AREA TRANSPORTATION STUDY

1968

ORIGIN-DESTINATION STUDY

ACCURACY CHECKS

■ IRON MOUNTAIN

■ KINGSFORD

■ NORWAY

**MICHIGAN DEPARTMENT
OF STATE HIGHWAYS**

65-7545

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF STATE HIGHWAYS

November 30, 1970
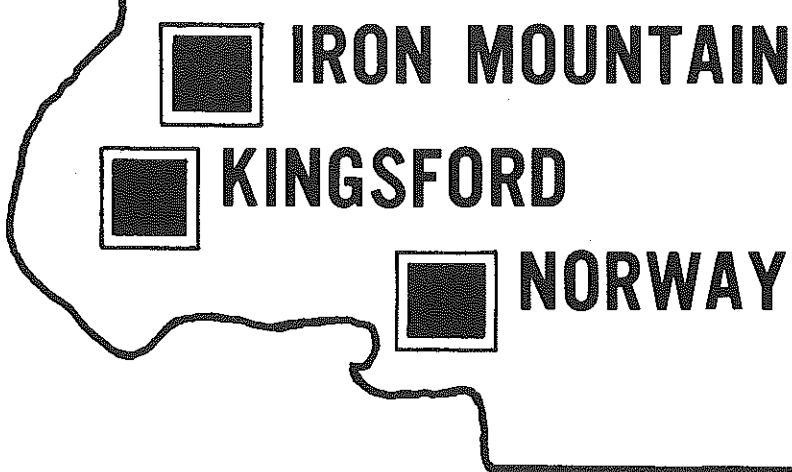
Mr. Sam F. Cryderman
Engineer of Transportation Planning
Transportation Planning Division
Michigan Department of State Highways
Lansing, Michigan

Dear Mr. Cryderman:

This presents the "Accuracy Checks" report for the 1968
Iron Mountain-Kingsford-Norway Area Transportation Study.
This "benchmark" publication fulfills a requirement of
the Federal Highway Administration.

The purpose of this report is to document the reliability
of base year data obtained from the origin-destination
survey.

This report was prepared by the following Transportation
Analysts of the Northwest Michigan Analysis Unit of the
Transportation Survey and Analysis Section: Phillip Lamb
and Dwight Searcy. Their supervisor is Leo Farman.

Respectfully,

Keith E. Bushnell, Engineer
Transportation Survey & Analysis

MICHIGAN
THE
GREAT
LAKE
STATE

IRON MOUNTAIN – KINGSFORD – NORWAY

AREA TRANSPORTATION STUDY

ACCURACY CHECKS

and

ADJUSTMENT FACTORS

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

1970

ACKNOWLEDGEMENTS

PREFACE

The 1968 Iron Mountain - Kingsford - Norway Origin-Destination Transportation Survey was conducted to obtain travel patterns and household characteristics for all persons living and traveling in and through this area in Dickinson County, Michigan.

Information was collected through four types of interviews: home, external, truck and taxi. Sampling techniques, recommended by the Bureau of Public Roads, were utilized in gathering the necessary data.

The sampling rates and techniques for selecting the sample are those recommended by the Manual of Procedures for Home Interview Traffic Study (BPR). The following sampling rates were used: home 25%, commercial vehicles 50%, and taxis 100%. There were 17,764 external interviews taken out of a total of 19,048 vehicles crossing the cordon line, for a 93.26% sampling rate.

Expansion of the internal sample data was on a tract basis. External expansion was done by hour period, by direction, by station. Commercial and Taxi data were expanded by the sampling rate.

The purpose of the first part of this report is to examine the completeness and validity of the expanded sample data itself. The expanded data will be checked against independently derived estimates of the same data.

On sample data, the purpose of this report is to document the procedures utilized and the results, conclusions, and recommendations obtained from the accuracy checks. Adjustments of the adjusted data and the trip file is documented as to procedure, results, and conclusions.

INTRODUCTION

Following is a report on the accuracy of the 1968 Origin-
Destination Transportation Survey conducted in the Iron Mountain-
Kingsford - Norway Area in the southern part of Dickinson County,
Michigan. It is essential to the Transportation Planning Process
that any data collected on a sample basis be examined for complete-
ness, representativeness as well as statistical validity.

The purpose of this report is to test the accuracy of the
sample data by comparing it with independent sources of data.

The Iron Mountain Area Origin-Destination Survey was conducted
during the months of June and July of 1968.

This report specifically checks the accuracy of the data
collected at the dwelling unit (D.U.) home interview, and in
particular the socio-economic data.

The interviewer when conducting the home interview at each
sample address, collects information not only on the number and
origin and destination of trips emanating from that address but
also those characteristics which exert influence on trip making for
the study area as a whole. Therefore, data items such as population,
automobiles, age, income, industry and occupation are also collected
along with the travel information. These data items will be
correlated with trips in the Trip Generation phase of the study.
This will be accomplished utilizing regression analysis to explain
the variance in trip making. Output from the above will be a set
of models or mathematical equations, relating socio-economic
population characteristics to trip making. These models will then

be used to predict future trip making, based on the population characteristics forecast, for a future year. Thus, it is critical that today's model be based on accurate and reliable data.

No task as comprehensive as the one reported on here could be accomplished without extensive contacts with, and help from the people, business firms and governmental agencies connected with the Iron Mountain - Kingsford - Norway Study Area. It is impossible, therefore, to make a complete listing of the many who contributed time and effort. In spite of this difficulty, acknowledgment must be made to the Planning Section, Urban Planning Unit of the Michigan Department of State Highways for the independent data for the Socio-economic Accuracy Checks.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TOTAL DWELLING UNIT ACCURACY CHECK

I.   PURPOSE

The purpose of the Total Dwelling Unit Accuracy Check is to

verify completeness of the Dwelling Unit Inventory Survey conducted

for the Iron Mountain Origin-Destination Study of 1968.   This accuracy

check is needed in determining if a representative sample of dwelling

units has been obtained.   The omission of a sizable portion of the

true universe will lead to under estimation of expanded universe

totals for all questions asked in the sample survey.   Since expansion

factors are based on the total number of dwelling units counted, it

therefore follows that any under counting of dwelling units will yield

totals which would also be lower.   This Accuracy Check will determine

if such omissions exist.

II.   PROCEDURE

The procedure for the Total Dwelling Unit Accuracy Check, an

independent estimate of the total number of dwelling units was

utilized.   Using the 1960 Census as the base, the total number of

dwellings was updated for the 1960-1968 period by adding the number

of building permits and subtracting the number of demolitions.

Extreme care was used in the updating process.   There were a

few problems confronting the updating procedure. One problem was

the lack of complete records for the unincorporated areas of the

study.   Razing permits are issued for structures and not for units.

This causes a problem when a multi-family dwelling is being
demolished because the razing permit shows only one structure
being torn down and gives no indication as to the number of units
actually being razed. This problem should not be a major problem
in the Iron Mountain - Kingsford - Norway Area Study. There has
been a minimum of urban renewal or major construction where razing
permits are often issued for entire blocks.

There is a difference in the definition of a dwelling unit
between the O-D study and the Census. The Census, unlike the
dwelling unit field survey, does not count each hotel room and
group quarters as a separate dwelling unit. If group quarters,
residential hotels, transient lodgings and multiple housings were
removed for the entire expanded total, it would amount to 160 units
or 2.15 percent of the 7,442 total O-D dwelling unit count.

The procedure used was essentially an update of the 1960 Census,
based on local building activity data. The updated Census was then
compared with the Total Dwelling Unit Field Survey.

III. RESULTS

See Table I.

The accuracy ratio for Norway Township yielded an accuracy ratio of 81.77. This is due to the fact that the O-D study area did not include the entire township. Since there was a 100 percent sample of all dwelling units taken in O-D tracts 6 and 25 and an estimate of seventy dwellings outside the study area in Norway township, the O-D data and the independent data compares reasonably. Census tracts 6 and 7 were compared with the Polk's Iron Mountain and Kingsford City Directory. The O-D data and the directory compared favorably. The 95.20 accuracy ratio for the city of Iron Mountain is well within the allowable limit of statistical accuracy.

TABLE I

TOTAL DWELLING UNITS

CENSUS TRACT	O-D DATA	INDEPENDENT DATA	ACCURACY RATIO
3	371	368	100.82
4	288	309	93.20
5	420	409	102.69
6	351	422	83.18
7	444	502	88.45
8	402	414	97.10
9N,11	154	152	101.32
9P	303	306	99.02
10	460	472	97.46
City of IRON MOUNTAIN	3,193	3,354	95.20
12	435	449	96.88
13	524	529	99.05
14	402	429	93.71
15	381	389	97.94
City of KINGSFORD	1,742	1,796	96.99
20	261	268	97.39
21	411	442	92.99
22	453	483	93.79
City of NORWAY	1,125	1,193	94.30
THREE CITIES	6,060	6,343	95.54
16,17,18N BREITUNG TWP.	1,068	995	107.34
18P,19N NORWAY TWP.	314	384	81.77
TWO TOWNSHIPS	1,382	1,379	100.22
STUDY AREA	7,442	7,722	96.37

TOTAL DWELLING UNIT ACCURACY CHECK

IRON MOUNTAIN, KINGSFORD AND BREITUNG AREA TRANSPORTATION STUDY
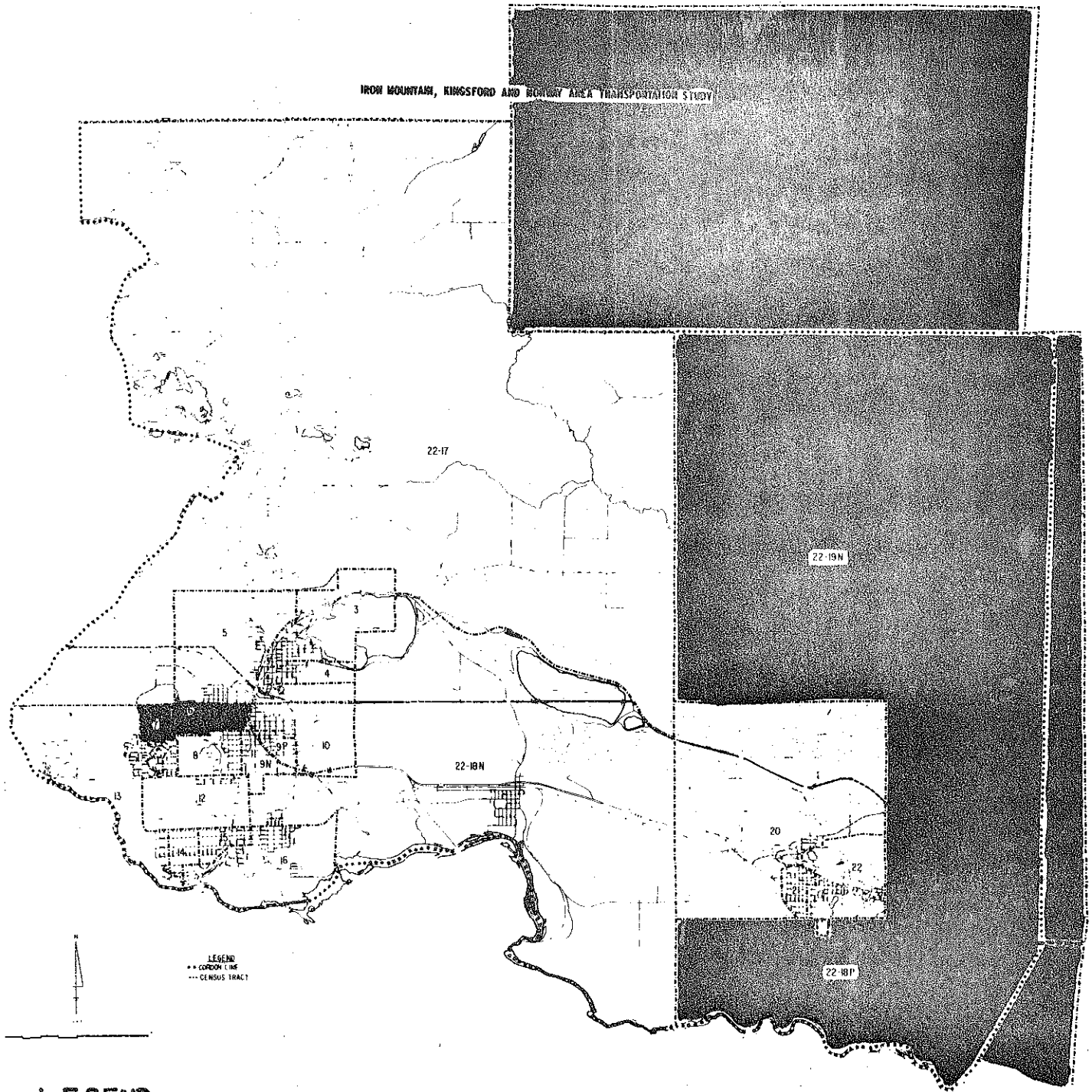
LEGEND:
□ Less than 10% Difference.
■ More than 10% Difference.

FIGURE I

IV. SUMMARY AND CONCLUSION

The purpose of the Total Dwelling Unit Accuracy Check is to
verify the procedures used and the completeness of Dwelling Unit
Inventory Survey. After careful evaluation of the Accuracy Check
Ratios, it was determined that the accuracy check ratio of 96.37
percent for the entire study area is within the allowable limits
of statistical accuracy. Also, the results as enumerated on a
tract basis are also acceptable. Therefore, the Dwelling Unit
Inventory Survey is representative of the true universe.

OCCUPIED DWELLING UNIT ACCURACY CHECK

I. PURPOSE

The total dwelling unit check found that the dwelling unit
survey was statistically representative of the universe of dwelling
units. Therefore, the next check is the occupied dwelling unit
check for the Iron Mountain - Kingsford - Norway Area.

II. PROCEDURE

This check was performed by comparing updated census data
with the O-D tabulations.

The census update of occupied dwelling units was performed
in the following manner:

1. The 1968 Census update of total dwelling units
    was used as the base.

2. It was assumed that the vacancy ratio in 1960
    for each census tract was also applicable in 1968.

3. The 1960 vacancy ratio was applied to the 1968
    total dwelling units to determine the number
    of vacant dwellings existing in 1968.

4. The number of 1968 vacant units was subtracted
    from 1968 total dwellings to obtain the number
    of occupied dwelling units.

