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State of California
Department of Public Works
Division of Highways

Materials and Research Department

M E M O R A N D U M

September 15, 1953

TO: F. N. Hveem

FROM: J. E. Barton

SUBJECT: District VII Sound Level Studies

Reference is made to the sound level studies conducted at several locations in District VII in response to a request by Headquarters Right of Way Department in a letter of April 3, 1953 signed by Mr. Hess. The arrangements for this study have been covered in various memorandums from Mr. Rudolph Hess and this office and also by discussion with Mr. R. O. Harding and Mr. E. T. Telford of District VII.

The general objective of this study was to make a quick determination of the relative difference in sound levels produced by highway vehicles operating on three types of highway cross section, i.e., on cut sections, elevated fills and where the road is level with the adjacent terrain.

The data are limited but seem to indicate that if the same source of noise were placed in the outer lane of a highway on a ground level section, medium fill, or a medium cut then the following general relationship of noise levels would exist considering the noise levels of the flat terrain as a base or datum. The actual values in decibels are included in Table II of the addendum.

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The locations observed were on the Hollywood and Santa Ana Freeways, plus a location on the Arroyo Seco and also on Foothill Boulevard. The exact locations are shown in the addendum.

After a brief discussion of the location sequence and type of traffic count the group proceeded to Location No. 1 which was near Universal International Studios on the Hollywood Freeway. Mr. Carey of Universal assigned Mr. F. W. Moran to the study and he met the group at this first location. His equipment consisted of one General Radio Sound Meter.

Locations 1, 2 and 3 were completed on this first day but it was agreed upon by the group that in addition to meter readings, tape recordings would be desirable. Mr. Moran, therefore, furnished the necessary equipment for taking tape recordings. This was a Magnecord Tape Recorder.

The next day Location No. 2 was repeated to procure recordings. In addition, all locations from No. 4 through 14, both sound level meter readings and tape recordings were taken on each test run plus 3 minutes of general traffic noise at each location.

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technically, bels and decibels are used as units for the logarithmic expression of ratios of power, voltage, or current in wire or radio communication.

One point that is important to know in analyzing sound level readings is that decibel quantities cannot be added directly. For example, a noise level of 80 decibels combined with another noise level of 80 decibels yields 83 decibels and not 160 decibels. This increase varies from 3 decibels when the two sounds are made simultaneously and are equal down to 0 when there is a difference between the two simultaneous sounds of 15 or more decibels. Of course the higher decibel predominates.

References to sound level studies that are recommended for a more complete coverage of the terminology and method of noise level studies are:

"Handbook of Noise Measurement" by Peterson and Beranek (General Radio Company)

"Truck Noise Measurement" by Andrews and Finch, University of California

Page 456, 1952 Proceedings of Highway Research Board

SUMMARY

This survey must be considered only as a preliminary study with the conclusions subject to change and further refinement. This is due to the small number of runs and the relatively short period of time covered at each location.

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This preliminary study has amplified the need for the following data before sufficient knowledge will be on hand to answer all pertinent questions pertaining to highway traffic noise:

1. A large number of readings should be made of each class of vehicle and the normal sound level determined for each class of vehicle. This work should be done in order to find the percentages of each class of vehicle that are producing the extremely high sound levels.

2. A large number of readings at various types of locations are necessary to determine the effect of grade, acceleration, deceleration, etc., on sound levels produced by these various classes of vehicles.

3. Frequency analysis is necessary to determine the intensity of the various frequency components. This is necessary in the study of annoyance properties. Such a study should probably also include a "jury" analysis.

4. To determine the differences in various locations it may be necessary to create a uniform sound source for use in all locations.

Attached are the following:

1. List of Locations
2. Summary Tables
3. Cross Sections and Photographs of the Locations

James E. Barton HP

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HP:egc

att

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TABLE I

SOUND LEVEL STUDY LOCATION LISTING

HOLLYWOOD FREEWAY

Location No. 1	.1 mile east of Lankershim Blvd. (Eastbound side, slight fill)
Location No. 2	.3 mile west of Barham Blvd. (Eastbound side, level)
Location No. 3	.1 mile west of Barham Blvd. (Eastbound side, slight cut)
Location No. 4	Wonder View Bridge (above East and West bound lanes)
Location No. 6	City Park, .1 mile east of Glendale Blvd. (Eastbound side, high fill)

SANTA ANA FREEWAY

Location No. 5	350 ft. west of Marrieta St. Underpass (Westbound side, cut)
Location No. 7	Centerline of Dacotah Street (Westbound side, fill)
Location No. 8	Centerline of Spence Street (Eastbound side, cut)
Location No. 9	Washington and Telegraph Streets (Intersection, level)

ARROYO SECO

Location No. 11	Ave. 43, 150' north of Mosher Avenue Overpass (Northbound side, cut)

FOOTHILL BOULEVARD

Location No. 14	Verdugo and Foothill Blvd. (Intersection, level)

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The following findings are indicated by the accompanying data:

1. In comparing a cut, fill, and level highway cross-section it is indicated from the data that as the distance away from the sound source is increased the sound level from a cut decreases more rapidly than does the sound level from either a fill or level section.

The readings taken at the 150 and 300 foot stations at locations 2, 7 and 8 indicate that the sound level from a cut is less, at these distances, than is the sound level from either a fill or level terrain. However, the 50 foot reading which occurred approximately at the right of way boundary was generally higher from the cut location than it was from either the fill or level terrain section.

