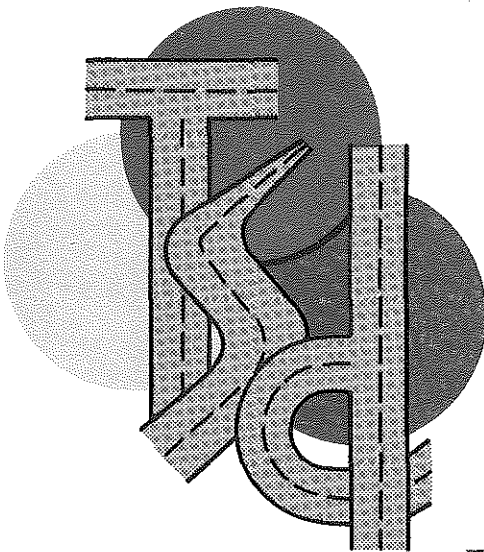


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14-FOOT WIDE MOBILE AND MODULAR HOME
TRANSIT STUDY

TSD-G-188-71



**TRAFFIC and
SAFETY
DIVISION**

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**DEPARTMENT OF STATE HIGHWAYS
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14-FOOT WIDE MOBILE AND MODULAR HOME
TRANSIT STUDY

TSD-G-188-71

Prepared by

Standards Unit
 Geometrics Section
 Traffic and Safety Division

March 15, 1972

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MICHIGAN DEPARTMENT OF STATE HIGHWAYS

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 State Highways Building - P.O. Drawer K
 Lansing, Michigan 48904

FOREWORD

This study was made at the request of Governor William G. Milliken in the promotion of safety on Michigan's highways. It was prompted by the enactment of Act 58, Public Acts of 1971.

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ACKNOWLEDGMENTS

We wish to express our appreciation to the Michigan State Police and Michigan Public Service Commission for their generous cooperation during the study period. A helicopter furnished by the Michigan State Police was utilized for spot aerial visual and photo surveillance. All field personnel were alerted to observe the effect of the new law on Michigan highways.

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PURPOSE OF STUDY

The purpose of this study is to evaluate the effects the movement of 14-ft wide mobile and modular homes have on the safe and efficient flow of traffic on the Michigan state highway system. The evaluation took into consideration the needs of the motoring public as well as the transportation needs of the mobile and modular home industries.

METHOD OF STUDY

The procedures used in conducting this study were as follows:

1. The study period was July 26, 1971 through February 29, 1972.
2. Seven study areas were selected in lower Michigan. These locations were kept under spot ground and air photo and visual surveillance.
3. The study was coordinated with the Michigan State Police and the Michigan Public Service Commission. Self-addressed data cards were furnished to these agencies which allowed them to report any conflicts regarding the 14-ft wide units.

SUMMARY

The hauling of 14-ft wide mobile and modular homes on Michigan's highways has an adverse effect on other motorists. Such hauling disrupts the free flow of traffic and creates hazardous conditions. These units also cause physical damage to the edge of pavement and shoulder areas. Michigan State Police accident reports and visual and photographic observations provide verification of these conditions.

FINDINGS:

The study proposal included a number of trunklines to be observed for movement of 14-ft wide mobile and modular homes. Soon after surveillance started, it became evident that three trunkline segments should be observed in greater detail.

1. US-131 -- Indiana State Line to M-60 -- a two-lane two-way 20 to 24-ft pavement and general rural area, 13.3 miles in length.
2. US-23 -- Ohio State Line to I-94 -- a freeway having two 12-ft lanes in each direction and a length of 35.4 miles.
3. US-127 -- I-94 to Trowbridge Road at East Lansing -- a freeway having two 11 or 12-ft lanes in each direction with a length of 32.6 miles.

These routes did not have any recorded accidents involving over 12-ft wide units during the period of the study. The 1970 accident rate for the normal mix of traffic per 100 million vehicle miles was 316, 106, 182 respectively.

We have observed shying of the opposing and trailing streams of traffic caused by the width and swaying characteristics of 14-ft wide units (see Photos 1, 2, 3 and 4). This evasive action invariably places those vehicles on the opposite shoulder area to avoid collision with the mobile units. With spring thawing and consequent soft shoulder conditions approaching, it is anticipated the shoulder damage will become more severe.