The Study Survey tabulations of occupied dwelling units were obtained in the following manner:

1. The 1968 Iron Mountain - Kingsford - Norway survey of total dwelling units was used as the base by O-D tract.

2. The expanded total of vacant dwelling units was obtained by expanding the vacant sample dwellings by O-D tract.

3. The number of occupied dwelling units was obtained by subtracting the expanded number of vacant units from the total number of dwelling units by O-D zone. One or more zones equals a tract.

4. Occupied dwelling units by O-D zone were combined into O-D tracts for the occupied dwelling unit check.

III. RESULTS

See Table II. The 1968 census update of occupied dwelling units was compared with the 1968 O-D Survey tabulations of occupied dwelling units by means of ratio analysis. The result of the Occupied Dwelling Unit Check shows a 96.37 percent accuracy ratio for the entire study area. In general, the pattern of the results of this check is similar to the Total Dwelling Unit Accuracy Check. This similarity indicates a strong consistency in data tabulations in that where the Total Dwelling Unit check was low, the Occupied Dwelling Unit Check was also low, and vice versa. The reasons for the low check in total dwelling units were explained previously.

TABLE II

OCCUPIED DWELLING UNITS

CENSUS TRACT	O-D DATA*	INDEPENDENT DATA	*B-1 TABLE ACCURACY RATIO
3	365	361	101.11
4	273	303	90.10
5	390	401	97.26
6	321	414	77.54
7	435	492	88.41
8	376	406	92.61
9N,11	126	150	84.00
9P	282	300	94.00
10	435	464	93.75
City of IRON MOUNTAIN	3,003	3,291	91.25
12	425	438	97.03
13	518	517	100.19
14	393	420	93.57
15	371	380	97.63
City of KINGSFORD	1,707	1,755	97.26
20	239	265	90.19
21	392	438	89.50
22	418	478	87.45
City of NORWAY	1,049	1,181	88.82
THREE CITIES	5,759	6,227	92.48
16,17,18N BREITUNG TWP.	996	946	105.29
18P,19N NORWAY TOWNSHIP	288	347	83.00
TWO TOWNSHIPS	1,284	1,293	99.30
STUDY AREA	7,043	7,520	93.66

OCCUPIED DWELLING UNIT ACCURACY CHECK

IRON MOUNTAIN, KINGSFORD AND NORWAY AREA TRANSPORTATION STUDY

LEGEND
• • CORDON LINE
• • • CENSUS TRACT
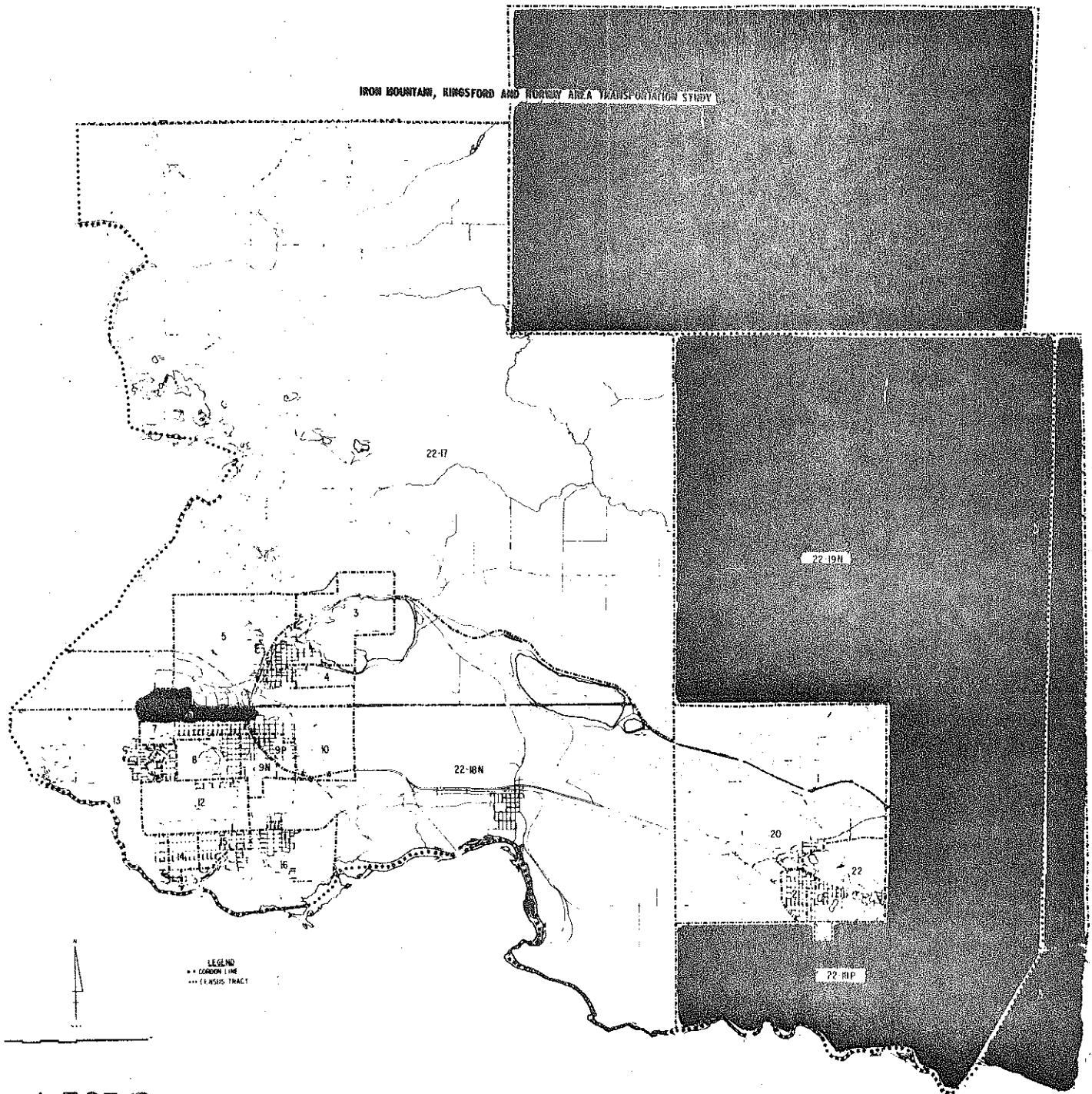
L E GEND:

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▬▬ More than 10% Difference.

FIGURE II

IV. SUMMARY AND CONCLUSIONS

The accuracy check ratio of 93.66 percent for the entire study area is within the allowable limits of statistical accuracy. Also, the results as enumerated on a tract basis are also acceptable. Therefore, the Occupied Dwelling Unit Survey is representative of the true universe of occupied dwelling units.

POPULATION ACCURACY CHECK

I. PURPOSE

The purpose of the Population Accuracy Check is to assess the completeness and representativeness of the O-D sample survey as it relates to the Area's population.

II. PROCEDURE

This check was performed by comparing updated census data with the O-D tabulations.

The census update of population was performed in the following manner:

1. The 1968 census update of occupied dwelling units was used as the base.

2. It was assumed that the 1960 ratio of population per occupied dwelling for each census tract was also applicable in 1968.

3. The 1968 occupied dwelling unit figure was multiplied by the 1960 ratio of population per occupied dwelling unit in order to derive a 1968 population.

The Study Survey tabulations of population were obtained in the following manner:

1. The 1968 Iron Mountain - Kingsford - Norway survey of population by O-D tract was used as the base.

2. Expansion factors were calculated for each tract based on the sampling rate.

3. Vacant dwelling units as well as incomplete interviews within each particular tract were taken into consideration.

4. Population was tabulated by O-D zone (See B-1 Table). Population by zone were combined into O-D tracts (See O-D tract - O-D zone equivalence table) for the population dwelling unit check.

III. RESULTS

See Table III. The 1968 census update of population was compared with the 1968 O-D Survey tabulations of population by means of ratio analysis. Because of the methodology used in obtaining independent data, the accuracy of the independent population data is dependent on the accuracy of the land use dwelling unit count, the occupancy ratio, and the persons per household ratio.

Census tract 6 has an accuracy ratio of 79.04 percent. This is due to the Dickinson Hotel and the Dutchys Hotel. These two hotels have 85 total rooms. Transient population were not tabulated into the O-D survey data but they were accounted for in the census. Census tract 9N, 11 has an accuracy ratio of 36.87 percent. The Veterans Administration Hospital is located in this tract. This hospital has 269 beds. Many of its patients were included in the 1960 census. They were not counted in the O-D Survey because they are not part of the trip generation phase. The hospital rooms were not counted in the census or the O-D Survey. That is why the Total and Occupied Dwelling Unit check for census tract 9N, 11 checked

-13-

TABLE III

POPULATION

CENSUS TRACT	O-D DATA	INDEPENDENT DATA	ACCURACY RATIO
3	1,041	1,076	96.75
4	754	885	85.20
5	1,121	1,203	93.18
6	939	1,188	79.04
7	1,298	1,333	97.37
8	1,150	1,157	99.39
9N,11	272	738	36.87
9P	866	876	98.86
10	1,131	1,197	94.49
City of IRON MOUNTAIN	8,572	9,653	88.80
12	1,270	1,375	92.36
13	1,683	1,722	97.74
14	1,277	1,260	101.35
15	1,205	1,220	98.77
City of KINGSFORD	5,435	5,577	97.45
20	732	795	92.08
21	990	1,244	79.58
22	1,312	1,381	95.00
City of NORWAY	3,034	3,420	88.71
THREE CITIES	17,041	18,650	91.37
16,17,18N BREITUNG TWP.	3,189	2,899	110.00
18P,19N NORWAY TOWNSHIP	855	1,038	82.37
TWO TOWNSHIPS	4,044	3,937	102.72
STUDY AREA	21,085	22,587	93.35

POPULATION ACCURACY CHECK
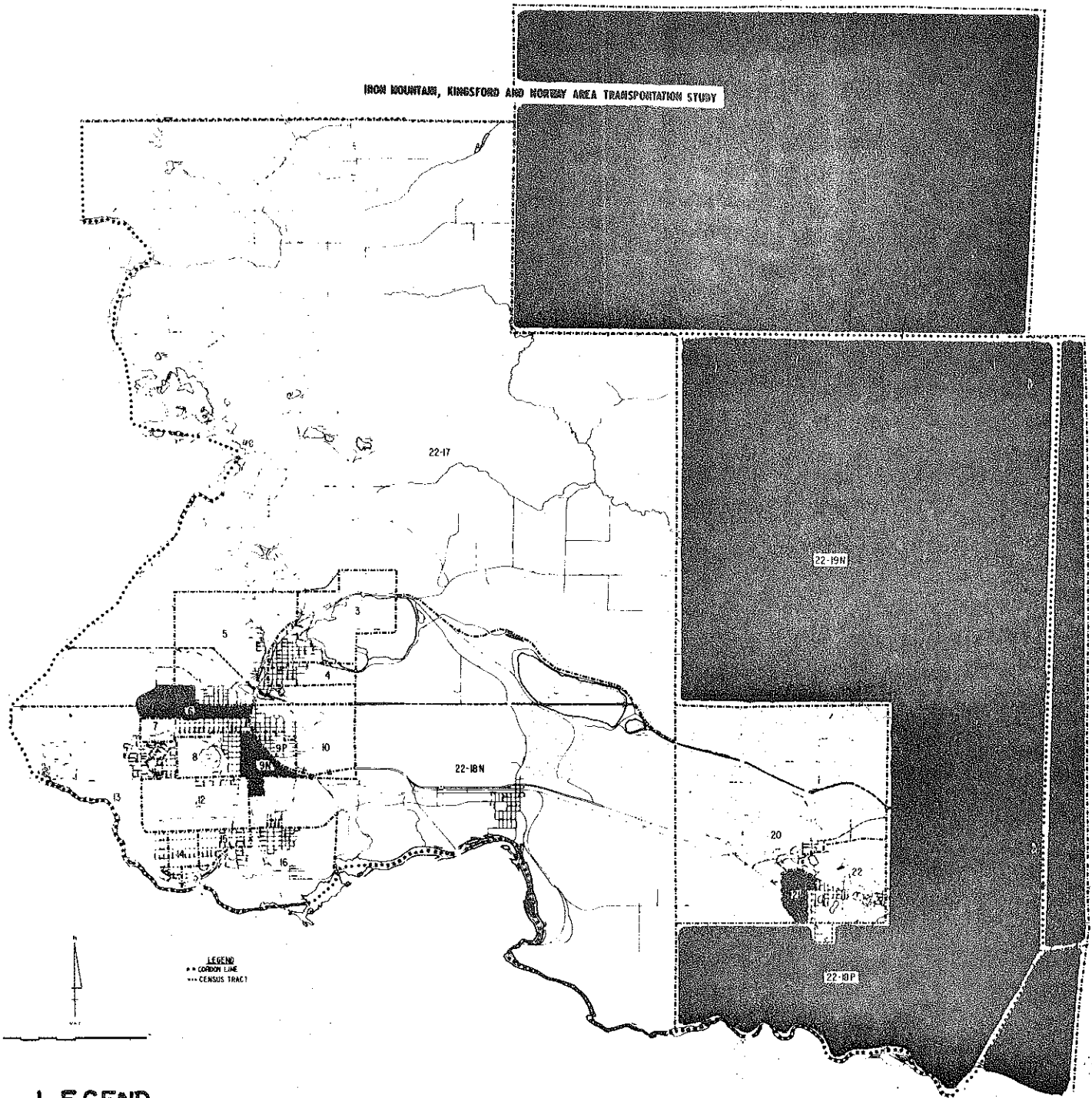
IRON MOUNTAIN, KINGSFORD AND NORWAY AREA TRANSPORTATION STUDY

L E GEND:
- ▭ Less than 10% Difference.
- ▬ More than 10% Difference.

FIGURE III

fairly reasonably. Census tract 21 located in the city of Norway with an accuracy ratio of 79.58 percent can be accounted for by the Anderson Memorial Hospital and the Norway Hotel.

IV. SUMMARY AND CONCLUSIONS

The accuracy check ratio of 93.35 percent for the entire study statistically verifies the completeness of the sample survey on population. These results indicate that the population as tabulated by the expanded Survey sample is representative of the universe.

SCHOOL CENSUS ACCURACY CHECK

I. PURPOSE

The purpose of the School Census Accuracy Check is to compare the expanded Survey sample data of school age population with the school census data.

II. PROCEDURE

This check was performed by comparing the 1968 school census data with the O-D tabulations.

The school census data were obtained in the following manner:

1. School census data for 1968 was obtained from the Dickinson-Iron County Intermediate School District. This included facility location and enrollment.