The sound levels from the fill and level sections seem to behave very nearly the same at all distances. However, there is some indication that at the 50 foot station the sound level is slightly lower for a fill than for the level section.

2. On only level terrain did the sound level decrease in obedience of physical laws as the distance away from the sound source increased. Except that, probably because of imperfect terrain, the readings did not always vary truly as the inverse square.

3. As shown in the case of Location No. 9 (Table III) the sound level at this busy intersection with starting and stopping is only slightly higher than that of free rolling traffic through this same intersection.

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The following procedure was followed at each location.

The desired distances away from the center of the nearest outer traffic lane were measured and staked. In this case the distances were 50, 150 and 300 feet. Because of physical restrictions it was not always possible to obtain the 300-foot reading.

The microphones for both the Magnecord Tape Recorder and the standard A. S. A. Sound Level Meter were set up side by side at a height above the ground of 5 feet at each desired distance. The recording microphone was a cardioid unidirectional type.

As only one meter was used the readings were all taken on the C or "flat" scale. A recording of each test run was made and the sound level reading recorded plus 3 minutes of general traffic at each distance. Recordings were taken at all locations except No's 1 and 3.

The sound department of Universal Internation Studios made the recordings and copied the originals in order that this department might have copies of the tapes for any future study.

As a pre-summary discussion it is important that the reader have an understanding of the decibel. As defined in Webster's Dictionary, the decibel is the usual unit for measuring the relative loudness of sounds, being approximately the smallest degree of difference of loudness ordinarily detectable by the human ear, the range of which includes about 130 decibels. Ordinary speech is about 60 decibels greater than sounds that are just at the level of audibility. More

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RELATIVE NOISE LEVEL TABLE

Highway Section	Distance at Right Angles From Centerline of Outer Lane		
	50'	150'	300'
Flat	Base 50	Base 150	Base 300
Fill (20' ±)	Less than Base 50	Same as Base 150	Same as Base 300
Cut (20' ±)	More than Base 50	Less than Base 150	Less than Base 300

Note: The base sound levels at any point will in general decrease approximately with the inverse square of the distance from the source.

In addition to this limited survey, the University of California is conducting an extensive and general study of this subject and plans to submit a report the latter part of this year.

This report covers a cooperative study arranged by the Right of Way Department in cooperation with the Association of Motion Picture Producers. The Universal International Studios furnished the personnel and equipment to take the sound level readings and tape recordings. The District VII Traffic Department furnished the personnel to record the traffic during each test period. The Materials and Research Department furnished technical assistance and coordination and the detailed data is retained in this departments files.

The following group met Mr. John E. Baldwin of the Assocation of Motion Picture Producers, Inc., at his office on June 22, 1953.

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TABLE II

SOUND LEVEL STUDY SUMMARY CHART

Loc. No.	Description of Location	Meter Dist. from Location in Feet	Peak Sounds in Decibels			% Grade	Remarks	
			High	Low	Ave.		General	Quiet
HOLLYWOOD FREEWAY								
1	5' fill, .1 mi. east of Lankershim	60	90	70	81	+ 1	70 - 72	62 - 66
	ditto	160	90	62	77	+ 1	68 - 72	62 - 64
2R	level, .3 mi. west of Barham Blvd.	50	104	80	90	0	76 - 78	70 - 72
	ditto	150	89	70	78	0	68 - 70	62 - 64
3	5' cut, .1 mi. west of Barham Blvd.	50	96	76	86	0	76 - 78	72 - 74
	ditto	150	78	68	74	0	72 - 74	66 - 68
4	Wonder View Bridge	Br. Deck, Eastbound	92	80	86	- 3	84 - 86	72 - 74
	ditto	Br. Deck, Westbound	102	78	90	+ 3		
6	21' fill, .1 mi. east of Glendale Blvd.	50	88	74	81	- 1	72 - 74	68
	ditto	150	88	75	78	- 1	70 - 74	68
2	level, .3 mi. east of Lankershim Blvd.	50	94	73	84	0	76 - 80	66 - 68
	ditto	150	84	70	78	0	70 - 74	64 - 66

NOTE: (1) The individual decibel readings were converted to loudness units at 1000 cps and then averaged. The average was then converted back to decibels.

(2) Under remarks "General" means general traffic and "Quiet" means the lowest sound level during the period of study. These periods were judged by the observors hearing.

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TABLE II (Continued)

Loc. No.	Description of Location	Meter Dist. from Location in Feet	Peak Sounds in Decibels			% Grade	Remarks	
			High	Low	Ave.		General	Quiet
SANTA ANA FREEWAY								
5	21' cut, 350' west of Marrietta St. Underpass	62	98	75	87	0	80 - 82	70 - 72
	ditto	150	82	66	76	0	72 - 74	62 - 64
7	15' fill, centerline of Dacotah St.	50	88	66	77	1	68 - 72	58 - 60
	ditto	150	84	70	78	1	70 - 72	66 - 68
	ditto	300	84	66	75	1	60 - 66	58
8	21' cut, centerline of Spence St.	50	96	80	87	0	76 - 80	70
	ditto	150	78	68	73	0	66 - 68	62
	ditto	300	76	64	69	0	60 - 64	58
9	level, Washington Blvd. & Telegraph Rd. Inter. (Traffic light control)	50	92	78	87	0	80 - 86	72
	ditto	150	88	72	82	0	76 - 78	68
	ditto	300	82	72	77	0	72 - 76	68
GENERAL								
11	Ave. 43 & Arroyo Seco	150				0	64 - 78	62
	ditto	270				0	62 - 70	58 - 62
14	Verdugo & Foothill Blvd.	100				0	68 - 86	58 - 62