Following are sample statements from data cards obtained through observations of State Police and Michigan Public Service Commission personnel:

Description of traffic conflict, congestion or highway misuse

1. 14-ft unit running with left side of mobile home over center line. Oncoming traffic forced onto shoulder of road. At times the unit would run on right shoulder kicking gravel onto roadway. (MPSC).
2. Gravel thrown on pavement, crossing center line. Observed two 14 ft meeting on this highway, mail boxes barely escaped (damage), the vehicles had slowed to a crawl, anyone walking would have to get in ditch. (MPSC).
3. Rig came south around a sharp, tight curve, crossed the center line and took up more than half the north-bound lane to get around that curve. (MSP).

Ground and aerial photographic record, including black and white photos, color stills and a thirty-five minute film, was compiled. It shows the shoulders and pavement edges will prematurely sustain damage on major hauling routes causing higher maintenance costs. This damage is attributed to the inability of the wide units to keep all wheels on the roadways, as well as difficulty of either the following or approaching vehicles to pass safely without encroaching on the shoulder area. As is indicated by Photos 5 and 6, deep rutting and consequent pavement edge failure are a result of frequent shoulder misuse by these oversize units.

Within the shoulder material are fine clay particles that act as a cementing or solidifying agent. Movement of large vehicles creates a down-draft causing the fine particles to blow away. The absence of these particles permits the shoulder material to difuse allowing gravel or aggregate to be easily thrown onto the road surface (see Photo 7). Although all large vehicles, such as semi-trucks, create a similar down-draft, the 14-ft wide units often travel on the shoulder, therefore accentuating the problem (see Photo 8). Further, the resultant gravel on the roadway surface is causing windshield and headlight damage when thrown by the oversize units or other vehicles traveling the highway. The proprietor of Don's Northside Standard Service Station on US-131 in Constantine stated that for a two-month period that he had observed the 14-ft wide units on US-131, he had sold about 70 headlights whereas for that same period of time he normally would have sold about a dozen. In a discussion with three insurance agents (two located in Constantine and one located in Dowagiac), all indicated a concern as a result of a recent high increase in damaged windshield claims.

Other inconvenience to the motoring public has been observed on various types of undivided roadways. On two-lane roadways considerable vehicle backup has been noted (see Photos 9 and 10). This appears to result from a combination of factors such as: lower speed of the mobile home relative to other traffic, hindrance to the visibility of the trailing motorist to see beyond the wide unit, and a longer passing distance because of the long assembly.

A lack of passing ability has been observed on the four- and five-lane undivided roadways in urban areas. Because of curbing and other side restrictions on the right edge of the roadway the hauler, especially with the 14-ft wide unit, is forced to drive on a portion of the inner or second lane. This restricts the passing ability of trailing traffic. In the case of the five-lane roadway, vehicles were observed illegally using the center or left-turning lane, or a portion thereof to pass an overwidth unit (see Photo 11).

Further inconvenience and hazards were observed when these overlength and overwidth units made turning movements (see Photo 12) in urban areas. Presently the criteria for intersection design in Michigan are based on the turning path of the WB-50 design vehicle. This vehicle (a semi-truck and trailer) is 55 ft long and 8 1/2 ft wide, whereas the mobile home with hauler is generally about 85 ft long and 14 ft wide. With these conditions it is physically impossible for the oversize units to negotiate the proper turning path at intersections. They are therefore causing a hazardous situation to other motorists (see Figure 1 and Photo 13).

The usual length of time for a study of this nature is 12 months. This permits the collection of data through all climatic conditions prevalent in Michigan. The duration of this study (7 months) is rather short for analysis of accident data. Accidents reported by the Michigan State Police for units over 12 ft wide

from July 26, 1971 through February 29, 1972 (recorded as of March 6, 1972) indicate that six units were involved (this includes one 13 ft wide). The accident rate on state trunklines for all classes of vehicles in 1970 was 388 for 100 million vehicle miles. It is estimated the accident rate for over 12-ft wide mobile and modular homes is four times as great as that for the normal mix of traffic on state trunklines. It is emphasized that the results of the analysis of over 12-ft wide mobile and modular homes accident data are based on estimates obtained by a statistical sampling procedure.

