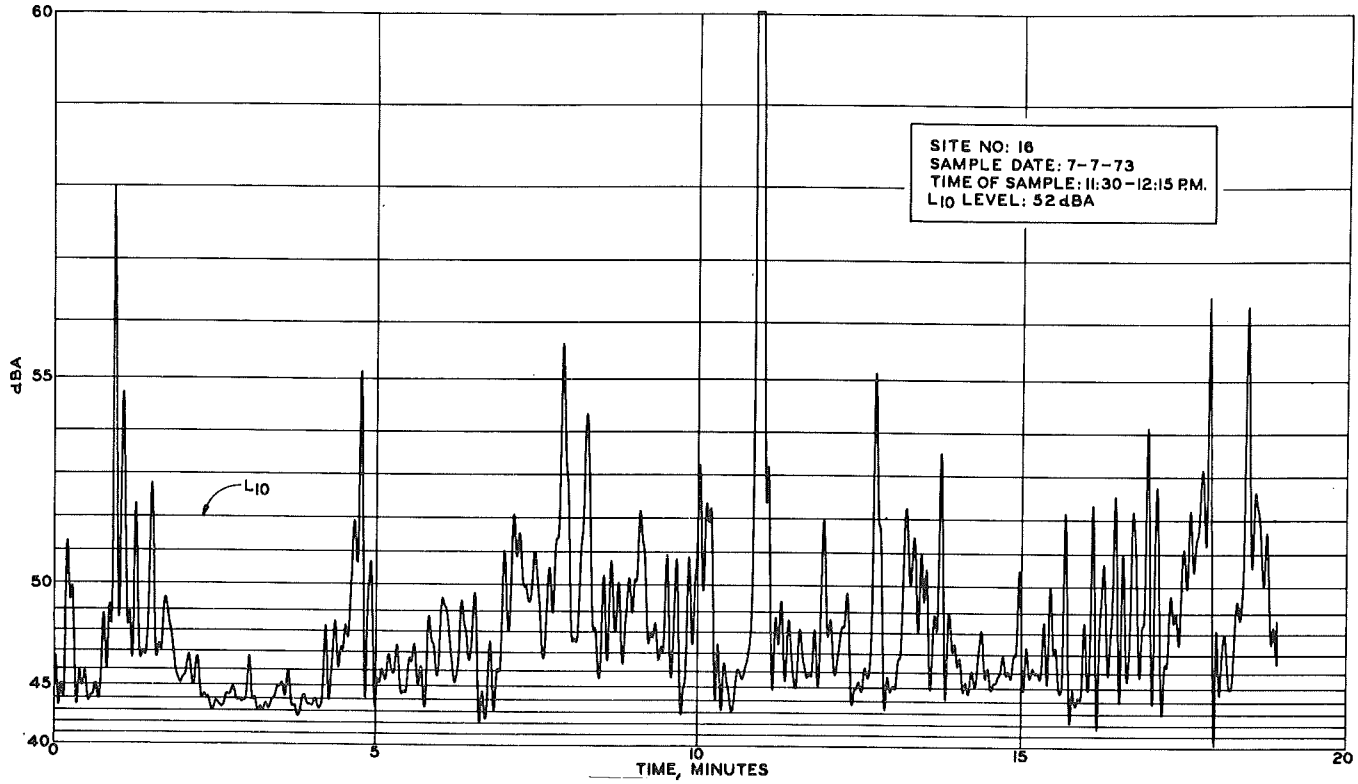


Figure 18. Microphone located on W side of Foss Avenue Baptist Church 20 ft from NW corner and 10 ft from wall. Observer looking NE. Sta. 591+50.