2. The school district boundaries were noted and all schools (public and parochial) enrollments were totaled by school district.

The Study Survey tabulations of school age population were obtained in the following manner:

1. The 1968 Iron Mountain - Kingsford - Norway survey of population by O-D tract was used as the base.

2. The age groups of 5-9, 10-14 and 15-19 years were combined from the I.A.S. by tracts.

3. The age (5-19 yrs.) group was expanded by the sampling rate for each tract.

III. RESULTS

See Table IV. The 1968 school census data was compared with the 1968 O-D Survey tabulations for school age (5-19 years) population. Discrepancies may be noted. Children may not be in school at 5 years of age, but they may start school at 6 years of age. Children may be out of school before 19 years of age thru graduation or drop-outs. Discrepancies should be small.

The accuracy ratio of 74.88 percent for the City of Norway, Vulcan, Norway and Waucedah twp. can be explained. The Survey area does not include all of Norway Twp. and none of Waucedah Twp. (See Total Dwelling Unit Check). The excluded area is mainly rural in nature. This area should include 100-200 school age children. This would explain most of the discrepancies and also increase the accuracy ratio for the study area which is within the allowable limit of statistical accuracy.

IV. SUMMARY AND CONCLUSIONS

A 90.88 percent check for the entire Survey Area statistically verifies the completeness of the sample survey. The 93.35 percent accuracy ratio for total population and 90.88 percent accuracy ratio for school census indicate that the population as tabulated by the expanded Survey sample is representative of the universe.

TABLE IV

SCHOOL CENSUS DATA

CITY OF IRON MOUNTAIN

O-D Tract	Ages 5-19		
3	270		
4	140		
5	110		
9	135		
10	245		
11	330		
12	270		
13	30		
14	225		
15	235	INDEPENDENT DATA	ACCURACY RATIO
TOTAL	1,990	2,215	89.84

CITY OF KINGSFORD and BREITUNG TOWNSHIP

O-D Tract	Ages 5-19		
1	272		
2	36		
8	23		
16	280		
17	530		
18	405		
19	310		
20	255		
21	285	INDEPENDENT DATA	ACCURACY RATIO
TOTAL	2,396	2,394	100.08

CITY OF NORWAY - VULCAN - NORWAY TWP. (WAUCEDAH TWP.)

O-D Tract	Ages 5-19		
6	19		
7	10		
22	150		
23	200		
24	320		
25	75		
26	150	INDEPENDENT DATA	ACCURACY RATIO
TOTAL	924	1,234	74.88

STUDY AREA

TOTAL	5,310	5,843	90.88

SCHOOL CENSUS ACCURACY CHECK

IRON MOUNTAIN, KINGSFORD AND NORWAY AREA TRANSPORTATION STUDY

LEGEND
• • CORDON LINE
• • • CENSUS TRACT
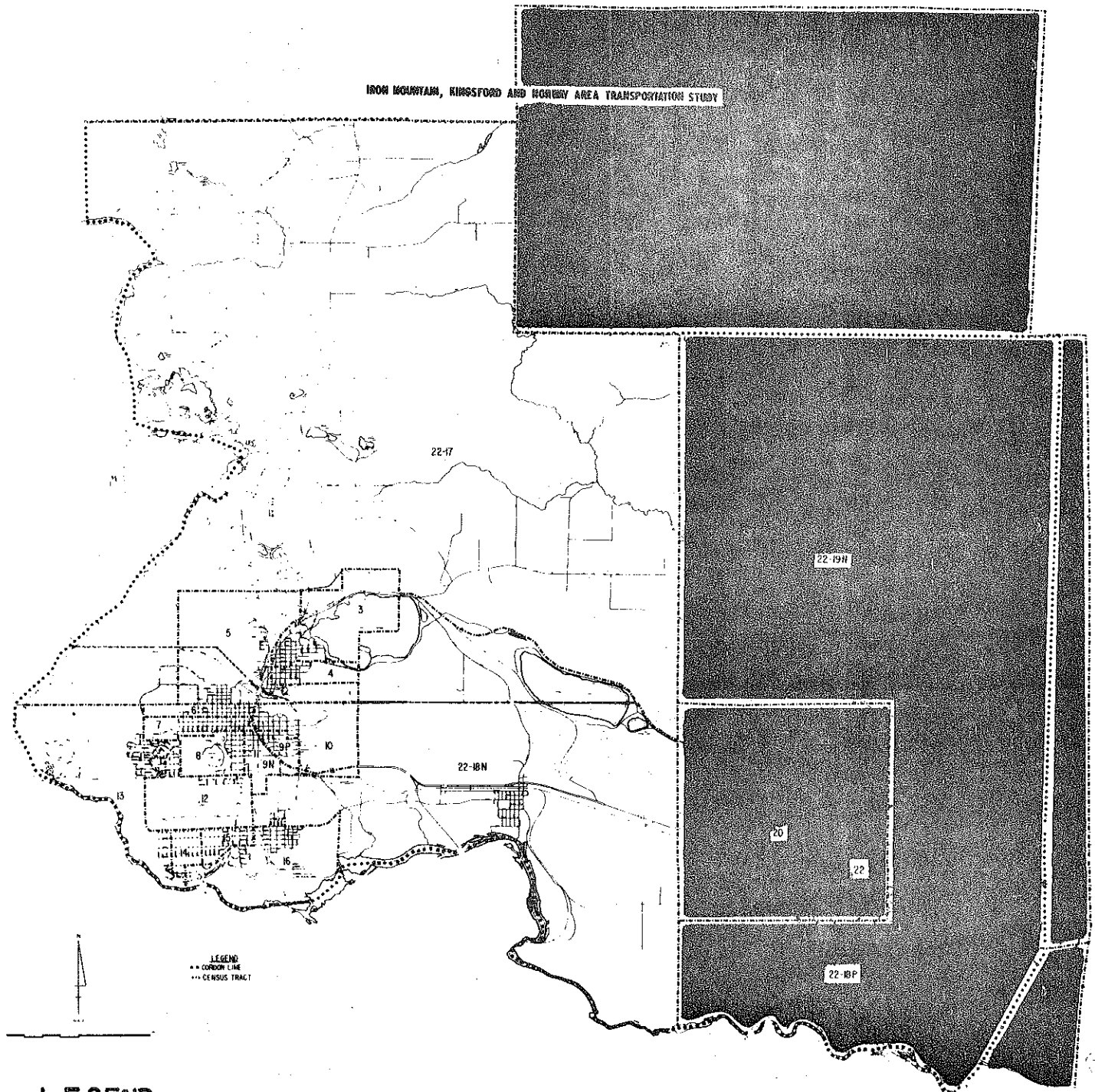
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▰ More than 10% Difference.

FIGURE IV

AUTOMOBILE ACCURACY CHECK

I. PURPOSE

The purpose of the Automobile Accuracy Check is to compare the expanded Survey sample data automobiles owned by or garaged at households in the Iron Mountain- Kingsford - Norway area with the census update of automobiles available by Governmental Unit.

II. PROCEDURE

This check was performed by comparing updated census data with the O-D tabulations.

The census update of automobiles available was performed in the following manner:

1. The 1960 ratio of registered autos in Dickinson County to those in each governmental unit was used to determine the 1968 auto availability.

2. The above ratio, combined with the 1968 Dickinson County registrations, thereby provided the 1968 figures.

The Study Survey tabulations of automobiles were obtained in the following manner:

1. The 1968 Iron Mountain - Kingsford - Norway survey of automobiles owned or garaged at households in the Survey area was used as the base.

2. Expansion factors were calculated for each tract based on the sampling rate.

3. Vacant dwelling units as well as incomplete
    interviews within each particular tract was
    taken into consideration.

4. Automobiles were tabulated by O-D zone (See B-1
    Table) Automobiles by zone were combined into O-D
    Tracts (See O-D tract - O-D zone equivalence table)
    for the automobile accuracy check.

III. RESULTS

See Table V. The 1968 census update of automobiles available
was compared with the 1968 O-D Survey tabulations of automobiles
available by means of ratio analysis. The result of the Automobiles
Available Check shows a 103.57 percent accuracy ratio for the study
area.

IV. SUMMARY AND CONCLUSIONS

The accuracy check ratio for the study area and sub-areas are
within the allowable limits of statistical accuracy. Therefore,
the Automobiles Available Survey is representative of the true
universe of automobiles available.

TABLE V

AUTOS AVAILABLE

CITY OF IRON MT.

O-D Tract	O-D* Autos
3	468
4	313
5	245
9	202
10	333
11	575
12	533
13	161
14	341
15	358
TOTAL	3,529

INDEP. DATA 3,410

ACCURACY RATIO 103.49

CITY OF KINGSFORD

O-D Tract	O-D* Autos	
16	561	
17	730	
18	421	
19	445	Indep.Data
TOTAL	2,157	2,198

ACCURACY RATIO 98.13

CITY OF NORWAY

O-D Tract	O-D* Autos	
7	19	
22	267	
23	502	
24	574	Indep.Data
TOTAL	1,362	1,139

119.58

BREITUNG TWP

O-D Tract	O-D Autos*	Indep. Data	Accuracy Ratio
1	429		
2	49		
8	22		
20	453		
21	434		
TOTAL	1,387	1,380	100.51

NORWAY TWP.

O-D Tract	O-D Autos*	Indep. Data	Accuracy Ratio
6	29		
25	107		
26	226		
TOTAL	362	368	98.37

	O-D	INDEP. DATA	ACCURACY RATIO
TOTAL	8,797	8,495	103.57

*Source: B-1 Table

AUTOMOBILE ACCURACY CHECK

IRON MOUNTAIN, KINGSFORD AND NORWAY AREA TRANSPORTATION STUDY

22-17

22-19N

22-18N

22-18P

LEGEND
CORDON LINE
CENSUS TRACT
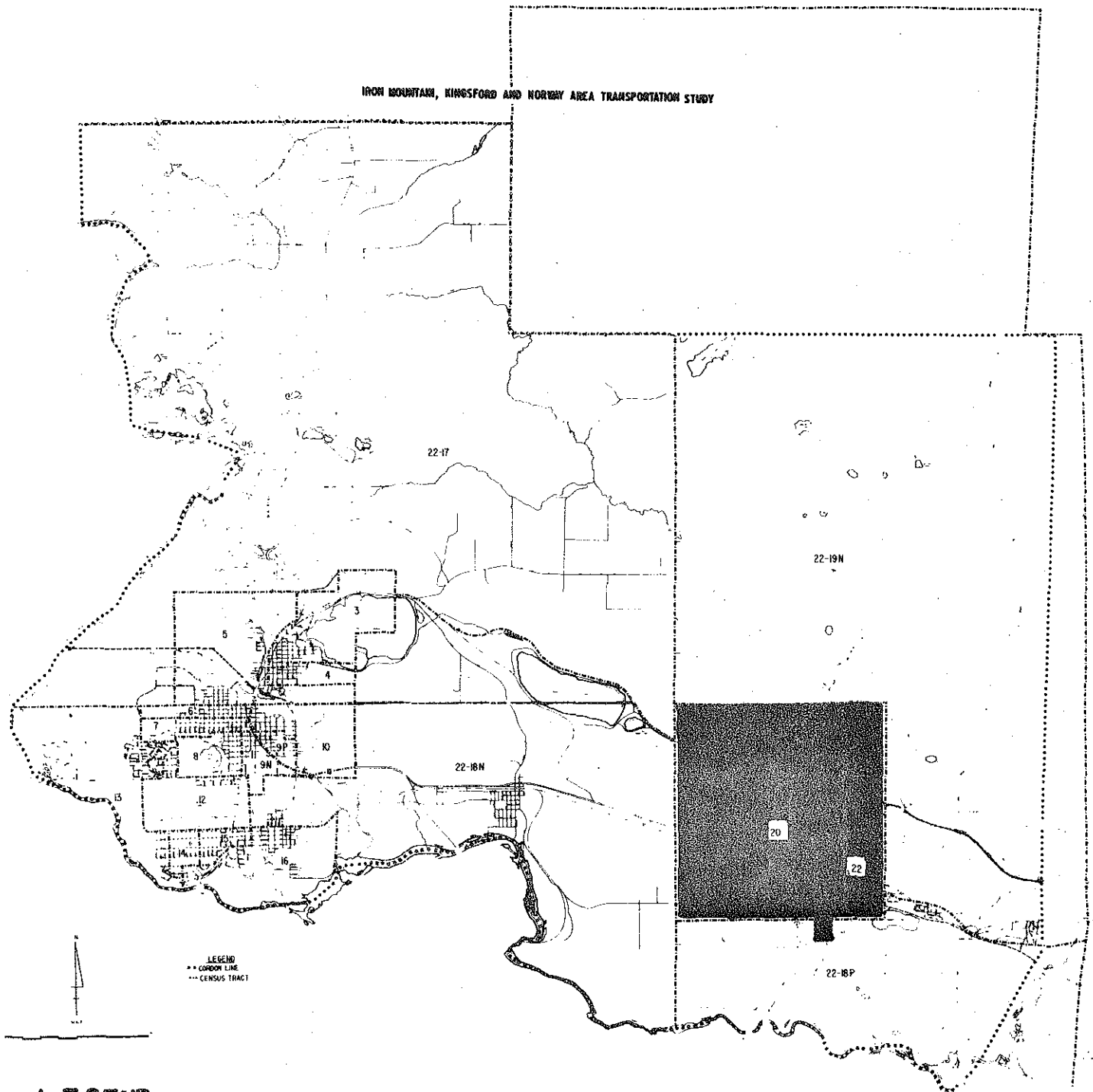
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More than 10% Difference.

FIGURE V

RESIDENT LABOR FORCE ACCURACY CHECK

I. PURPOSE

The purpose of the Resident Labor Force Accuracy Check is to compare the expanded Survey sample data of resident labor force with the updated census data.

II. PROCEDURE

This check was performed by comparing updated census data with the 1968 O-D tabulations.

The census update of the labor force was performed in the following manner:

1. The ratio of population to labor force, for 1960, was used as the base.

2. It was assumed that the 1960 ratio of population to labor force for each governmental unit was also applicable for 1968.

3. The 1968 population was multiplied by the 1960 ratio of population to labor force. Since the 1960 labor force was only given by governmental unit, 1968 estimates were also made by governmental unit.

The Study Survey tabulations were obtained in the following manner:

1. The 1968 Iron Mountain - Kingsford - Norway survey of resident labor force was used as the base.

2. Expansion factors were calculated for each tract based on the sampling rate.

3. The 1968 survey sample of persons employed and unemployed were multiplied by the expansion factor for that particular tract.