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TABLE III

SOUND LEVEL STUDY SUMMARY CHART

Loc. No.	Description of Location	Meter Dist. from Location in Feet	Peak Sounds in Decibels			% Grade
			High	Low	Ave.	
9	Washington Blvd. Inter. (Free Running)	50	92	78	86	0
	(Start)	50	92	80	87	0
	(Combined)	50	92	78	86	0
9	(Free Running)	150	82	76	79	0
	(Start)	150	88	72	82	0
	(Combined)	150	88	72	81	0
9	(Free Running)	300	78	74	76	0
	(Start)	300	82	72	76	0
	(Combined)	300	82	72	76	0

* Arithmetical

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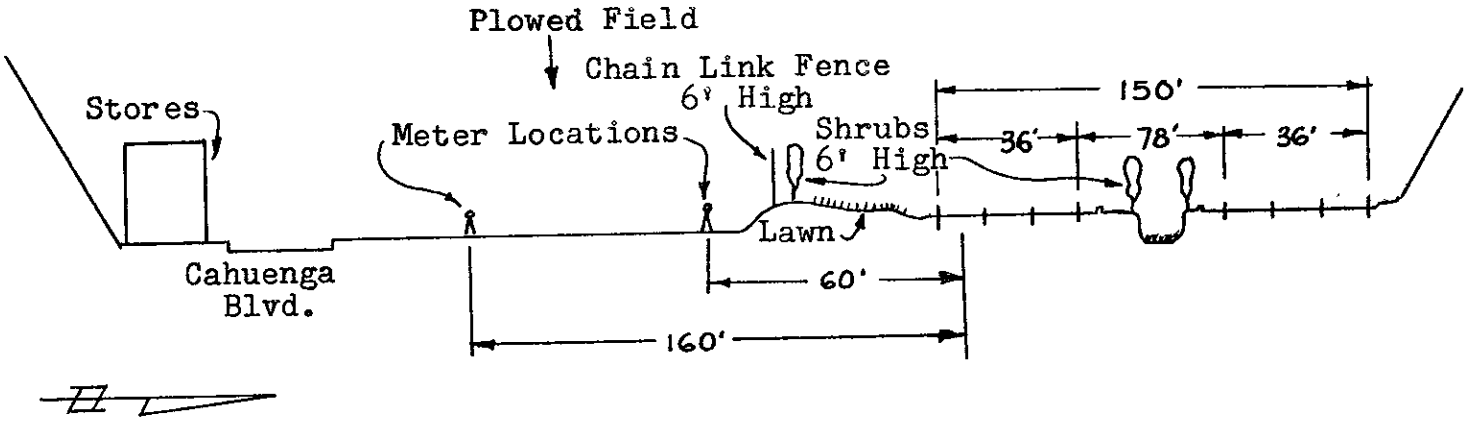
LOCATION NO. 1

.1 mile east of Lankershim Blvd. on Hollywood Freeway

As viewed from 150 ft. meter location



The pavement surface is approximately
5 feet higher in elevation than meter locations.

Average Peak Decibel Reading at 60' = 81
Average Peak Decibel Reading at 160' = 77

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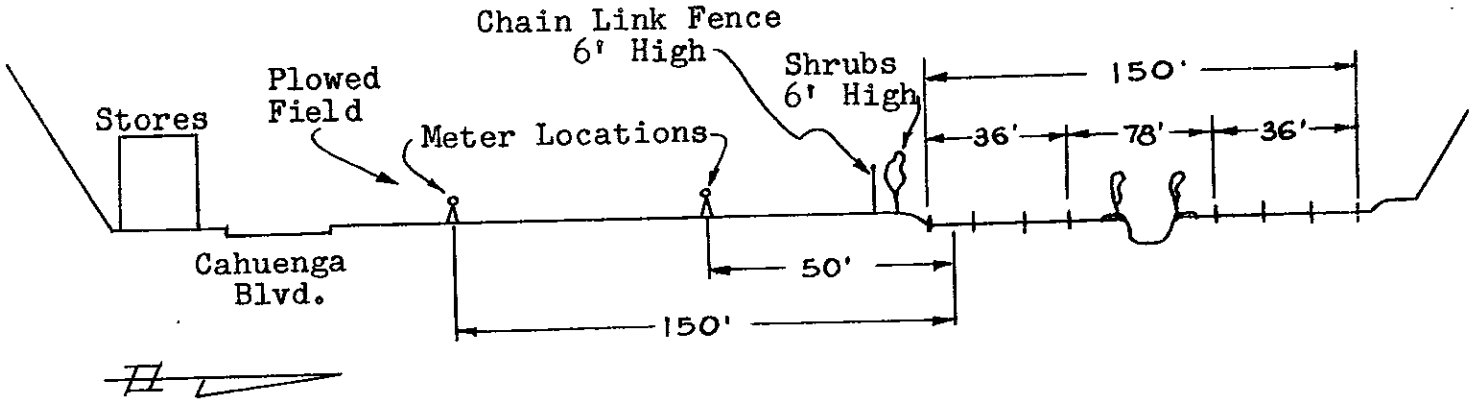
LOCATION NO. 2

.3 mile west of Barham Blvd.
on
Hollywood Freeway

As viewed from 150 ft. meter location



The pavement surface is approximately level with meter locations.