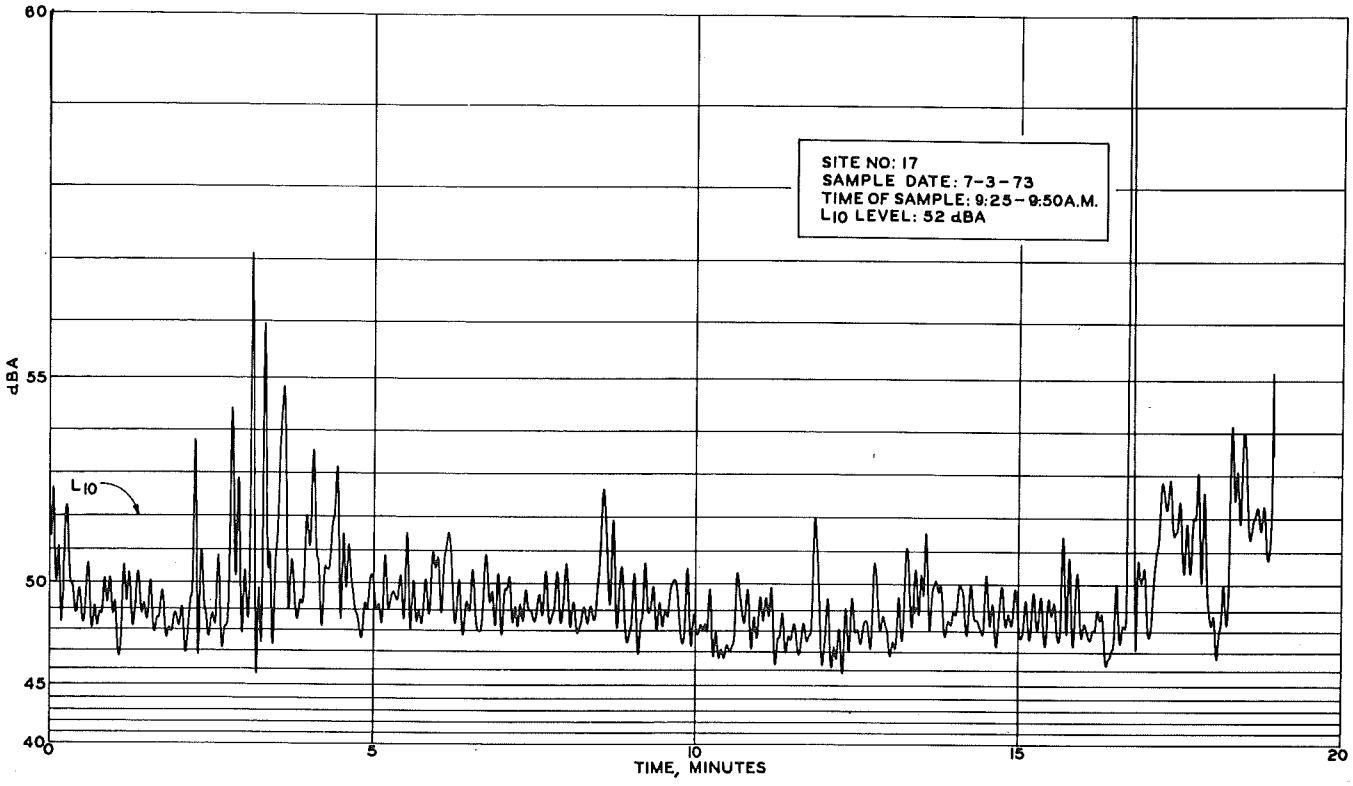


Figure 19. Microphone located 75 ft N of NE corner of gymnasium of Joseph G. Messer Elementary School. Observer looking NW. Sta. 630.