During the time of this study, Michigan's mobile home industry was not geared for full-scale 14-ft wide production. The majority of the homes being transported in Michigan were manufactured in Indiana, Ohio and Wisconsin. It is believed that the aforementioned conditions could increase as Michigan's 14-ft wide mobile home manufacturing potential is realized.

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14-ft wide unit forcing approaching
passenger vehicle onto shoulder
(US-131 S. of Constantine - 20-ft roadway)

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14-ft wide unit forcing approaching
truck and passenger vehicle onto shoulder
(US-131 S. of Constantine - 20-ft roadway)

Photo 3



14-ft wide unit forcing trailing
passing vehicle onto shoulder (note right trailer
wheel in rut on edge of pavement)
(US-131 S. of Constantine - 20-ft roadway)

Photo 4



14-ft wide unit forcing trailing
passing vehicle onto shoulder on 4-lane divided roadway
(US-131 North of Three Rivers)

Photo 5



Deep rutting and edge of
roadway break up due to undermining
(US-131 S. of Constantine - 20-ft roadway)

Photo 6



Deep rutting and edge of
roadway break up
(US-131 S. of Constantine - 20-ft roadway)

Photo 7



14-ft wide unit driving on the shoulder and causing the clay particles to be blown from the shoulder area (US-131 S. of Three Rivers - 22-ft roadway)

Photo 8



14-ft wide unit being hauled on the shoulder area blowing the clay particles from the shoulder and denoting gravel that has been thrown onto the roadway (US-131 S. of Constantine - 20-ft roadway)

Photo 9



Back up of vehicles following
14-ft wide unit
(US-131 S. of Three Rivers - 22-ft roadway)

Photo 10



Back up of vehicles following
14-ft wide unit
(US-131 S. of Three Rivers - 22-ft roadway)

Photo 11.



14-ft wide unit on a five-lane roadway and a vehicle using the left-turn lane illegally for passing (M-11 City of Grand Rapids - 60-ft roadway)

Photo 12



14-ft wide units forcing a vehicle onto the shoulder area (US-131 Village of Constantine - 20-ft roadway)