Average Peak Decibel Reading at 50' = 90
Average Peak Decibel Reading at 150' = 78

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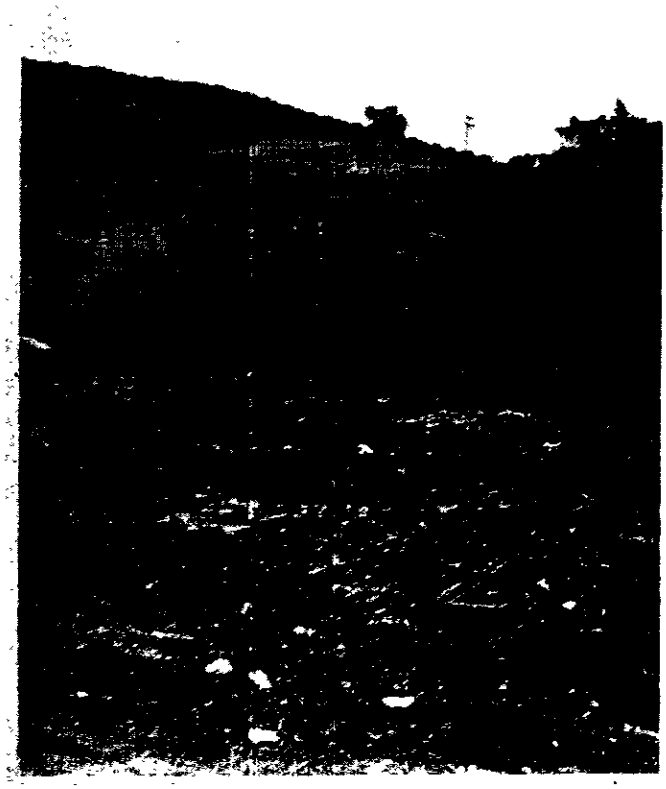
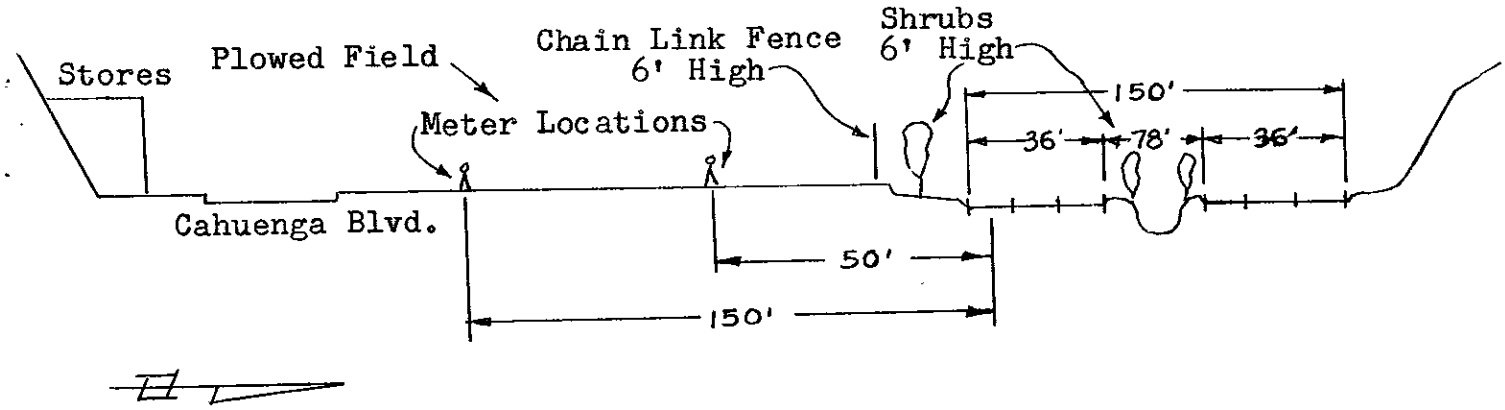
LOCATION NO. 3

.1 mile west of Barham Blvd.
on
Hollywood Freeway



As viewed from 150 ft. meter location



The pavement surface is approximately
5 feet lower in elevation than the meter locations.

Average Peak Decibel Reading at 50' = 86
Average Peak Decibel Reading at 150' = 74

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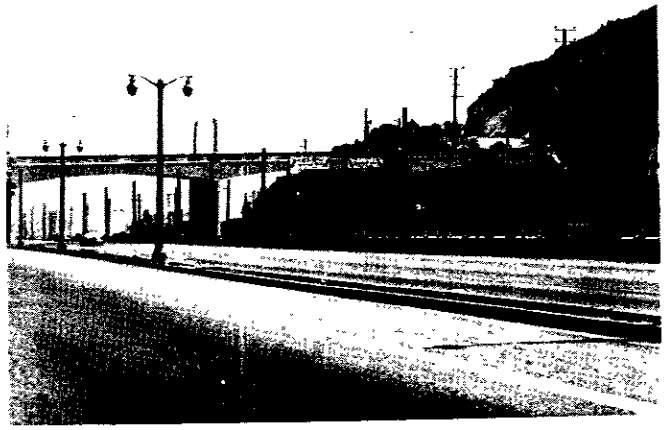
LOCATION NO. 4

Wonder View Bridge
on
Hollywood Freeway



General View

Meter locations were directly over
the center lane of both east and west
bound lanes on the bridge deck.