III. RESULTS

See Table VI. The 1968 census update of resident labor force was compared with 1968 0-D Survey tabulations of resident labor force by means of ratio analysis. The accuracy check for the total resident labor force for Iron Mountain was 94.02 percent, Kingsford was 98.22 percent, Norway was 91.90 percent and the three cities were 94.79 percent. These are well within the allowable limit of statistical accuracy. The Survey data had more than three times as many unemployed persons in the resident labor force as the updated census data! The discrepancy can be explained. "It was assumed that the 1960 ratio of population to labor force---was also applicable for 1968." Since 1960, there has been a reduction of lumbering and mining. The Upper Peninsula has been suffering from high unemployment rates. The Survey was taken during the months of June and July, 1968. The influx of students into the labor market will boost unemployment.

IV. SUMMARY AND CONCLUSIONS

The accuracy check ratio for the total resident labor force for the sub-study areas and the three cities total are well within acceptable limits and verifies the completeness of the sample survey on resident labor force. These results indicate that the resident labor force as tabulated by the expanded Survey sample is representative of the universe.

There will not be a First Work Trip Accuracy Check at this time for the following reasons:

1. A first work trip computer program is not available.

2. From the list of major employers in the Survey area, eleven employers had more than 100 employees. The maximum number of employees were only 410 employees at Hanna Mining Company.

3. Many of the employees are part time or seasonal employees.

4. Seasonal employees are usually hired and work outside the Survey area.

5. The largest employer is Kimberly Clark Corporation, which is located in Niagara, Wisconsin. They have 830 employees. Many employees live within the Survey area and work in Wisconsin.

6. Many firms are located outside the Survey area, but they use an Iron Mountain address.

TABLE VI

RESIDENT LABOR FORCE

CITY OF IRON MOUNTAIN

O-D TRACT	EMPLOYED	UNEMPLOYED	TOTAL
3	330	125	455
4	310	65	375
5	260	40	300
9	140	75	215
10	230	80	310
11	425	100	525
12	355	120	475
13	90	35	125
14	245	65	310
15	265	150	415
O-D TOTAL	2,650	855	3,505
Indep. Data	3,456	272	3,728
Accuracy Ratio	76.68	314.33	94.02

CITY OF KINGSFORD

	EMPLOYED	UNEMPLOYED	TOTAL
16	325	120	445
17	515	115	630
18	290	135	425
19	265	115	380
O-D TOTAL	1,395	485	1,880
Indep. Data	1,774	140	1,914
Accuracy Ratio	78.64	346.43	98.22

CITY OF NORWAY

	EMPLOYED	UNEMPLOYED	TOTAL
7	12	2	14
22	180	70	250
23	295	145	440
24	360	105	465
O-D TOTAL	847	322	1,169
Indep. Data	1,179	93	1,272
Accuracy Ratio	71.84	346.24	91.90

3-CITIES				
	O-D	4,892	1,662	6,554
	Indep. Data	6,409	505	6,914
	Accuracy Ratio	76.33	329.11	94.79

RESIDENT LABOR FORCE ACCURACY CHECK

IRON MOUNTAIN, KINGSFORD AND NORWAY AREA TRANSPORTATION STUDY

22-17

22-19N

3

5

4

6

7

8

9P

9N

10

22-18N

13

12

20

14

22

16

22-18P

LEGEND
CORDON LINE
CENSUS TRACT
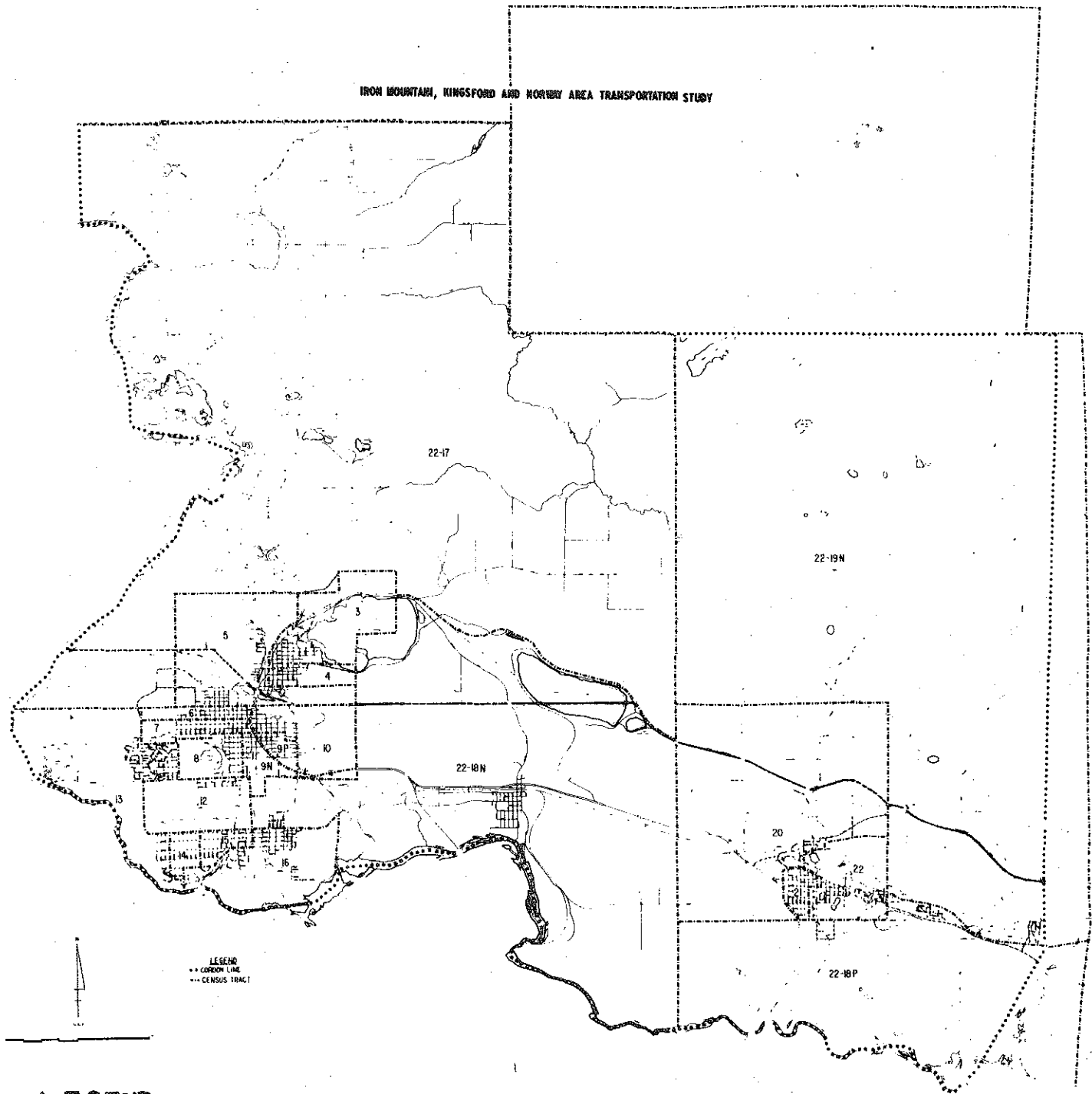
L EGEND:

Less than 10% Difference.

More than 10% Difference.

FIGURE VI

INCOME ACCURACY CHECK

I. PURPOSE

The purpose of the Income Accuracy Check is to compare the 1968 O-D Survey sample data with independent data in order to check for consistency.

II. PROCEDURE

This check was performed by comparing the updated independent data with the O-D tabulations. Both median income and household income by category were compared.

The independent estimate of median income and income by range was performed in the following manner:

1. The ratio of household income between Dickinson County and the local government units, for 1960, was used as the base. Figures were used from "Sales Management" magazine.

2. This ratio along with 1968 estimates for Dickinson County were used to obtain local area household income.

The Study Survey tabulations were obtained in the following manner:

1. The 1968 Iron Mountain - Kingsford - Norway survey for income was used as the base.

2. Expansion factors were calculated for each tract based on the sampling rate.

-30-

3. The 1968 survey sample by each income group was
    multiplied by the expansion factor for that particular
    tract.

4. For calculation of median income, the number of
    expanded households in a particular income group
    was multiplied by the mid-point of that particular
    income group. The highest income group was $16,000
    and over. For this group, $16,000 was used as the
    mid-point.

The independent data of household income by category had:
$5,000 - $7,999 and $8,000 - $9,999 categories. The O-D Survey
had $5,000 - $6,999; $7,000 - $8,999; and $9,000 - $9,999 categories.
These independent and the O-D categories were combined for comparison
purposes into a $5,000 -$9,999 category.

III. RESULTS

See Tables VII, VIII, IX, and X. Both median income and income
by range show similar results. This similarity indicates a consistency
in the data in that differences revealed by median income were
reiterated by the income by category check.

IV. SUMMARY AND CONCLUSIONS

Income is a very difficult data item to obtain accurately. One
reason is the tendency of persons to consider it a private matter and
they are not anxious to make it public. Another reason may be that
persons may be inclined to over or under state their income. Both
checks indicate areas of both close agreement and wide disparities
between the data sets.

It is our judgment that there are serious discrepancies in the income comparison checks. Income (at this time) will not be used in Trip Generation. The Income Accuracy Check was included in this report for information purposes! If income data is used in Trip Generation further checks will be made. Income checks will not be included in the summary.

TABLE VII
HOUSEHOLD
INCOME

CITY OF IRON MOUNTAIN

O-D TRACT	$ 1,500	$ 4,000	$ 6,000	$ 8,000	$ 9,500	$ 11,000	$ 13,000	$ 15,000	$ 16,000+
3	135	70	65	45	10	20	10	5	
4	70	50	35	65	20	20			
5	50	15	45	20	5	15		5	5
9	70	25	35	35	10				
10	90	35	25	60	20	15	5		10
11	110	20	35	60	45	30	5	20	25
12	40	70	50	75	25	35	15	20	15
13	30	10	35	10			5		10
14	80	45	35	25	20	10	15	5	
15	135	40	65	25	20	30	10	5	10
TOTAL	810	380	425	420	175	175	65	60	75
	1,215,000	1,520,000	2,550,000	3,360,000	1,662,500	1,925,000	845,000	900,000	1,200,000

O-D
Household
Income
$$\frac{15,177,500}{2,065} = \$5,871$$ Indep. $7,443   Accuracy Ratio   78.88

-33-

TABLE VIII
SEH
INCOME

CITY OF KINGSFORD

O-D TRACT	$ 1,500	$ 4,000	$ 6,000	$ 8,000	$ 9,500	$ 11,000	$ 13,000	$ 15,000	$ 16,000+
16	55	75	65	40	30	45	25	15	20
17	85	45	90	85	30	50	30	15	15
18	115	45	70	65	20	25	5	5	
19	130	45	40	60	10	25	5		
TOTAL	385	210	265	250	90	145	65	35	35
	577,500	840,000	1,590,000	2,000,000	855,000	1,595,000	845,000	525,000	560,000

O-D Household Income $\frac{\$9,387,500}{1,480}$ = $6,343   Independent $7,580   Accuracy Ratio 83.68

CITY OF NORWAY

O-D TRACT	$ 1,500	$ 4,000	$ 6,000	$ 8,000	$ 9,500	$ 11,000	$ 13,000	$ 15,000	$ 16,000+
7	4		3		1		1		1
22	60	30	35	35	15	5			5
23	110	65	40	60	25	35	15		5
TOTAL	174	95	78	95	41	40	16		11
	261,000	380,000	468,000	760,000	389,500	440,000	208,000		176,000

O-D Household Income $\frac{\$3,082,500}{550}$ = $5,605   Independent $7,087   Accuracy Ratio 79.09

STUDY AREA

O-D TRACT	$ 1,500	$ 4,000	$ 6,000	$ 8,000	$ 9,500	$ 11,000	$ 13,000	$ 15,000	$ 16,000
TOTAL	1718	953	1091	990	411	435	181	121	140
	2,577,000	3,812,000	6,546,000	7,920,000	3,904,500	4,785,000	2,353,000	1,815,000	2,240,000

O-D Household Income $$\frac{35,952,500}{6040} = \$5,952$$ Independent $7,028 Accuracy Ratio 84.69

TABLE X

HOUSEHOLD INCOME

CITY OF IRON MOUNTAIN

	$0-2,999	$3,000-4,999	$5,000-9,999	$10,000 and over	TOTAL
O-D Data	810	380	1,020	375	2,585
Independent Data	849	609	1,451	382	3,291
Accuracy Ratio	95.41	62.40	70.30	98.17	78.55

CITY OF KINGSFORD

	$0-2,999	$3,000-4,999	$5,000-9,999	$10,000 and over	TOTAL
O-D Data	385	210	605	280	1,480
Independent Data	453	325	774	203	1,755
Accuracy Ratio	84.99	64.62	78.17	137.93	84.33

CITY OF NORWAY

	$0-2,999	$3,000-4,999	$5,000-9,999	$10,000 and over	TOTAL
O-D Data	174	95	214	67	550
Independent Data	305	218	521	137	1,181
Accuracy Ratio	57.05	43.58	41.07	48.91	46.57

THREE CITIES

	$0-2,999	$3,000-4,999	$5,000-9,999	$10,000 and over	TOTAL
O-D Data	1,369	685	1,839	722	4,615
Independent Data	1,607	1,152	2,746	722	6,227
Accuracy Ratio	85.19	59.46	66.97	100.00	74.11

SOCIO-ECONOMIC ACCURACY CHECK

SUMMARY

	ACCURACY RATIO
Total Dwelling Units	96.37
Occupied Dwelling Units	93.66
Population	93.35
School Census	90.88
Autos Available	103.57
Resident Labor Force	94.79

Furthermore, the checks on a Census Tract basis are equally representative of the universe.

The above summary shows that for the data items which were checked, all fall well within acceptable limits. The conclusion to be made is that the O-D study data accurately reflects the socio-economic characteristics of the study Area. Therefore, it is our judgment that the O-D socio-economic data can and will be used in later phases of the study, especially Trip Generation. Based on the findings and conclusions documented in this section of this report, it is recommended to proceed with the Travel Characteristics Accuracy Checks.