Photo 13

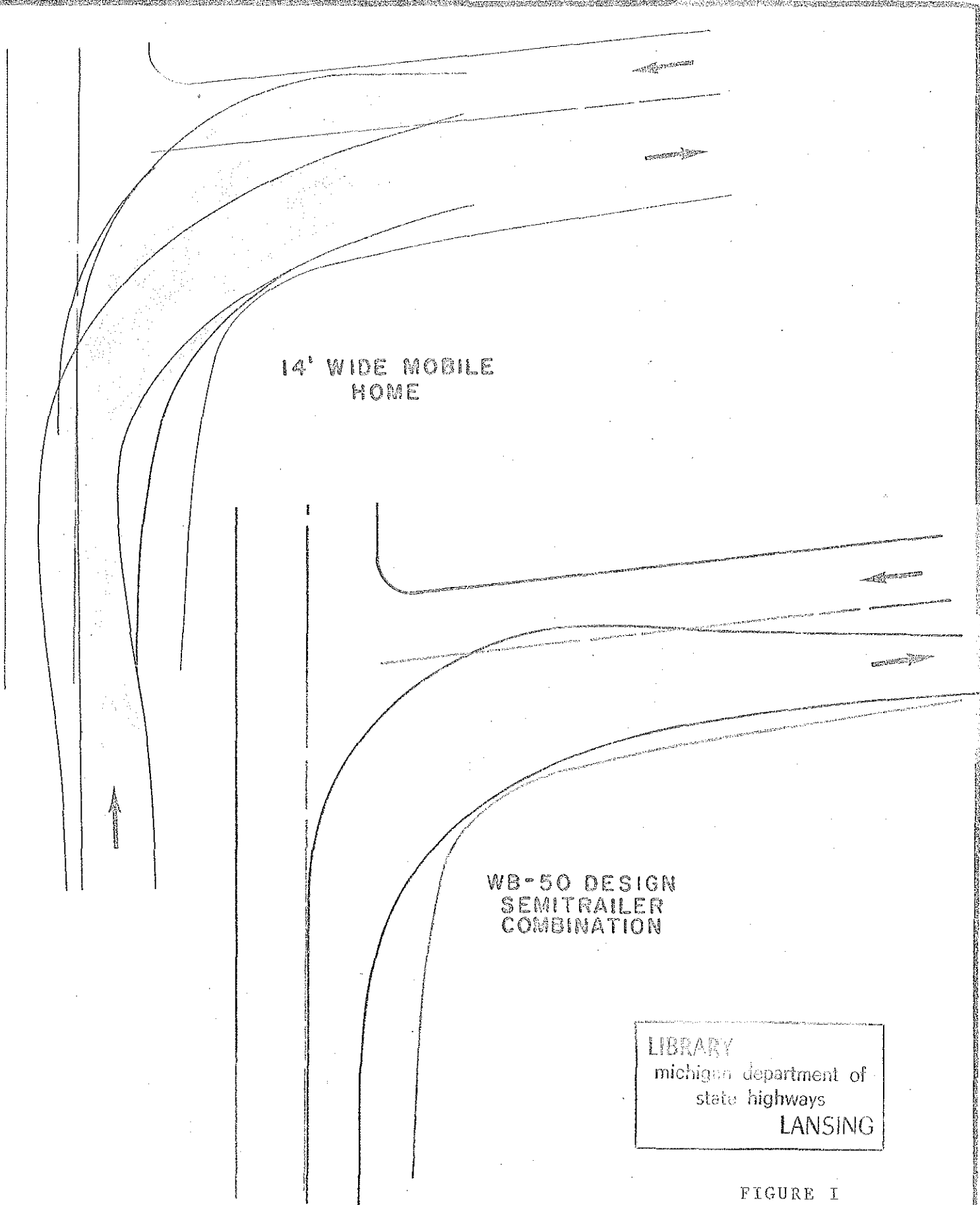


14-ft wide unit turning outside of the intended turning path to negotiate curve on US-131 (US-131 Village of Constantine - 20-ft roadway)

Photo 14



14-ft wide unit being hauled with two wheels in center of shoulder area to avoid rut at edge of roadway (US-131 S. of Constantine - 20-ft roadway)



14' WIDE MOBILE HOME

WB-50 DESIGN SEMITRAILER COMBINATION

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FIGURE I

STATE OF MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC DIVISION	AUTH. NO.		DRAWN
	COPY. REC.		DATE
	REV.		SCALE
	SHEET	OF	PLAN

Comparison of turning paths of 14' wide mobile home and WB-50 Design Vehicle at an intersection on US-131 in the Village of Constantine, Michigan



STATE OF MICHIGAN

OFFICE OF THE GOVERNOR

LANSING

WILLIAM G. MILLIKEN
GOVERNOR

July 22, 1971

Dear Hank:

I believe the potential highway safety hazards created by Public Act 58 require a careful monitoring of the movement of 14-foot wide mobile home and modular housing units on Michigan highways. Your department and the Department of State Police should work closely in evaluating the impact of this new law on the movement of highway traffic in Michigan and on our traffic safety situation.

During the next year I want to be informed immediately of any accident attributable to the wider width vehicles and would appreciate a monthly report of any problems which may stem from the passage of this legislation.

Warm personal regards.