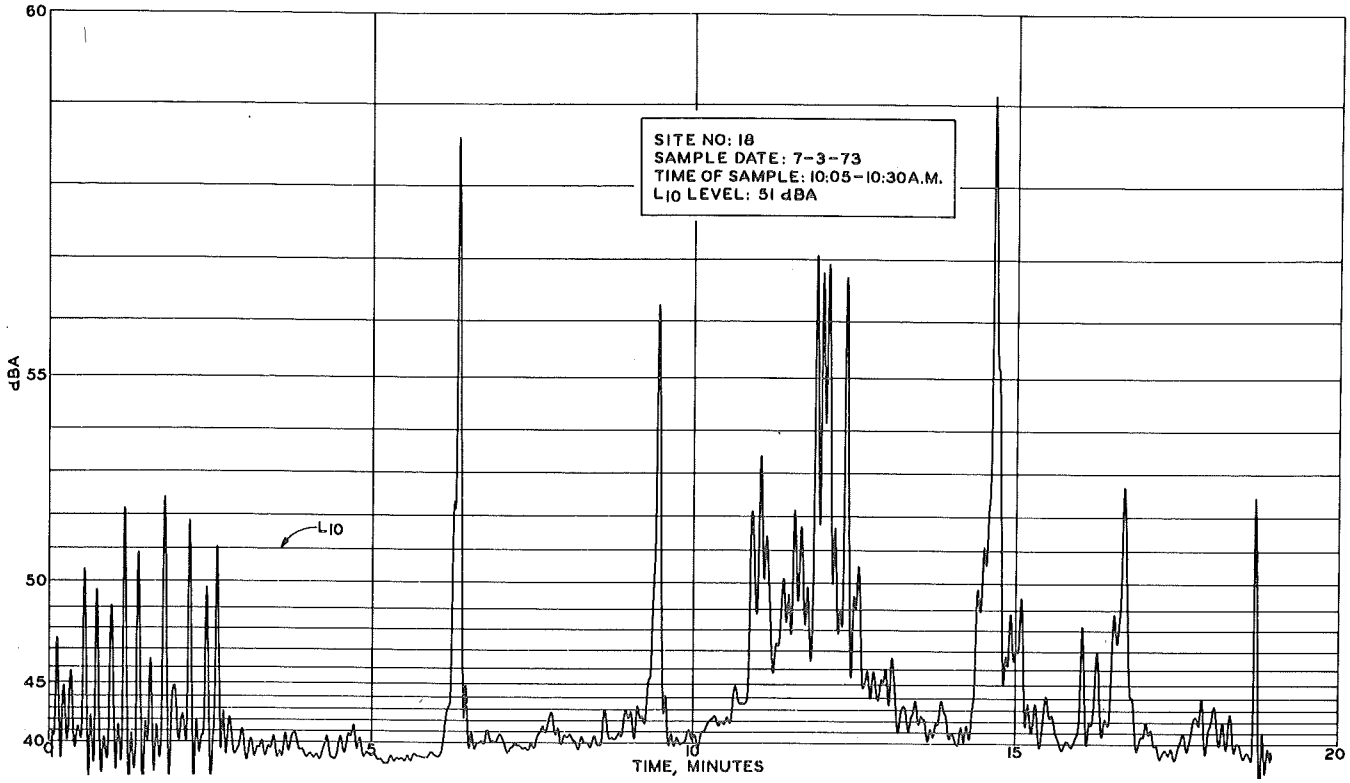


Figure 20. Microphone located 20 ft N of SE corner 6 ft from E wall of Emmanuel Temple Apostolic Church. Observer looking NW. Sta. 632.