Average Peak Decibel Reading, Eastbound = 86
Average Peak Decibel Reading, Westbound = 90

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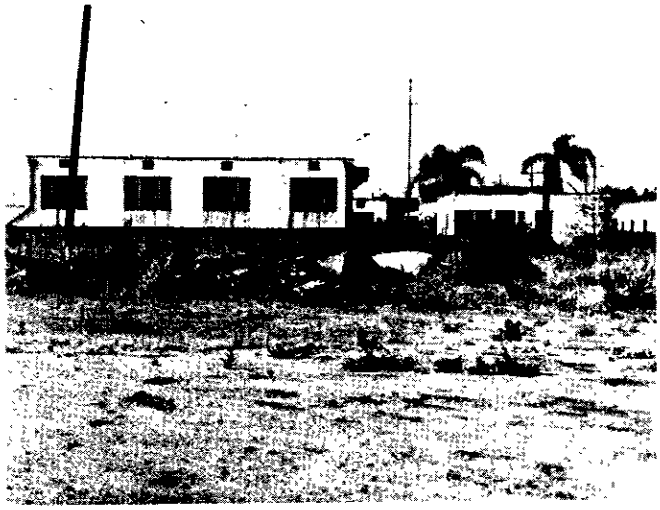
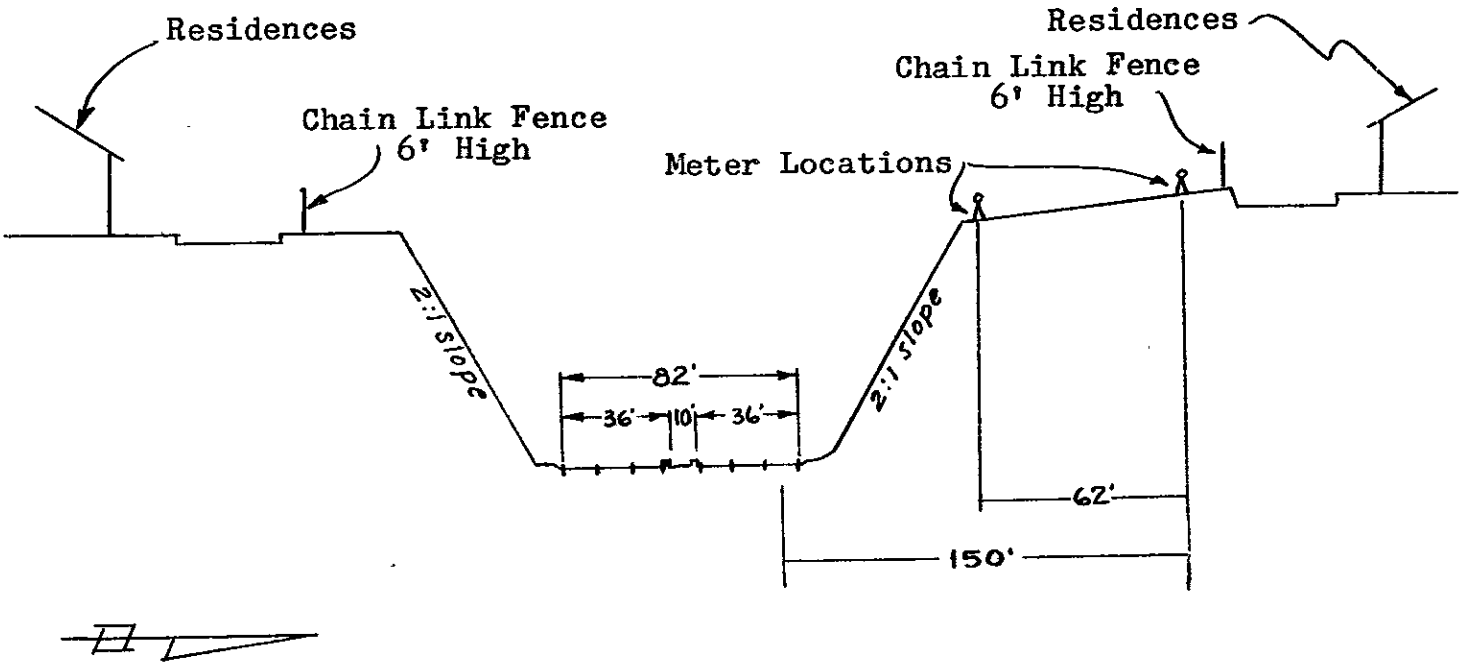
LOCATION NO. 5

350 feet west of Marrieta Street Underpass
on
Santa Ana Freeway



150 ft. meter location as viewed from 62 ft. meter location

Roadway as viewed from 62 ft. meter location



The pavement surface is approximately
21 feet lower in elevation than the meter locations.