Sincerely,

William G. Milliken
Governor

Mr. Henrik E. Stafseth
Director
Department of State Highways
Highways Building
Lansing, Michigan

ACT NO. 58, PUBLIC ACTS OF 1971

Section 1. Section 719a of Act No. 300 of the Public Acts of 1949, as amended by Act No. 156 of the Public Acts of 1969, being section 257.719a of the Compiled Laws of 1948, is amended to read as follows:

Sec. 719a. (a) Notwithstanding any other provisions of this act, no person shall operate a towing vehicle, having attached a mobile home having a body length in excess of 45 feet and having a combined length of over 60 feet, a realistic body width of over 100 inches at base rail and a height of over 12 1/2 feet on the highways of this state. The jurisdictional authority may issue permits herein required as a prerequisite for the movement of over-length and over-width mobile homes to mobile home transport companies, mobile home manufacturers and dealers and in the ordinary course of their business when requested permitting mobile homes to a width of 14 feet plus normal appurtenances not to exceed 6 inches and permitting mobile homes to a realistic body length of 65 feet and having a combined length of 85 feet and permitting combinations of prebuilt housing modules having a total length not to exceed 65 feet and having a combined length of 85 feet. Any such permit shall provide the days and times of day, but in no case on Saturdays, Sundays, holidays or the noon before until the noon after a holiday, during which such movement shall take place and shall be issued only upon condition that the permittee comply with permit requirements and limitations of law, to insure the operation of any mobile home under permit in a manner which will not impede traffic on the highways and with safety in the movement of any mobile home, and only at a safe speed and when the pavement is not slippery. There shall be no movement of 14 feet wide mobile homes when the wind velocity exceeds 25 miles per hour. On all units exceeding 80 feet in overall combination length, or 12 feet in overall width the permit shall provide that the mobile home be equipped with 2 flashing amber lights on the rear of the mobile home and 1 flashing amber light on the top of the towing vehicle. There shall be displayed on the front bumper of the towing vehicle and the back of the mobile home signs with the words "oversize load". The signs shall be of durable material, in good condition, with black lettering on interstate yellow background. Each letter shall be of block lettering at least 12 inches high at the front and at least 16 inches at the rear of the unit. The words and letters shall be proportionately spaced on the sign. Vehicle escort shall be required on those roads where the state police deem escort vehicles necessary for highway safety. The provisions of this section relating to widths beyond 10 feet 5 inches, including normal appurtenances shall not be applicable to highways which are designated as a part of the national system of interstate and defense highways. The distance between mobile home axle centers shall not be less than 34 inches and the axles and tires shall meet standards established by the state highway commissioner. This section shall not grant or give authority to the state highway commissioner that did not exist on July 1, 1956, in accordance with the provisions of title 23 United States code, section 127.

This act is ordered to take immediate effect.