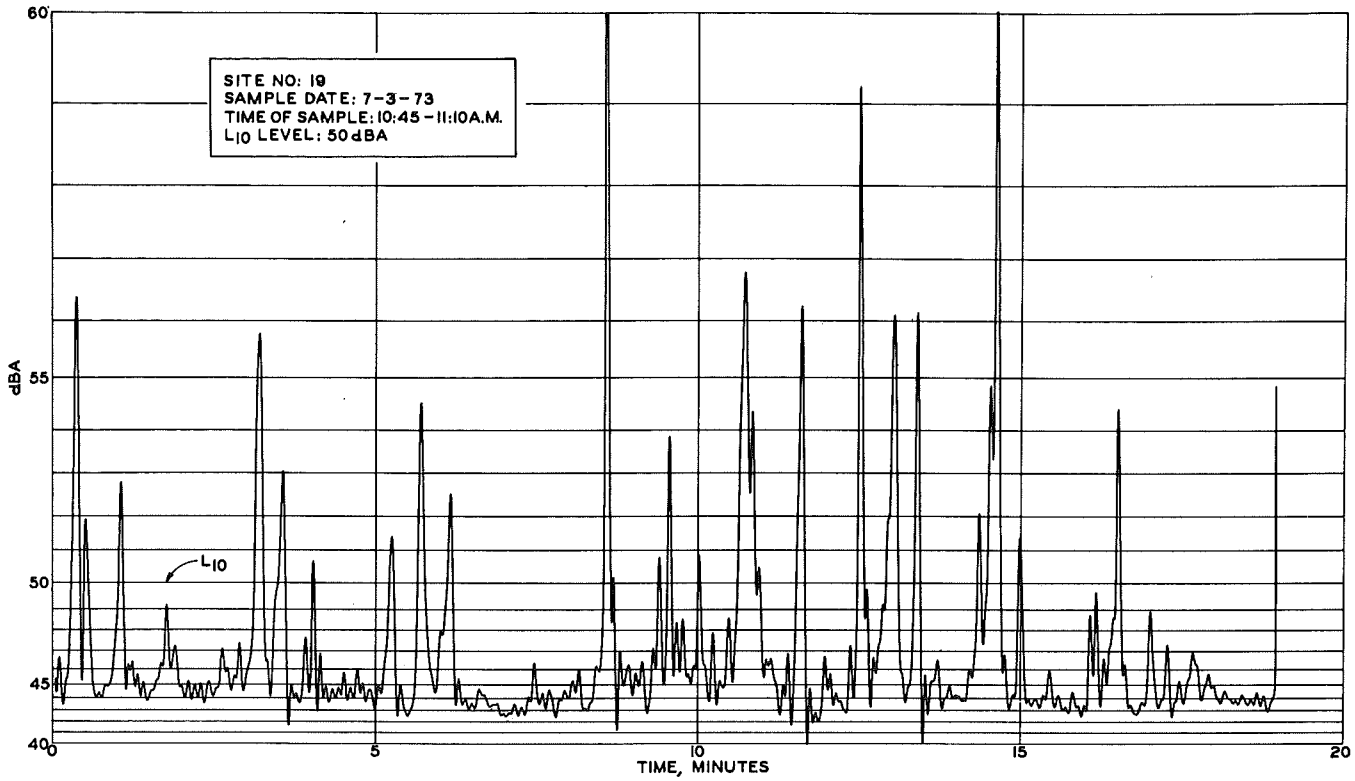
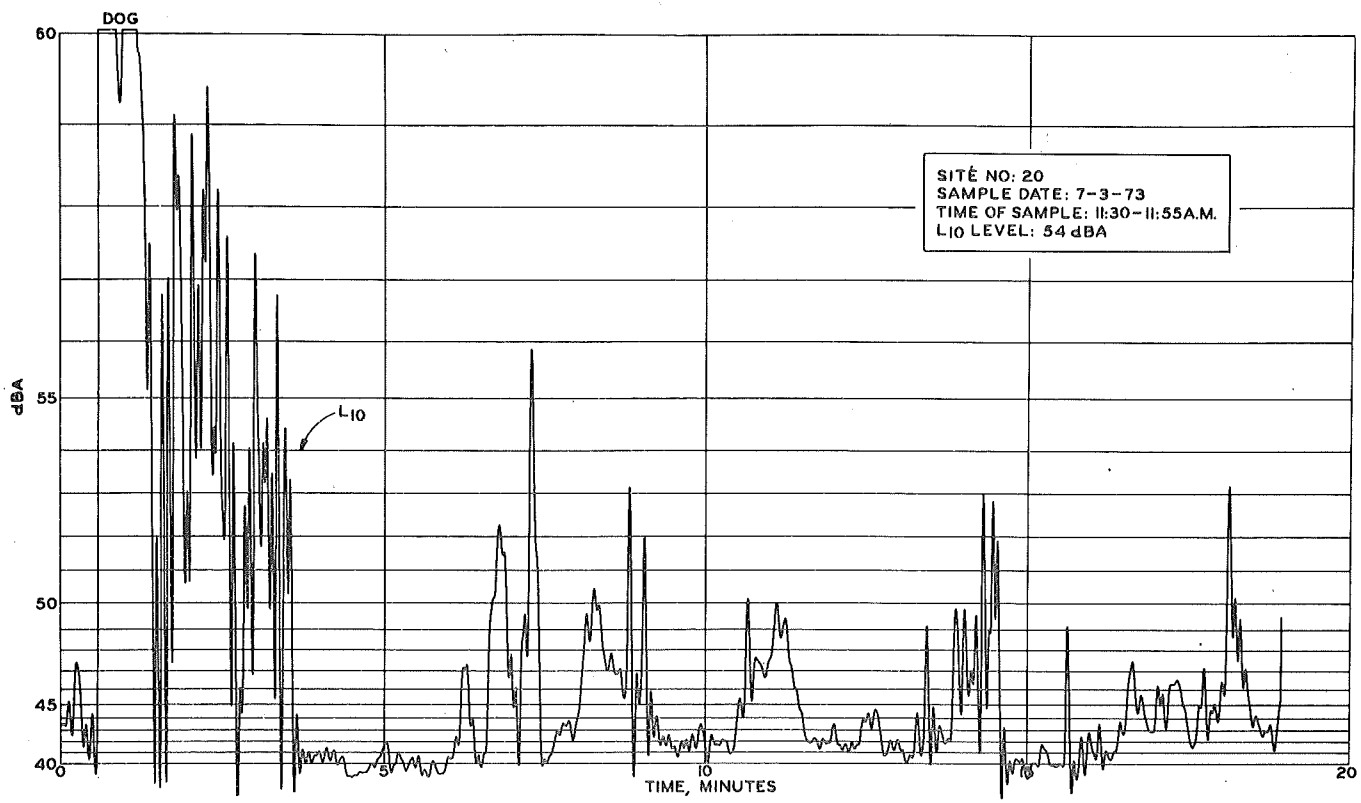