Average Peak Decibel Reading at 62' = 87
Average Peak Decibel Reading at 150' = 76

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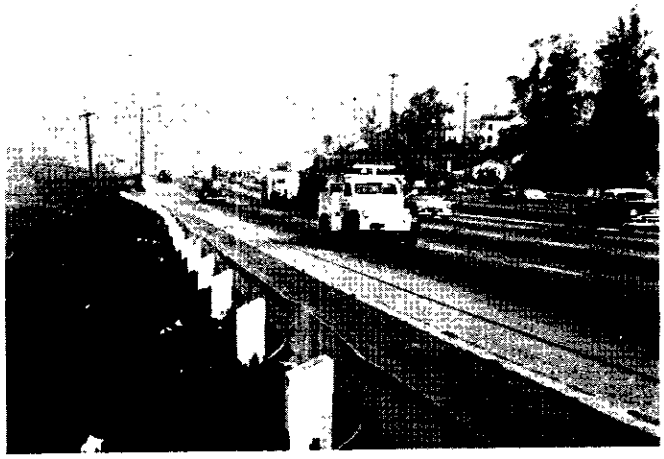
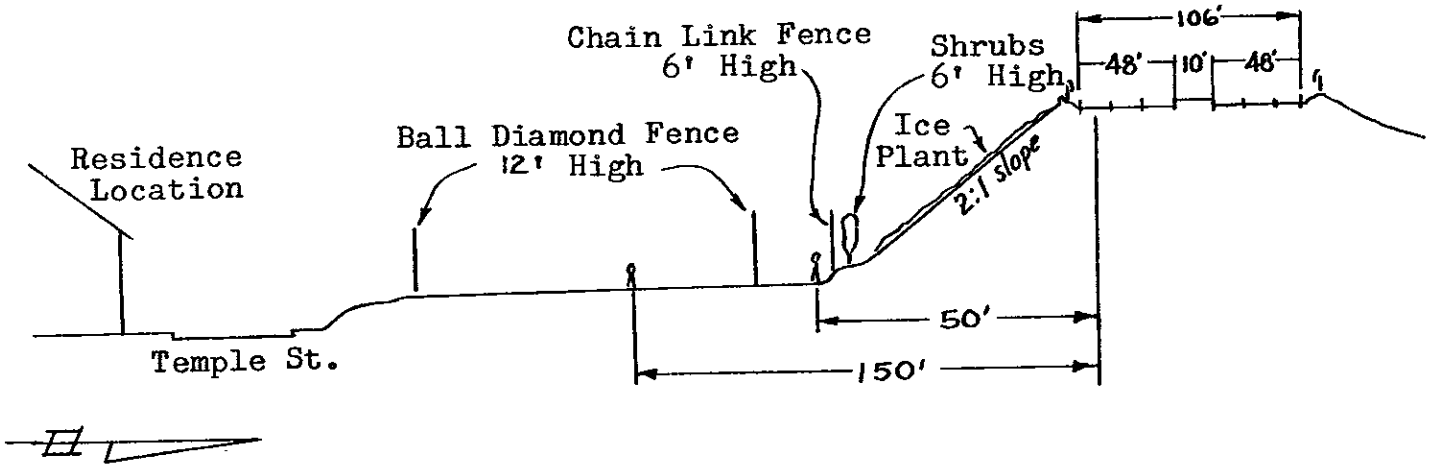
LOCATION NO. 6

City Park, .1 mile east of Glendale Blvd.
on
Hollywood Freeway



General view facing west



The pavement surface is approximately
21 feet higher in elevation than meter locations.

Average Peak Decibel Reading at 50' = 81
Average Peak Decibel Reading at 150' = 78

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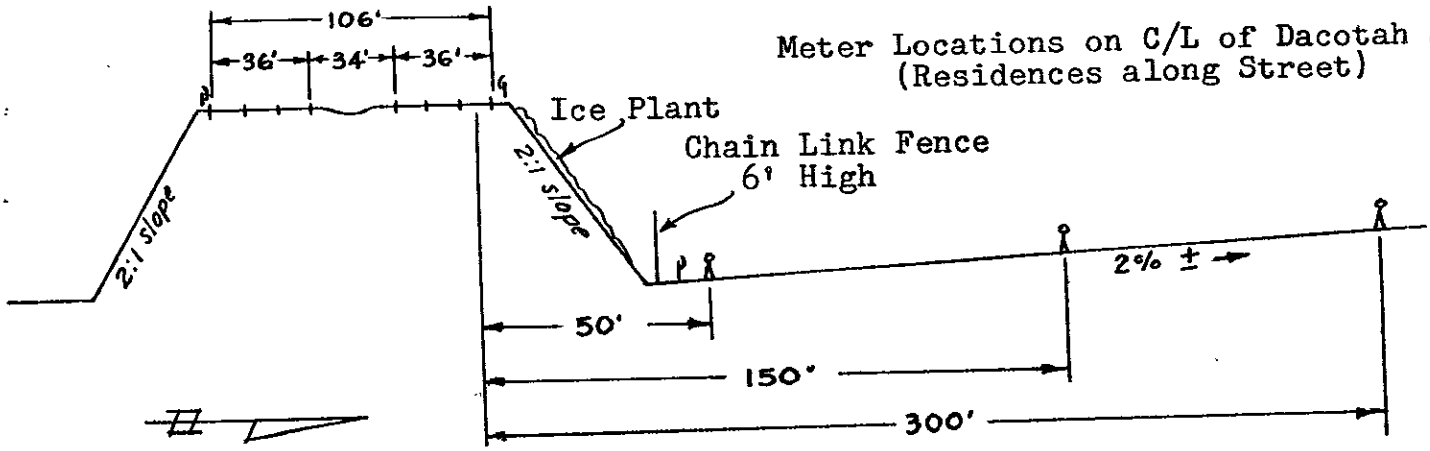
LOCATION NO. 7

C/L of Dacotah Street
on
Santa Ana Freeway

As viewed from 300 ft. meter location



The pavement surface is approximately
15 feet higher in elevation than meter locations.