PROVISIONS GOVERNING THE MOVEMENT OF
14 FOOT WIDE MOBILE HOMES AND MODULAR UNITS

As provided by the Department of State Highways

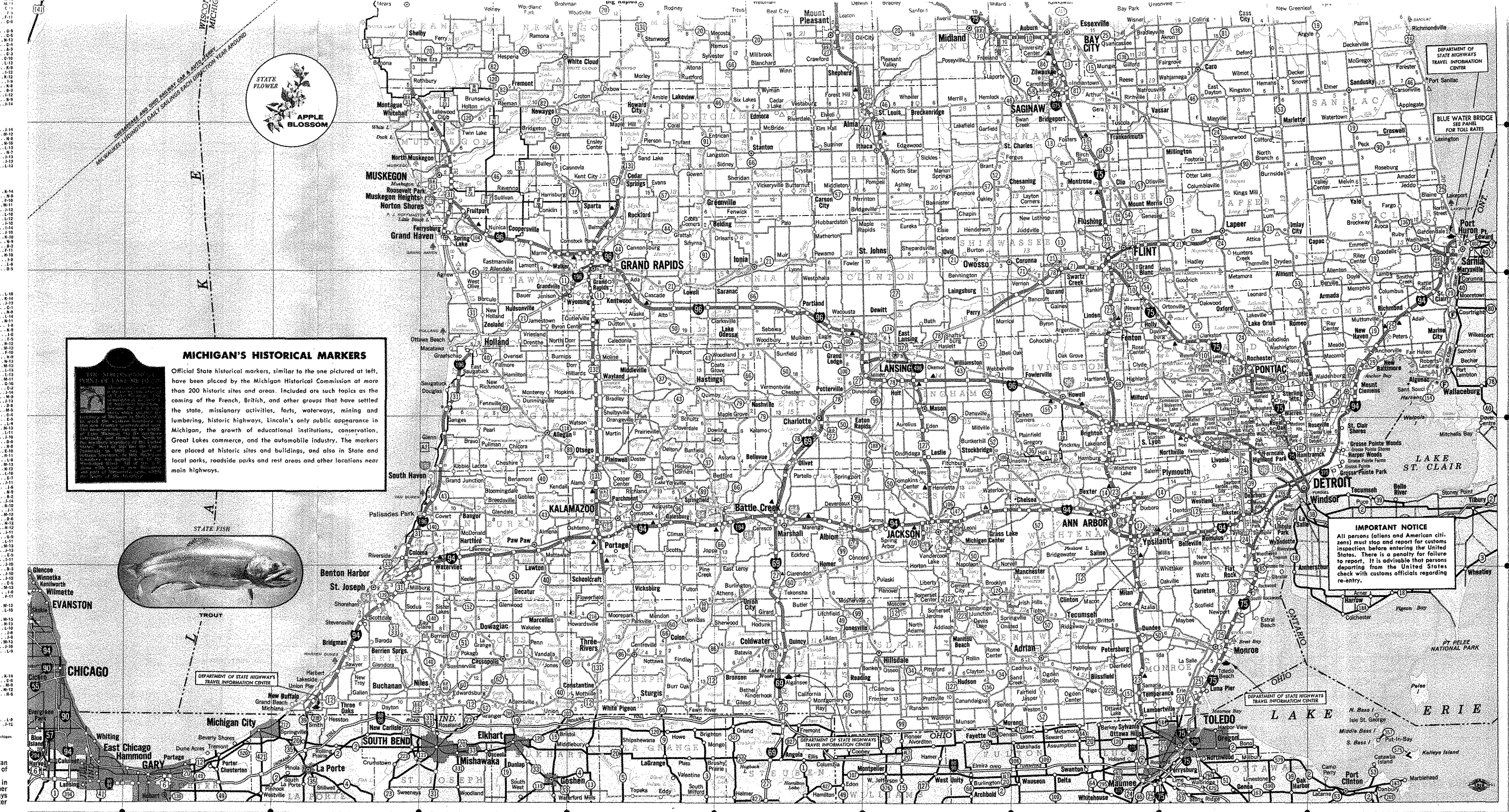
Section Number
Within Permit:

Provision:

- (1) Permit valid only if favorable driving and traffic conditions prevail.
- (3) Movements to be made during periods of reduced traffic. Vehicles traveling under this permit shall maintain a distance of not less than 2000 feet apart.
- (4) Vehicle to pull off highway to allow traffic to pass when excessive congestion develops.
- (5) To be towed by at least a 1 1/2 ton truck with dual wheels.
- (9) Movement shall display 6 clean, plain red flags at least 16" square, one on each end of front bumper of towing vehicle supported on a short staff at an angle so as to wave freely, and one on each corner of mobile home or building module so placed that they can be clearly seen by approaching traffic.
- (13) To be followed by one escort vehicle with flashing amber signals on top of cab, a reasonable distance in rear of movement.
- (15) At least 2 flashing amber lights to be placed on extreme rear of load and one on top of cab of towing vehicle. All flashing amber lights to be visible for a distance of 500 feet.
- (19) Movement to be made between the hours of 9 a.m. and 3 p.m.
- (21) To be equipped with 2 oversize load signs of black, block lettering on interstate yellow background. One 6'X16" sign with 12" lettering on front bumper of towing vehicle. One 8'X18" sign with 16" lettering on rear of load not less than 7' above highway. Towing vehicle headlights to be turned on low beam.
- (21a) Permit not valid for movement when wind velocity exceeds 25 MPH.
- Oversize vehicles shall not be moved in excess of 35 MPH.