Figure 21. Microphone located 100 ft from W side of Marion Harrow Elementary School. Observer looking NE. Sta. 653.



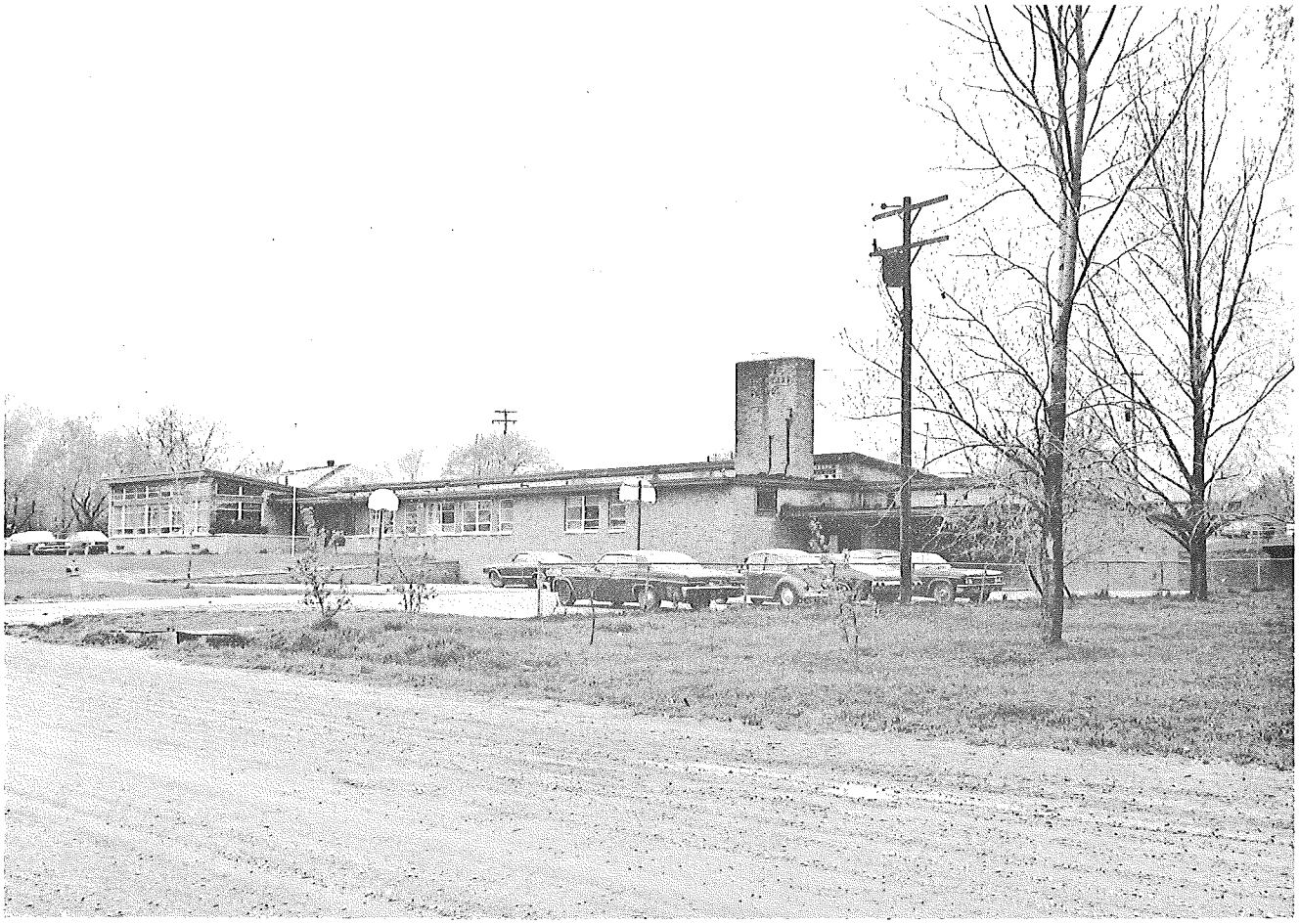


Figure 22. Microphone located 10 ft from E side of Kurtz Elementary School. Observer looking NW. Sta. 654.