CORDON LINE COMPARISON

I. PURPOSE

The purpose of the Cordon Line Comparison accuracy check is to determine the accuracy with which the Internal Survey duplicated the External Survey. A cordon trip has one trip end within the Survey Area and the other trip end outside the Survey Area. This accuracy check compares cordon trips, made by residents living within the Survey Area, that are sampled in both the Internal and External Surveys. These trips were therefore sampled twice and one set of data must be eliminated from the trip files to eliminate duplication.

Since the sampling rate in the External Survey was 93 percent and in the Internal Survey only 25 percent, the External Survey is more likely to accurately reflect Cordon Line trips. Thus, the Internal data for these cordon trips was eliminated.

The duplication of these trips gives an accuracy check on the expansion of the Internal Survey data.

II. PROCEDURE

The MDSH's Cordon Line Comparison Program summarizes the cordon trips made by vehicles garaged within the cordon. The number of trips from both the Internal and External Surveys were tabulated by hour period, by direction, by 24-hour period and by vehicle type. Passenger cars and taxis are grouped together as are all truck types. The external stations on the Cordon Line are shown in Figure XIA.

III. RESULTS

See Table XI. This table indicates that 4,421 autos-taxis and 878 trucks, for a total of 5,299 vehicles, were reported crossing the Cordon Line from the Internal Survey. The External Survey reported 5,380 autos-taxis and 1,046 trucks, for a total of 6,426 vehicles. The overall comparison of 82.46 percent was therefore obtained.

Graphs were drawn of the hourly distribution of the two vehicle type groups and for total vehicles. See Figures XIB, XIC and XID. There was an hour shift in the graphs. There is a time lag on the trips reported in the Internal Survey because the beginning time of the trip is assigned as the time of crossing the Cordon Line. If this hour shift was not done, this would result in a skewed graph. This occurs particularly in large areas such as this Survey area.

IV. SUMMARY AND CONCLUSIONS

The Cordon Line Compairson shows an accuracy ratio of 82.17 percent for autos-taxis and 83.94 percent for trucks. The overall comparison was 82.46 percent. There is consistency in data tabulations. The graphical plots of total and individual vehicle type comparisons were considered reasonable. It was therefore concluded that the Internal Survey successfully duplicated the cordon trips reported in the External Survey and that the internal trip duplication should be eliminated from the trip files.

TABLE XI

CORDON LINE COMPARISON

CORDON TRIPS	INTERNAL SURVEY	EXTERNAL SURVEY	PERCENT COMPARISON
Autos-Taxis	4,421	5,380	82.17
Trucks	878	1,046	83.94
Total	5,299	6,426	82.46

IRON MOUNTAIN–KINGSFORD–NORWAY O-D
EXTERNAL STATION LOCATIONS
FIGURE XIA

IRON MOUNTAIN, KINGSFORD AND NORWAY AREA TRANSPORTATION STUDY
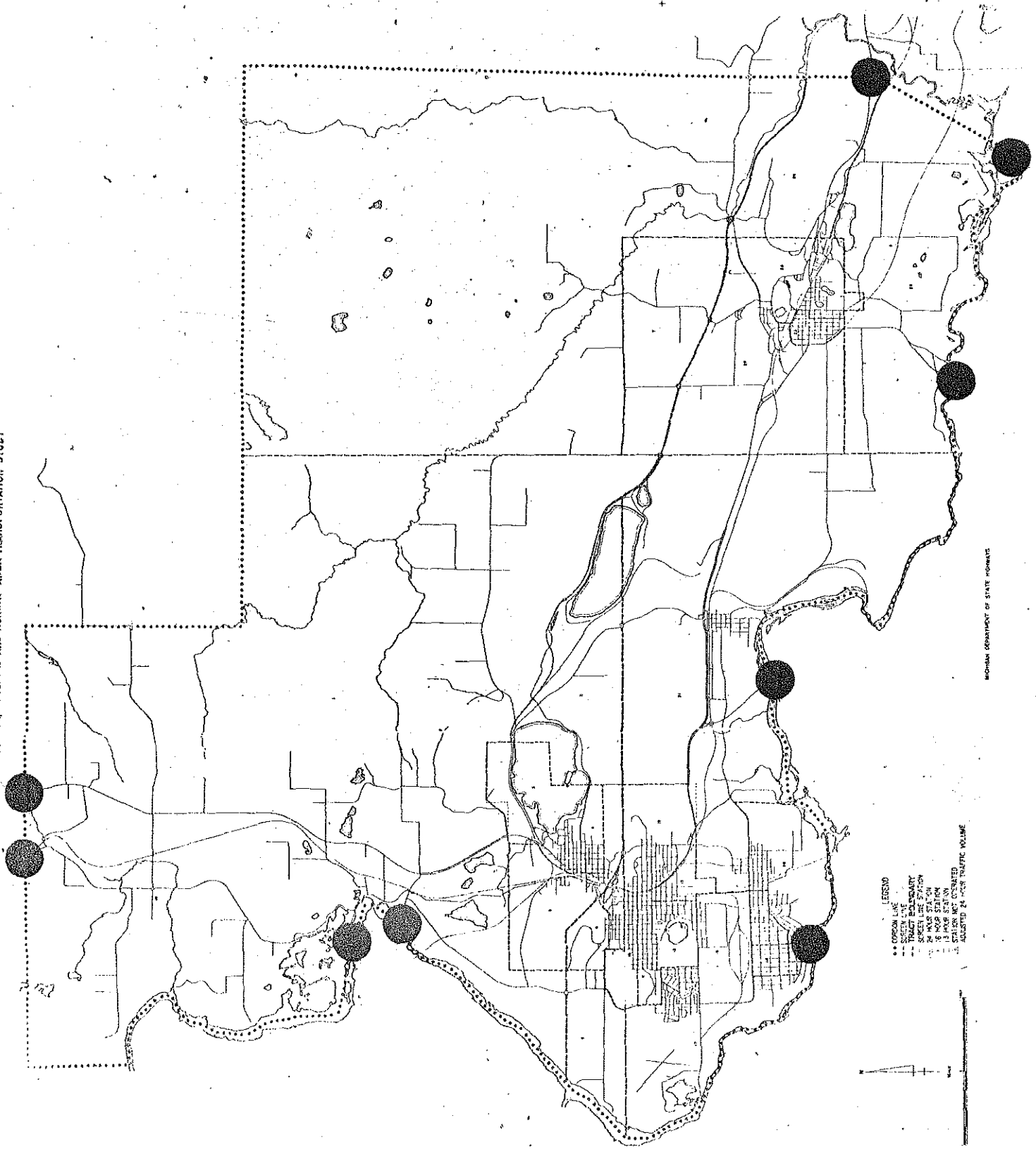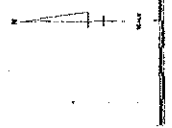
Iron Mountain–Kingsford–Norway O-D
Passenger Car and Taxi
Figure XIB
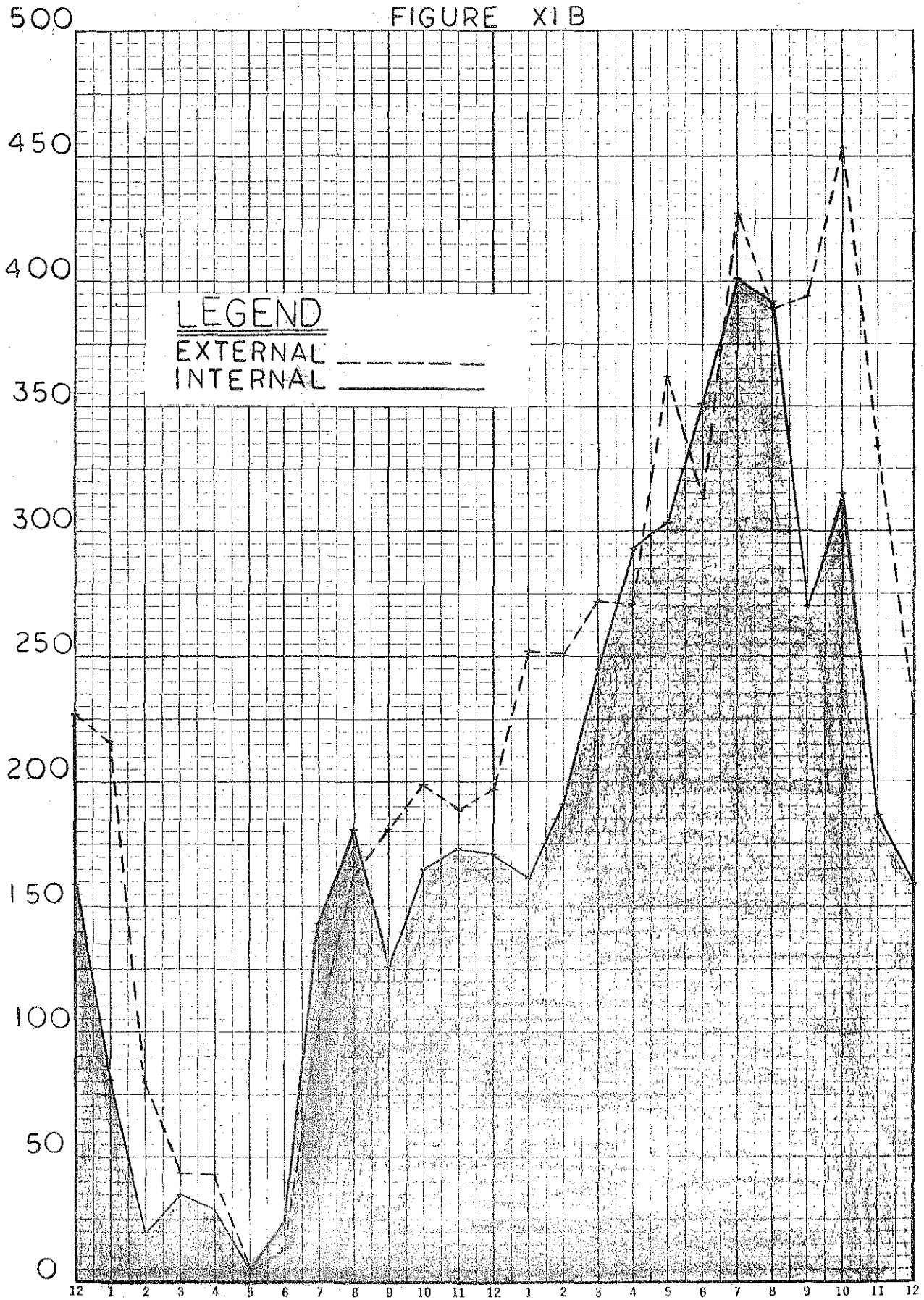
LEGEND
EXTERNAL ─────
INTERNAL ─────