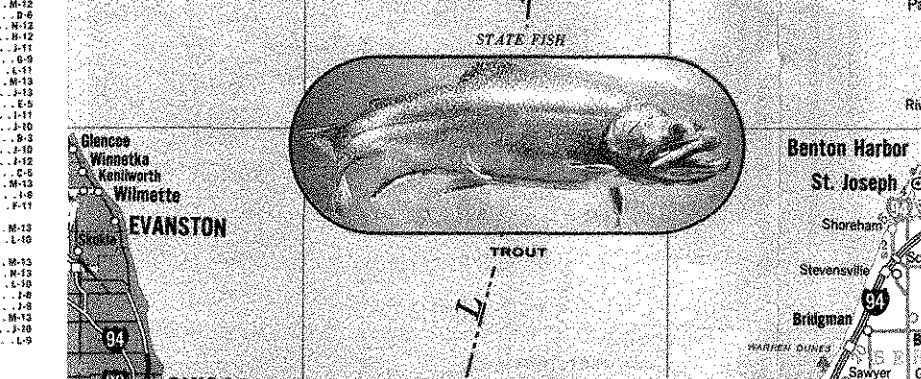


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MICHIGAN'S HISTORICAL MARKERS

Official State historical markers, similar to the one pictured at left, have been placed by the Michigan Historical Commission at more than 200 historic sites and areas. Included are such topics as the coming of the French, British, and other groups that have settled the state, missionary activities, forts, waterways, mining and lumbering, historic highways, Lincoln's only public appearance in Michigan, the growth of educational institutions, conservation, Great Lakes commerce, and the automobile industry. The markers are placed at historic sites and buildings, and also in State and local parks, roadside parks and rest areas and other locations near main highways.



ABOUT YOUR 1972 MAP

Far in the distant past, huge masses of ice—known as glaciers—moved across the North American Continent, forming and shaping our continental topography. Nowhere do they do their work more spectacularly than around the land known today as Michigan.

Lake Superior, for example, which wastes out to the entire northern shore of Michigan's Upper Peninsula, is an enormous body of fresh water that filled a basin scooped out of rock by glacial action. Lake Superior, with nearly 32,000 square miles of water surface and a maximum depth of 1,333 feet, is one of the largest bodies of fresh water in the world.

The same glacial movements that formed the Great Lakes, also left smaller inland basins which today provide Michigan with more than 11,000 lakes and more than 36,000 miles of streams.

Michigan's vast water resources have played a vital role in the development of the state. Today, Michigan has another vast resource—the man-made network of state highways that provides access to virtually all of Michigan's water wonderland.

Theme of the 1972 Official Michigan Highway Map focuses on the scenic and recreational appeal of Michigan's lakes and shorelines—and an excellent system of toll-free highways to get you there.

IMPORTANT NOTICE

All persons (alien and American citizen) must stop and report for customs inspection before entering the United States. There is a penalty for failure to report. It is advisable that persons departing from the United States check with customs officials regarding re-entry.

Estimation of Average Distance Traveled

By 14 ft Wide Mobile Homes

Data Used: A sample of size 393 was drawn from a file of 3581 travel permits in Michigan during the period of August 1971 thru February 1972. The results are shown in the table below.

Methodology: It is assumed that the sample mean \bar{y} (i.e. average distance traveled) is normally distributed about the corresponding population values. The 99% confidence limits on the population mean are

$$\bar{y} \pm (ts/\sqrt{n})\sqrt{1 - (n/N)}$$

where \bar{y} : Average distance traveled
s: Standard deviation
t: The value of the normal deviate corresponding to the desired confidence probability.
n: Sample size
N: Total records in the population

Applying the data in the above Table, we obtain

$\bar{y} = 101.00$ and $s = 68.547$ (These are results of a computer program)

Therefore, the 99% confidence limits on true average distance traveled are

$$101.00 \pm \frac{2.58 (68.547)}{\sqrt{393}}\sqrt{1 - 0.1097}$$

This gives 92.58 miles and 109.42 miles for the 99% confidence limits. Hence, we can assert with a degree of confidence of 99% that the interval from 92.58 miles to 109.42

miles contains the true average distance traveled by 14 ft wide mobile homes in the State of Michigan during the study period.

Recommendation: It is established in probability theory that the sample mean \bar{y} is an unbiased estimate of population mean. Therefore, it is recommended that average distance of 101.00 miles per trip be used in our statewide study during that period.