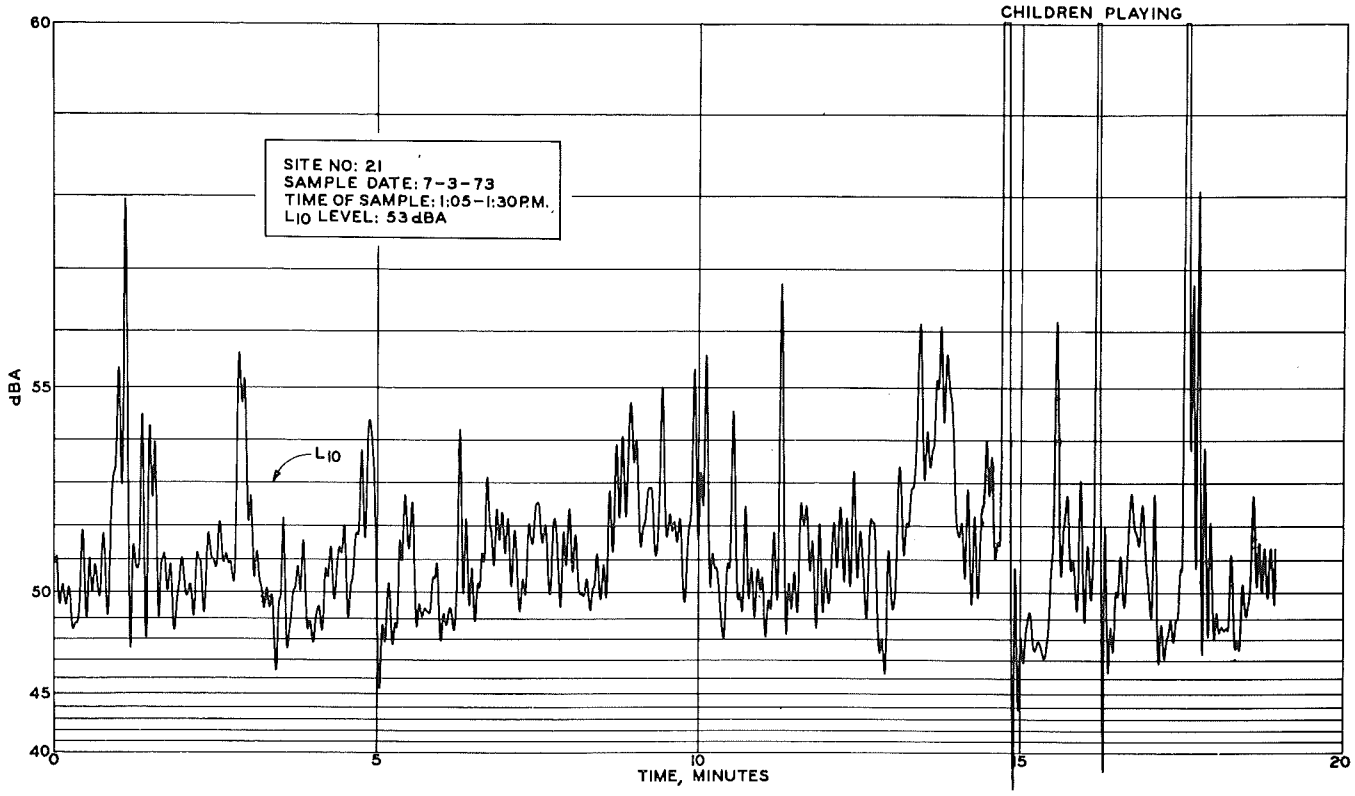


Figure 23. Microphone located 15 ft from W part of Buick Community School. Observer looking E. Sta. 688.