IRON MOUNTAIN – KINGSFORD – NORWAY O-D
TRUCKS
FIGURE XI-C

LEGEND
EXTERNAL – – – –
INTERNAL ————
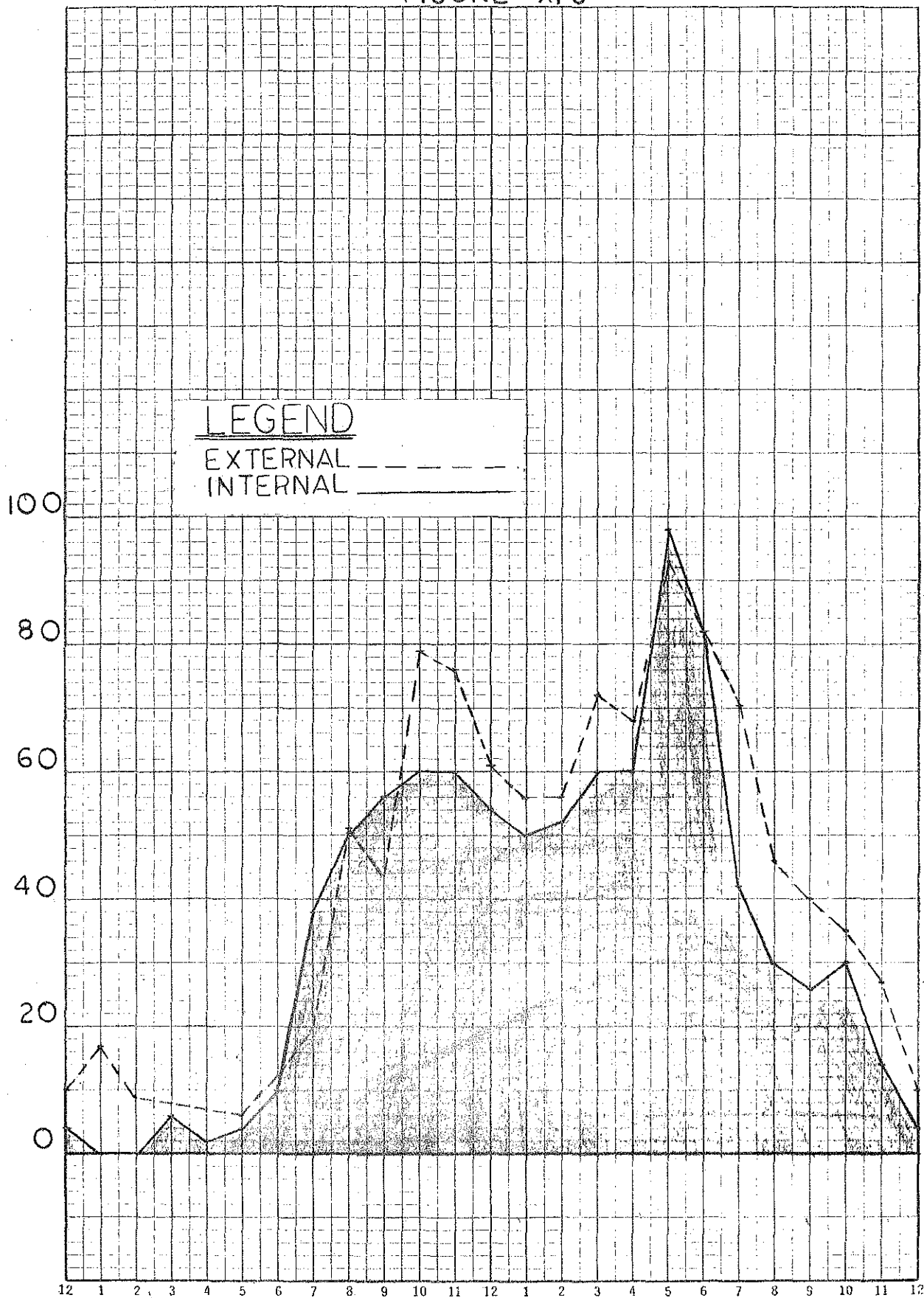
IRON MOUNTAIN - KINGSFORD - NOPWAY O-D
TOTAL VEHICLES
FIGURE XI D
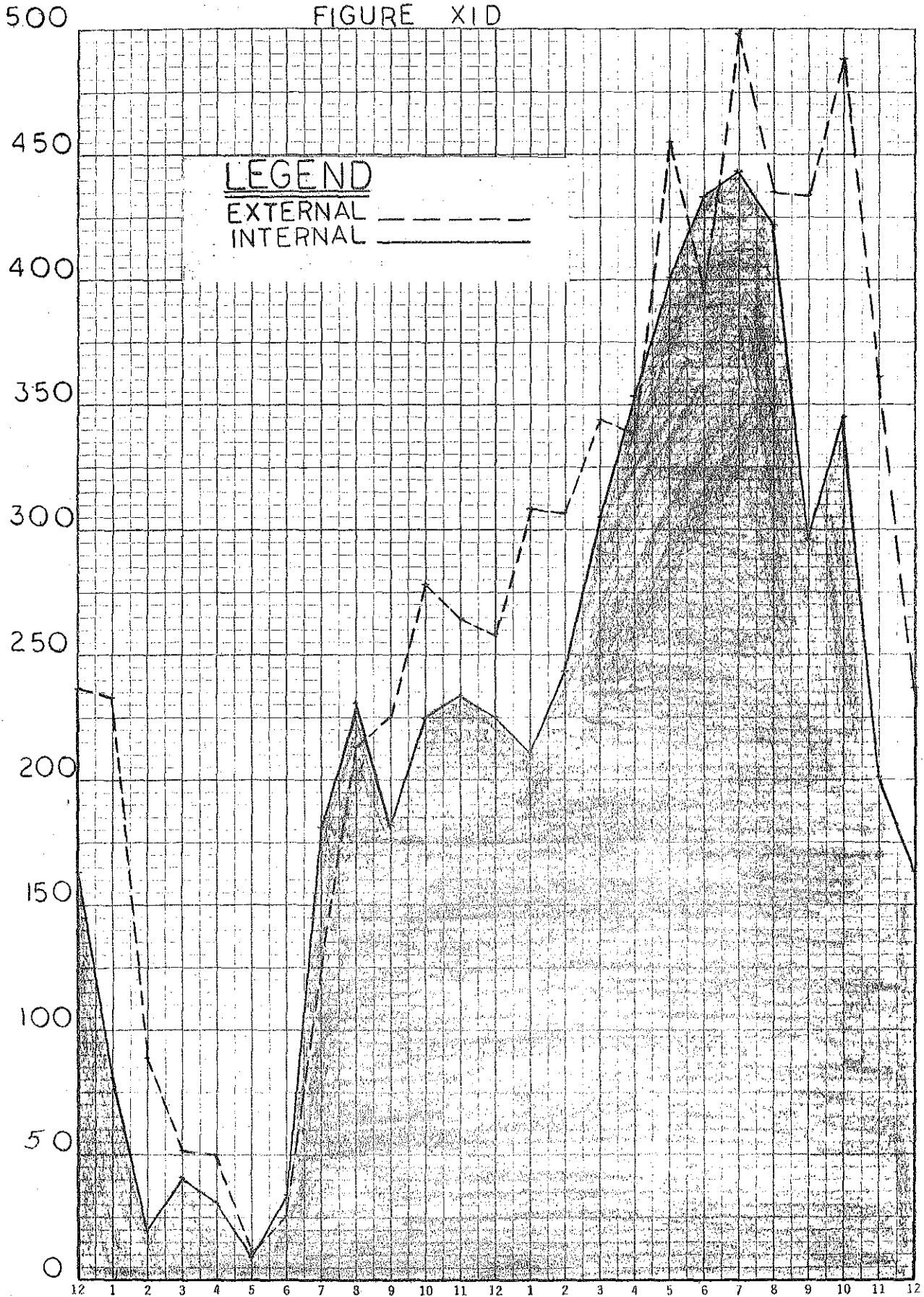
LEGEND
EXTERNAL _ _ _ _ _
INTERNAL _____

SCREENLINE ACCURACY CHECK

I. <u>Purpose</u>

   The purpose of the Screenline Accuracy Check
is to determine the completeness and accuracy with
which vehcile trips are reported in the Internal
and Truck-Taxi Surveys. Expanded vehicle trips by
each vehicle type are compared to the manual classi-
fication of vehicles crossing the screenline.

II. <u>Procedure</u>

   Manual classification and machine counts were
taken at each of the nine screenline stations. Since
Screenline Station Number Three carries 84 percent
of the total screenline volume, it was designated
as a key station and machine counts were taken for
the complete study period. The screenline counts
at each of the screenline stations were checked for
daily and monthly variations.

   The Iron Mountain-Kingsford-Norway Study Area
was divided into 162 zones, which includes 9 external
stations. The screenline was so situated that it
extended entirely across the internal area and that
it follows, not cut, traffic zone boundaries. The
M.D.S.H. Screenline Comparison Program summarized the
expanded reported vehicle trips with an origin on one

side and a destination on the other side for each
hour period according to the time the trip began.
This was done for each vehicle type.

III. Results

The result of the Screenline Accuracy Check
as shown in Table Xll was 74.1 percent comparison
over all.

Graphs were drawn of the hourly distribution of
each vehicle type. Figure XlllA shows the hourly
distribution of all vehicles crossing the screen-
line and Figure XlllB shows auto-drivers (passenger
cars). The similarity of the distributions shown in
these two graphs results because autos comprise 85.04
percent of the vehicles counted at the screenline.
The largest discrepancies occurred during the midday.

Figure XlllC shows the distribution for all types
of trucks. Single unit trucks and trailer combination
trucks were not shown separately because "trucks" are
sampled in the truck survey without regard to "type".
Since trucks were sampled as a group and will be
treated as such in the trip generation phase, they
will be referred to only as trucks in the text of this
report.

Figure X111D shows the distribution for taxi
trips crossing the screenline. The hourly comparisons
are not good, but the 24-hour comparison of 26 reported
vs. 28 counted taxis for a 92.9 percent comparison is
good. Taxis comprise only 0.15 percent of the ground
crossings.

When the screenline comparisons were made, the
extent of multiple screenline crossings was not
known. It could not be of any substantial volume.
There are only nine screenline stations. Screenline
Station Number Three carries 83.65 percent of the total
screenline crossings. No other screenline station
carries more than five percent of the total screenline
crossings. For multiple crossings to occur, the
vehicle would have to travel two to five times further.
The Screenline Assignment Accuracy Check gives further
analysis of multiple screenline crossings.

IV. Summary and Conclusion

The basic conclusions, based on results of the
Screenline Accuracy Check, are that under-reporting
exists and that therefore, adjustments are needed to
the trip files. Because passenger car trips, which
comprise 85.04 percent of the vehicles crossing the
screenline, had a 75.4 percent comparison, these
trips must be factored to the ground count.

-47-

The results of the truck comparison was 66.5 percent for total truck crossing the screenline. A factor must be applied to increase the number of reported trucks crossing the screenline. Truck travel accounts for only 14.81 percent of the vehicles crossing the screenline.

Because taxis had such a close comparison - 92.9 percent or 26 of 28 trips - and because they comprise of only 0.15 percent of the vehicles crossing the screenline, no factoring will be done to the taxi trips.

TABLE XII

Screenline Accuracy Check

Vehicle Check	Ground Count Crossings	Reported Crossings	Percent Comparison
Autos	16,289	12,282	75.4
Single-Unit	2,607	1,696	65.1
Combination	231	191	82.7
Total Trucks	2,838	1,887	66.5
Taxis	28	26	92.9
Total Vehicles	19,155	14,195	74.1

SCREENLINE

IRON MOUNTAIN, KINGSFORD AND NORWAY AREA TRANSPORTATION STUDY

FIGURE XIIA

-50-
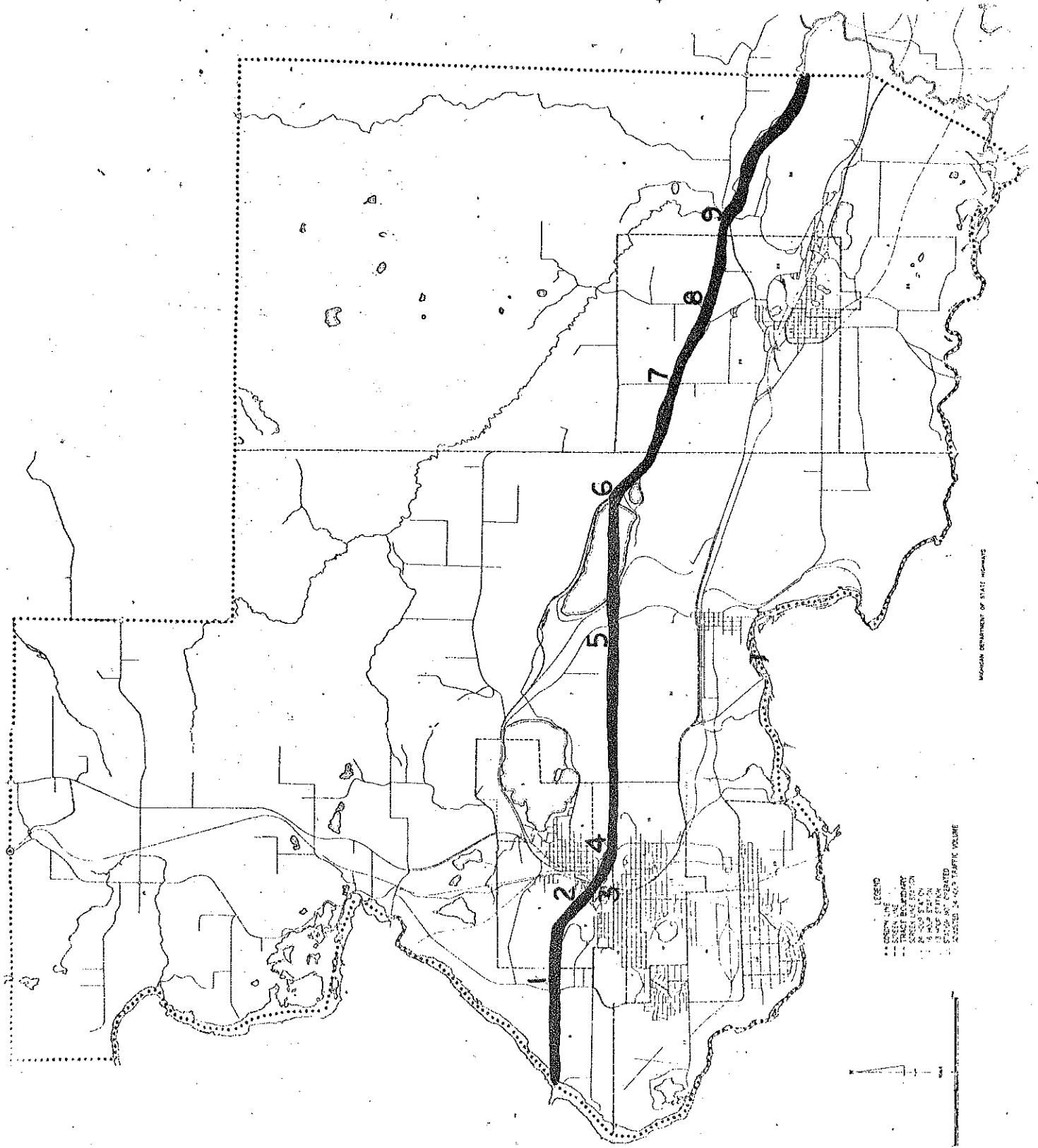
TABLE XIIA

IRON MOUNTAIN-KINGSFORD-NORWAY AREA

SCREENLINE STATION LOCATIONS

STATION NO.	ROAD OR ROUTE	LOCATION
1	Western Avenue	0.3 Mi. N. of Holland 0.6 Mi. S. of Lehman
2	Kimberly	0.3 Mi. SW of Sixth Street
*3	US-2, US-141, M-95	Between Kent & Third (on Bridge)
4	Park Ave. (East side Cutoff)	0.4 Mi. N. of A Street
5	Quinnesec	0.9 Mi. N. of Quinnesec - N. of US-2
6	County Road #336	1.2 Mi. N. of US-2
7	Section "5" Road	0.2 Mi. N. of Bociak Farm Road
8	Pearneys Lane Road	0.2 Mi. NE of Grosso Farm Road
9	County Road #573 (Sixteenth Aven.- Pine Creek Road)	1.2 Mi. NE of Pearneys Lane Road

*Key Station

TABLE XIII

IRON MOUNTAIN-KINGSFORD-NORWAY
SCREENLINE COUNTS

STA. NO.	PASS. CARS	PERCENT	SINGLE UNIT TRUCKS & BUSES	PERCENT	TRAILER COMB	PERCENT	TOTAL TRUCKS	PERCENT	TAXI	PERCENT	TOTALS	PERCENT
1	714	4.38	165	6.33	0		165	5.81	0		879	4.59
2	637	3.91	104	3.99	1	0.43	105	3.70	2	7.14	744	3.88
3	13705	84.14	2068	79.32	224	96.97	2292	80.76	25	89.29	16022	83.65
4	341	2.09	51	1.95	0		51	1.80	1	3.57	393	2.05
5	364	2.24	62	2.38	3	1.30	65	2.29	0		429	2.24
6	125	0.77	25	0.96	2	0.87	27	0.95	0		152	0.79
7	90	0.55	37	1.42	1	0.43	38	1.34	0		128	0.67
8	124	0.76	44	1.68	0		44	1.55	0		168	0.88
9	189	1.16	51	1.96	0		51	1.80	0		240	1.25
TOTALS	16289	100.00	2607	100.00	231	100.00	2838	100.00	28	100.00	19155	100.00
PERCENT	85.04		13.61		1.20		14.81		0.15		100.00	