Average Peak Decibel Reading at 50' = 77
Average Peak Decibel Reading at 150' = 78
Average Peak Decibel Reading at 300' = 75

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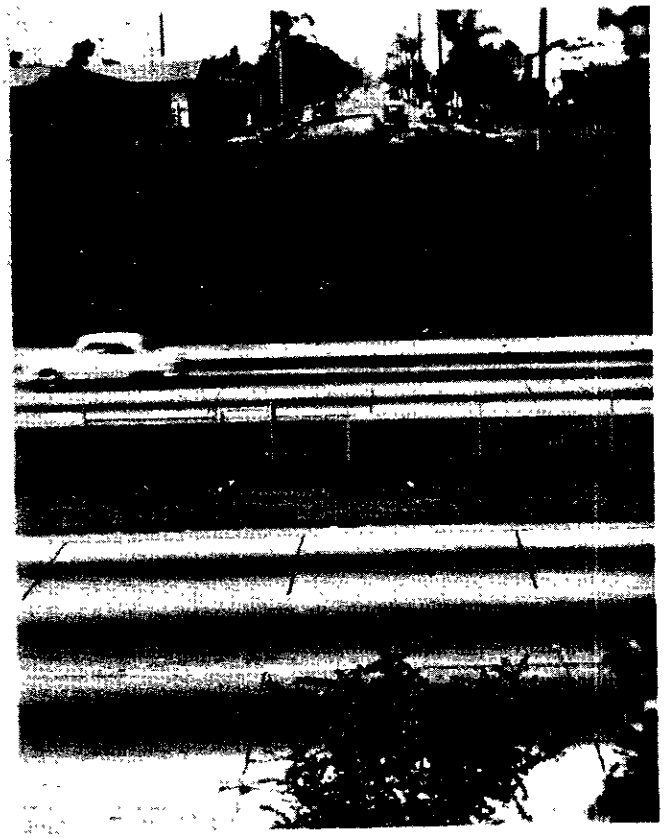
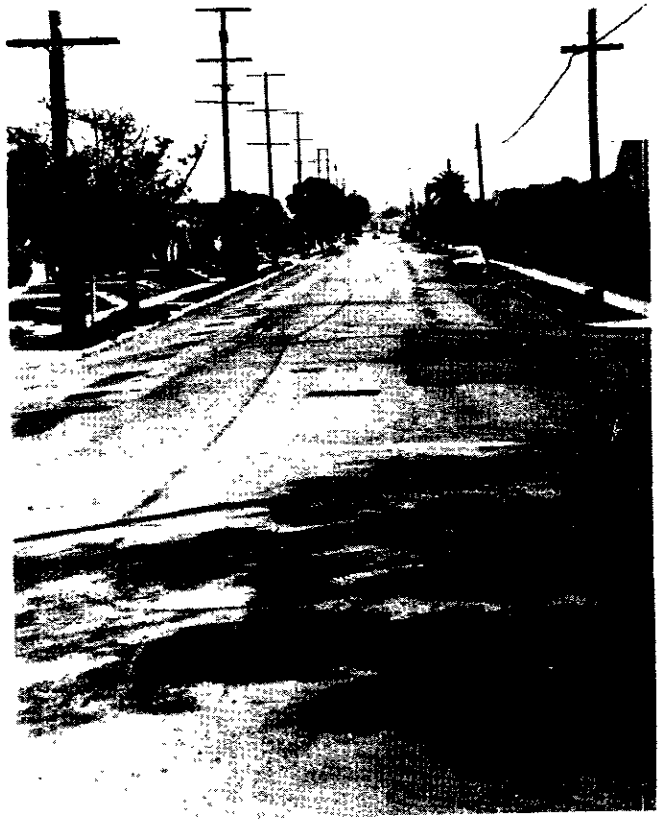
LOCATION NO. 8