TOTAL VEHICLE
SCREENLINE COMPARISON

FIGURE XIIIA

-53-

AUTO— DRIVER
SCREENLINE COMPARISON

FIGURE XIII B

TOTAL TRUCK SCREENLINE
COMPARISON

COUNTED _____
REPORTED _____
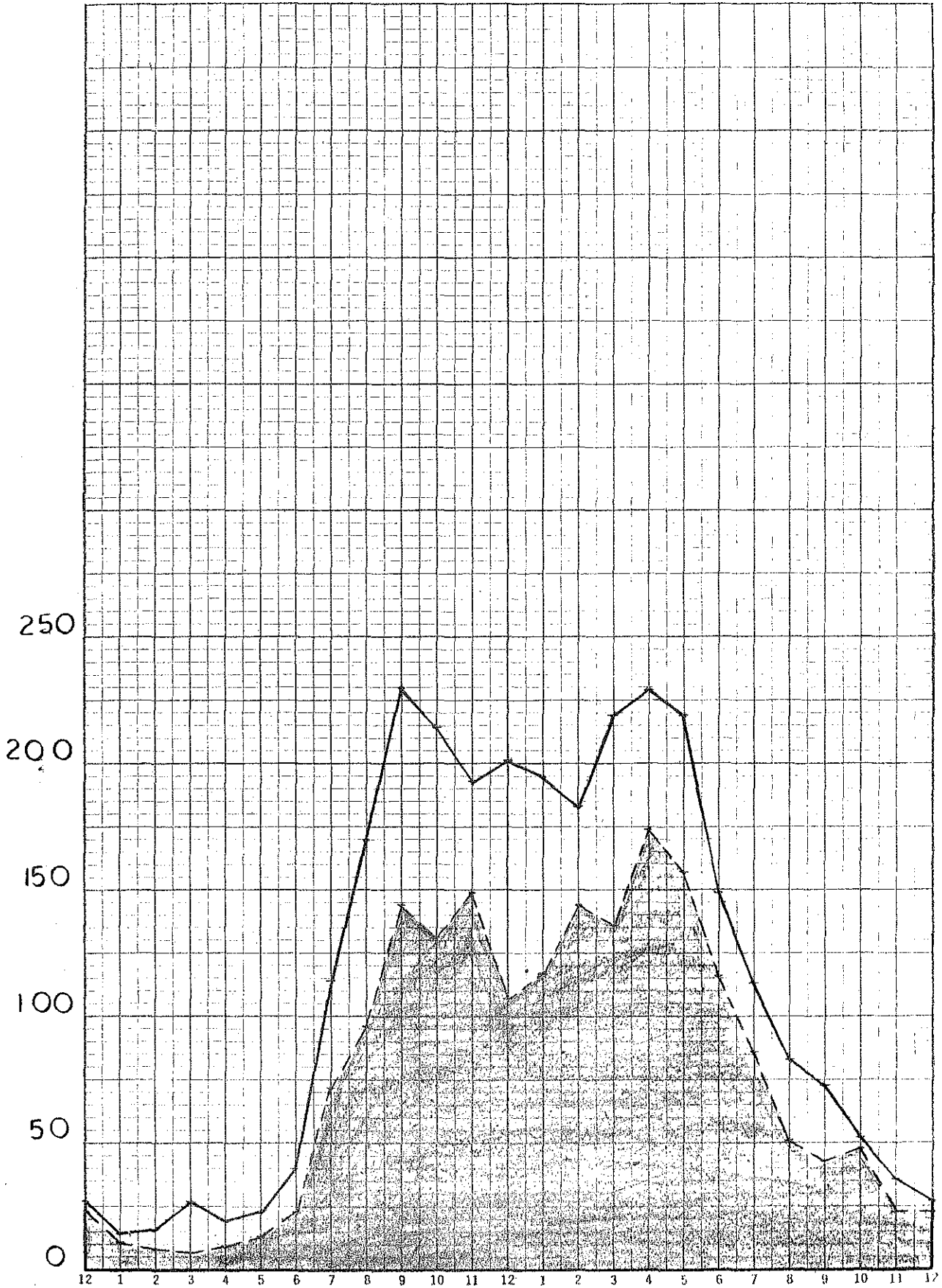
FIGURE XIIIC

-55-

TAXIS
SCREENLINE COMPARISON
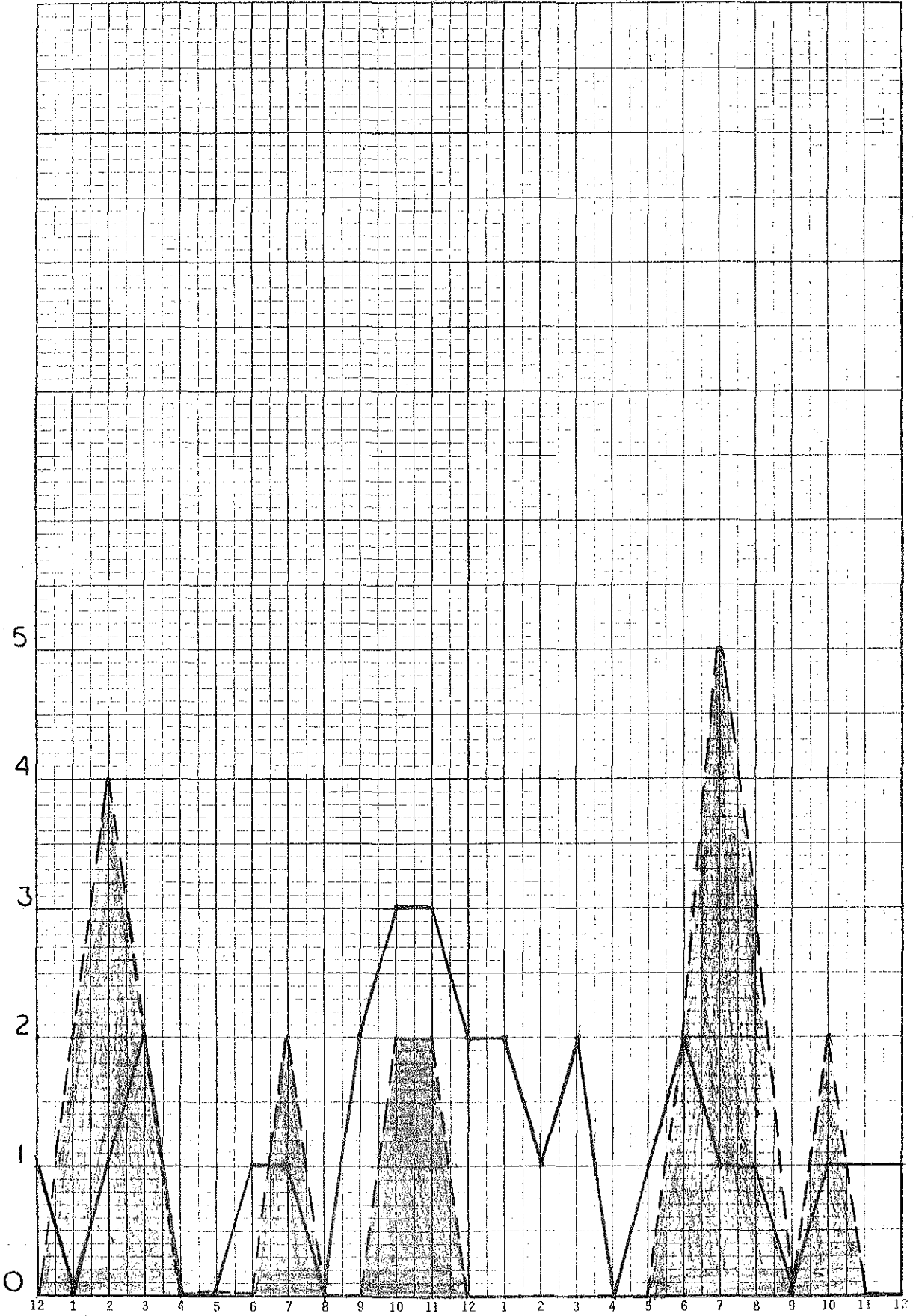
FIGURE XIIID

ASSIGNMENT CHECKS

SECONDARY SCREENLINES AND V.M.T.

I. Purpose

The previous accuracy checks compared area to area move-
ments with no consideration of routes. To make an eval-
uation of the expanded (but unadjusted) trip data when
placed on the street network, an assignment of an
unadjusted trip table to the network was made. These checks
will enable a judgment of the extent of geographic bias
in the reporting (and under-reporting) of trips.

II. Procedure

A series of secondary screenlines were drawn at locations
designed to intercept a substantial number of trips. Figure
XIV shows the location of these screenlines. In addition,
the study area was sub-divided into six jurisdictions
(figure XV) designed to evaluate assigned trips in geograph-
ical areas smaller than the study area. An unadjusted
trip table was assigned to the network. The secondary
screenline analysis was made by tabulating the computer
assigned trips on the links crossing the secondary
screenlines and comparing wtih ground counts on the same
links. Counts were estimated for links where none was
available. The second comparison is of Vehicle Miles
Traveled (V.M.T.) from the assignment and the ground count
in each of the jurisdictions within the study area. VMT

is obtained by multiplying the street(link) distance in miles by the traffic volume. The VMT totals (assigned and ground count) for all the links within each jurisdiction were added and compared.

III Results

The results of the secondary screenline comparisons are given in Table XIV. An examination of those screenlines that showed substantial deviation indicated that, in most instances, the problem was one that could be eliminated by calibration. As often is the case in an uncalibrated network a substantial over-assignment to the state trunklines occurred. The percent comparisons for the CBDs of 73.5, 77.5 and 85.1 percent are in general agreement with the 74.1 percent comparison at the primary screenline. The 81.4 percent comparison for the total secondary screenlines compares favorably with the 82.5 percent agreement at the cordon line and the 74.1 percent agreement at the primary screenline.

Further analysis of the unadjusted assignmnet was made using the VMT from the assignment with the count VMT. Table XV gives the results of this comparison. The total VMT comparison is in general agreement with the 74.1 percent comparison at the primary screenline and the 82.5 percent comparison at the cordon line. Traffic in the central area

is being diverted to faster facilities, therefore bypassing the central areas.

IV. Summary and Conclusions

The net result of all the Secondary Screenlines was an 81.4 percent comparison and 85.5 percent comparison for the V.M.T. From these results, it was concluded that the assignment process reasonably distributed reported vehicular trips. It was also concluded that under-reporting exists in the internal survey and therefore, the trip files should be adjusted. It was also determined that the network should be calibrated and that proper calibration of the network will result in better comparisons.
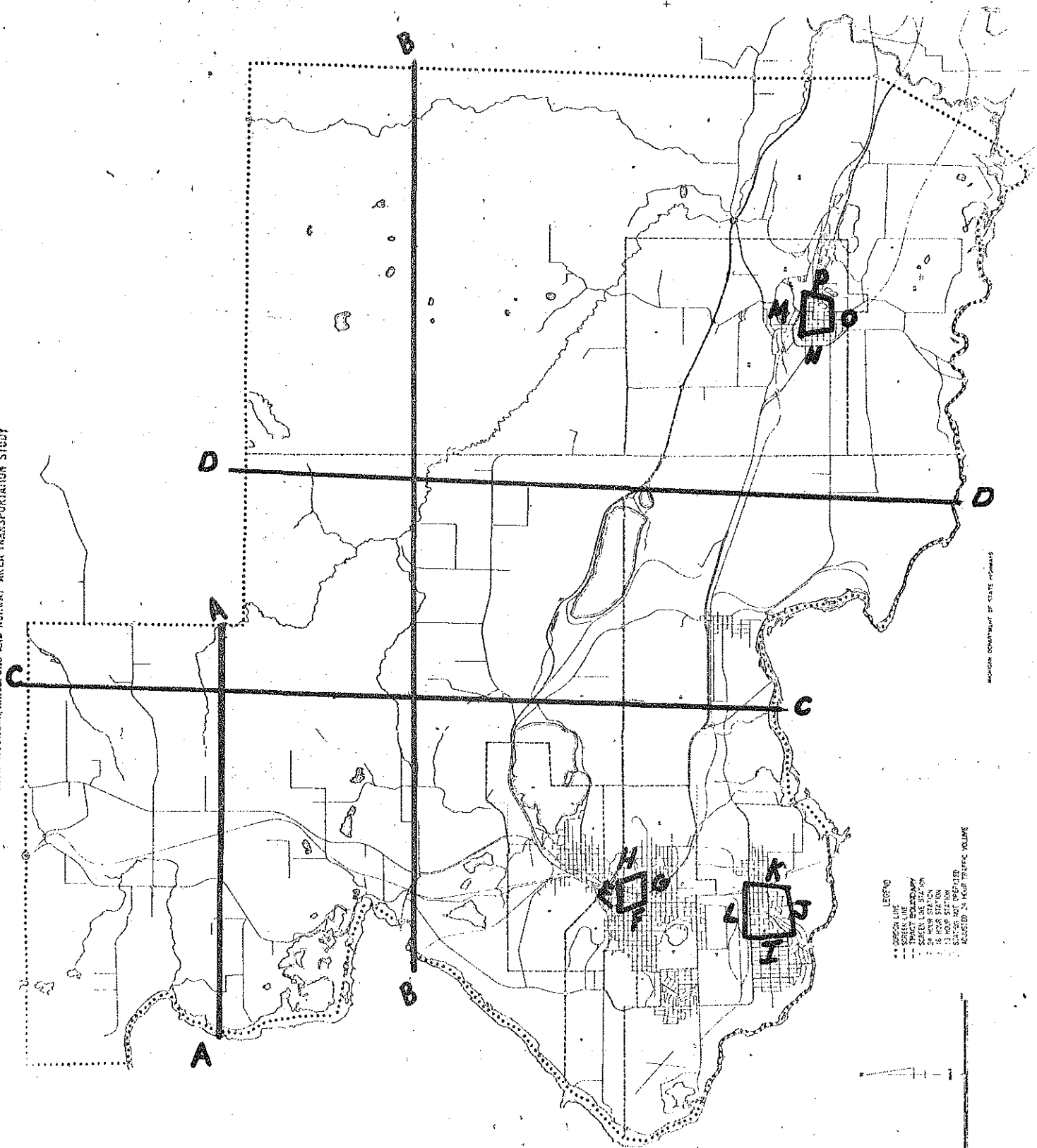
SECONDARY SCREENLINES
FIGURE XIV
-60-

AREA JURISDICTIONS
FIGURE XV

TABLE XIV

SECONDARY SCREENLINE COMPARISONS

	Screenline	Counted Crossings	Assigned Crossings	Percent Comparison			
A	East-West	3,010	2,807	93.3			
B	East-West	7,160	7,451	104.1			
					10,170	10,258	100.9
C	North-South	11,270	10,817	96.0			
D	North-South	5,450	5,638	103.3			
					16,720	16,455	98.4
E	North CBD(I)	16,870	12,844	76.1			
F	West CBD(I)	4,980	5,570	111.8			
G	South CBD(I)	27,140	17,185	63.3			
H	East CBD(I)	1,200	1,271	105.9	50,190	36,870	73.5
I	West CBD(K)	3,170	3,469	109.4			
J	South CBD(K)	2,784	2,784	100.0			
K	East CBD(K)	2,985	2,540	85.1			
L	North CBD(K)	9,140	5,210	57.0	18,079	14,003	77.5
M	North CBD(N)	3,500	1,474	42.1			
N	West CBD(N)	4,710	4,969	105.5			
O	South CBD(N)	4,290	2,499	58.3			
P	East CBD(N)	6,260	6,154	98.3			
					18,760	15,096	85.1
	TOTALS	113,919	92,682	81.4			

(I) Iron Mountain
(K) Kingsford
(N) Norway

TABLE XV

V.M.T. BY JURISDICTION

JURISDICTION	COUNT	ASSIGNED VOLUME	PERCENT COMPARISON
1	50,686	42,000	82.9
1A	15,651	9,000	57.5
2	23,402	17,000	72.6
3	22,217	20,000	90.0
4	17,637	17,000	96.4
5	79,782	74,000	92.8
Total	209,375	179,000	85.5

ASSIGNED SCREENLINE CHECK

I. Purpose

The purpose of this accuracy check is to compare the
assigned reported vehicular trips with the ground
counts and the 1968 screenline. In addition, a com-
parison of assigned reported vehicular trips with
screenline vehicular trip summaries will indicate the
magnitude of double crossings at the screenline.