C/L of Spence Street on Santa Ana Freeway

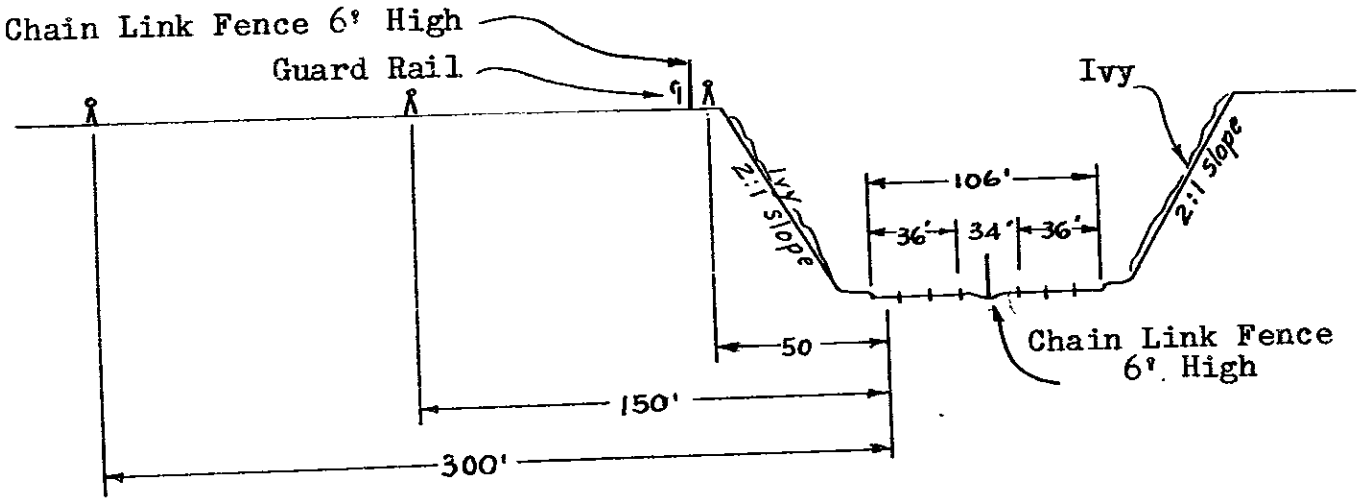


Roadway as viewed
from 50 ft. meter location



150 ft. & 300 ft. meter locations as
viewed from the 50 ft. meter location

Meter Locations on C/L Spence Street
(Residences along Street)



The pavement surface is approximately
21 feet lower in elevation than the meter locations.

Average Peak Decibel Reading at 50' = 87
Average Peak Decibel Reading at 150' = 73
Average Peak Decibel Reading at 300' = 69

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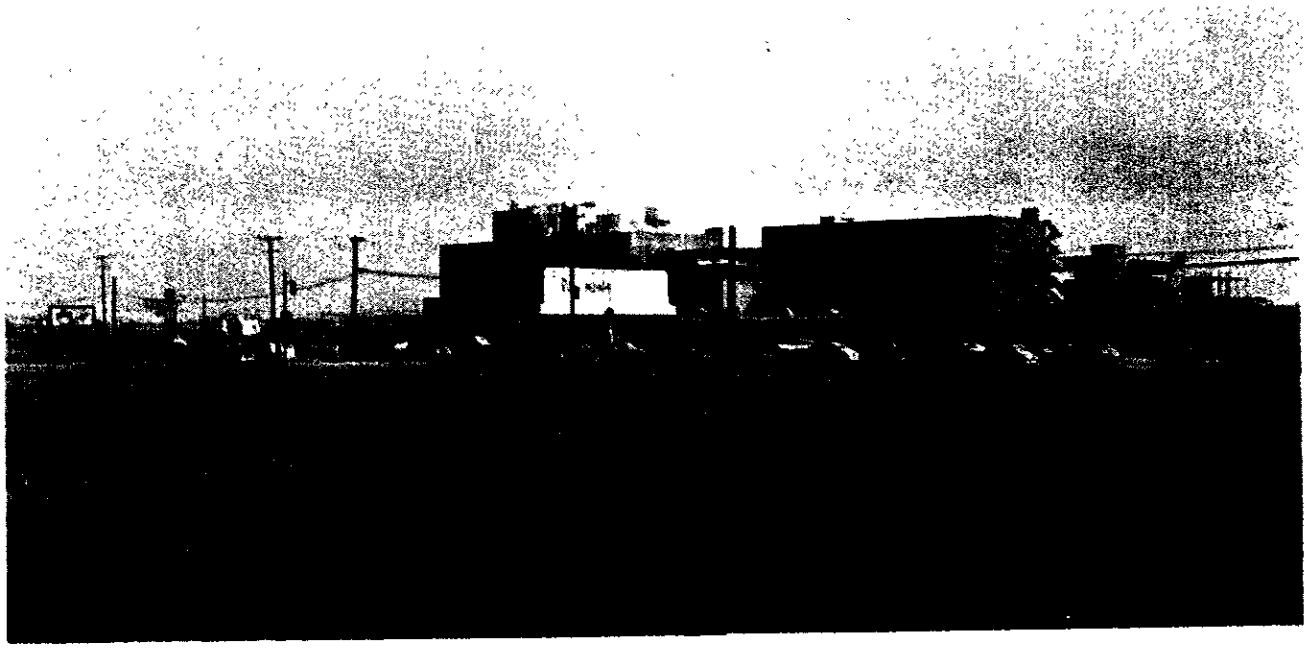
LOCATION NO. 9

Washington Blvd. and Telegraph Road
Intersection near Santa Ana Freeway



General View
Facing east from 300 ft. meter location

The pavement surface is approximately level with meter locations.

Sound Level Readings were taken at 50, 150 and 300 feet from Stop Sign on line as viewed in accompanying photo.

Average Peak Decibel Reading at 50' - 86
Average Peak Decibel Reading at 150' - 81
Average Peak Decibel Reading at 300' - 76

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LOCATION NO. 14

Verdugo and Foothill Blvd.
(Intersection)

General View

The location is level. The Sound Level measurements were taken on the church steps, 100 feet from the center of the intersection.

General Traffic - 68 to 86 Decibels
Quiet Periods - 58 to 62 Decibels

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