II. Procedure

As mentioned earlier, extensive traffic counting was
conducted at the screenline in 1968. Comparisons
between counted and assigned volumes were made on a
station-by-station basis.

III. Results

Table XVI lists the 9 stations on the 1968 screenline.
All 9 stations were on the traffic assignment network.
Analysis of each individual station indicates that
several stations were under-assigned while others were
over-assigned. The stations were grouped into West,
Central and East to further evaluate the over versus
under assignment of trips. It appears that some trips
are being diverted through Station 2 that should be
through Station 1. Trips being diverted through Station
4 should be through Stations 5 to 8.

The comparison of total assigned vehicle crossings with counted vehicle crossings resulted in a 74.1 percent accuracy ratio which was the same reported in the Screenline Accuracy Checks. No assigned trips crossed the screenline more than once.

IV. Summary and Conclusions

The 1968 Screenline Check resulted in an overall percentage comparison of 74.1 percent. No double crossings were indicated. Aside from the obvious conclusion that the network needs further calibration, it was concluded that the zone-to-zone movements were reasonably assigned, if not for individual links, then for sections of the screenline. The results of the traffic assignment are definitely being affected by under-reporting in the Internal Survey and that the trip table must be adjusted to remove this effect. The traffic assignment technique is able to reproduce measured traffic volumes and V.M.T., although adjustments to the network are required to more closely approximate these volumes and V.M.T.

TABLE XVI

1968 SCREENLINE COMPARISONS

STATION	COUNTED CROSSINGS	ASSIGNED CROSSINGS	PERCENT COMPARISON
1	879	510	58.0
2	744	647	87.0
3	16,022	11,756	73.4
4	393	745	189.6
5	429	276	64.3
6	152	14	9.2
7	128		
8	168	65	38.7
9	240	182	75.8
TOTAL	19,155	14,195	74.1

SCREENLINE ADJUSTMENT

I. Purpose

Adjustment to the survey data is necessary to account
for the underreporting of trips found in the previous
accuracy checks.

II. Procedure

Table XVII is a summary of the data necessary to develop
adjustment factors. The amount of underreporting for
the internal data was found for each vehicle type.
Underreporting for auto-driver trips was found to be
59.88%, trucks 105.9% and for taxi 7.69%.

Auto-Driver

Auto-driver trips both crossing, and not crossing,
the screenline were compiled by the MDSH Screenline
comparison program. The results of the program are pre-
sented by purpose in Table XVIII. The two percentage
breakdowns compare favorably. Of those crossing, 77.47
percent are homebase trips while 74.09 percent of the
total trips are homebased. The screenline, therefore,
is assumed to be representative of total trips for the
study area. It was determined that a comparison of only
75.4 percent between internal trips and the ground count
was achieved. The normal sampling problems such as for-
gotten trips, refusals, etc. can be blamed for this dis-
crepancy. An examination of an hourly comparison (Figure
XVI) indicates that the bulk of the deficiency in trips

occurs between 10 AM and 10 PM.

It is apparent that the discrepancy is not of a uniform
nature and, therefore, the use of a single factor was
not appropriate. Also, the under-reporting was not
confined to off-peak hours only, so the methods of
applying a flat factor for all non-work trips was also
rejected. The technique ultimately used required the
factoring of the trips by purpose categories.

Five purpose categories were estiablished based upon
an analysis of the percentage destribution. The selec-
tion was centered upon choosing categories that reflected
a large proportion of the total crossings and also past
experiences with adjustment in cities of similar size .

The five purposes selected are:

> Homebased Work
> Homebased Shopping
> Homebased Social-Recreation
> Homebased Other
> Non-Homebased

The factors were developed by use of the "Screenline
Adjustment by Trial and Error" Program.[1] This program
was developed by the Michigan Department of State Highways.
It utilizes a trial and error method to obtain adjustment
factors. These adjustment factors can be developed for a
maximum of 18 purpose categories over a 24-hour period.

[1]

Screenline Adjustment by Trial and Error, prepared by
Evelyn Jensen, Programmer, M.D.S.H.

The value of the adjustment factor can range from a lower bound of one to an upper bound (U_i) which can be varied by purpose. It follows that this program calculates an adjustment factor T; for each purpose ($1 \leq T; \leq U_1$) such that the sum of the reported trips for each hour approximates the ground count for that hour.

The factors arrived at were considered reasonable in consideration of the total and peak hours fit achieved. The relative ranking of the purposes after adjustment was consistant except for the decrease caused by holding HB Work stationary. The factors developed along with their application to the screenline crossings are shown in Table XIX. The final comparison (Table XX) shows a 100 percent relationship to the original ground count of 16,289. The final results of the auto-driver trip adjustment are displayed in Figure XVII. The application of screenline factors to total auto-driver trips by purpose is shown in Table XXl. The internal auto-driver trips increased from 37,830 to 61,705 trips.

TABLE XVII

SCREENLINE UNDERREPORTING

	Auto-Driver	Truck	Taxi
Tir	37,839	4,480	201
Tic	6,692	898	26
Tec	5,590	989	0
Tic + Tec	12,282	1,887	26
Tgc	16,289	2,838	28
$\frac{\text{Tic + Tec}}{\text{Tgc}}$	75.4	66.5	92.9
Uic	.5988	1.059	0.0769

Tir = Total trips reported in internal survey
Tic = Internal Survey Screenline crossings
Tec = External Survey Screenline crossings
Tgc = Ground count at Screenline
Uic - Under-reporting in internal survey screenline crossings

$$Uic = \frac{Tgc - (Tic + Tec)}{Tic} *$$

* Evaluation of Survey Data, U.S. Department of Transportation, Bureau of Public Roads, 1969.

TABLE XVIII

UNADJUSTED
INTERNAL AUTO-DRIVER TRIPS

TRIP PURPOSE	CROSSING	PERCENT	NOT CROSSING	PERCENT	TOTAL	PERCENT
HB WORK	1,503	22.49	5,585	17.93	7,088	18.74
HB BUS	258	3.86	1,251	4.02	1,509	3.99
HB SHOP	829	12.41	5,149	16.53	5,978	15.80
HB SCHOOL	2	0.03	45	0.14	47	.12
HB SOC-REC.	1,733	25.93	6,147	19.73	7,880	20.83
HB MODE-CHGE	6	0.09	6	0.02	12	.03
HB EAT-MEAL	269	4.03	1,214	3.90	1,483	3.92
HB MEDICAL	57	0.85	219	0.70	276	.73
HB SERVE PAS.	520	7.78	3,238	10.40	3,758	9.93
HB Total	5,177	77.47	22,854	73.37	28,031	74.09
NHB WORK	239	3.58	1,772	5.69	2,011	5.32
NHB BUS	188	2.81	643	2.06	831	2.20
NHB SHOP	290	4.34	2,069	6.64	2,359	6.24
NHB SCHOOL	0	0.00	11	0.04	11	0.03
NHB SOC-REC.	554	8.29	2,223	7.14	2,777	7.34
NHB MODE-CHGE	0	0.00	0	0.00	0	0.00
NHB EAT-MEAL	30	0.45	127	0.41	157	0.42
NHB MEDICAL	7	0.10	25	0.08	32	0.08
NHB SERVE PAS.	198	2.96	1,423	4.57	1,621	4.28
NHB Total	1,506	22.53	8,293	26.63	9,799	25.91
TOTAL	6,683	100.00	31,147	100.00	37,830	100.00

TABLE XIX

ADJUSTED AUTO-DRIVER TRIPS
CROSSING THE SCREENLINE

TRIP PURPOSE	UNADJUSTED CROSSINGS	PERCENT	FACTOR	ADJUSTED CROSSINGS	PERCENT
HB WORK	1,503	22.49	1.00	1,503	14.07
HB BUS	258	3.86	1.89	488	4.57
HB SHOP	829	12.41	1.40	1,161	10.86
HB SCHOOL	2	0.03	1.89	4	0.04
HB SOC-REC.	1,733	25.93	1.67	2,894	27.08
HB MODE-CHGE	6	0.09	1.89	11	0.10
HB EAT-MEAL	269	4.03	1.89	508	4.75
HB MEDICAL	57	0.85	1.89	108	1.01
HB SERVE PAS.	520	7.78	1.89	983	9.20
HB Total	5,177	77.47		7,660	71.68
NHB WORK	239	3.58	2.01	480	4.49
NHB BUS	188	2.81	2.01	378	3.54
NHB SHOP	290	4.34	2.01	583	5.46
NHB SCHOOL	0	0.00	2.01	0	0.00
NHB SOC-REC.	554	8.29	2.01	1,114	10.42
NHB MODE-CHGE	0	0.00	2.01	0	0.00
NHB EAT-MEAL	30	0.45	2.01	60	0.55
NHB MEDICAL	7	0.10	2.01	14	0.13
NHB SERVE PAS.	198	2.96	2.01	398	3.72
NHB Total	1,506	22.53		3,027	28.32
TOTAL	6,683	100.00		10,687	100.00

TABLE XX

AUTO-DRIVER SCREENLINE COMPARISON

CROSSING	UNADJUSTED	ADJUSTED
Internal	6,683	10,687
External	5,599	5,599
Total	12,282	16,286
Ground Count	16,289	16,289
Percent Comparison	75.4	100.00

UNADJUSTED SCREENLINE CROSSINGS

Figure XVI

-74-
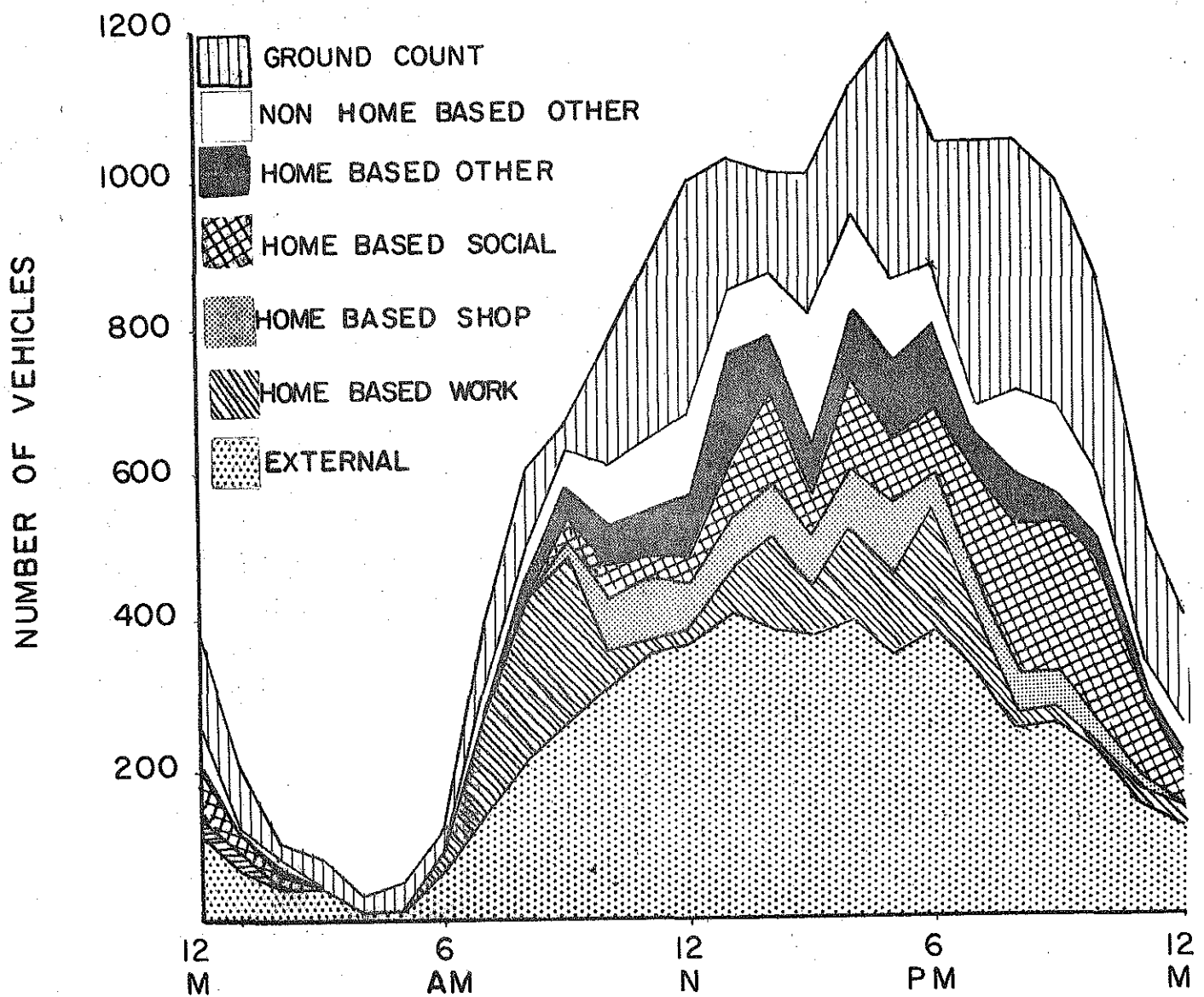
ADJUSTED SCREENLINE CROSSINGS
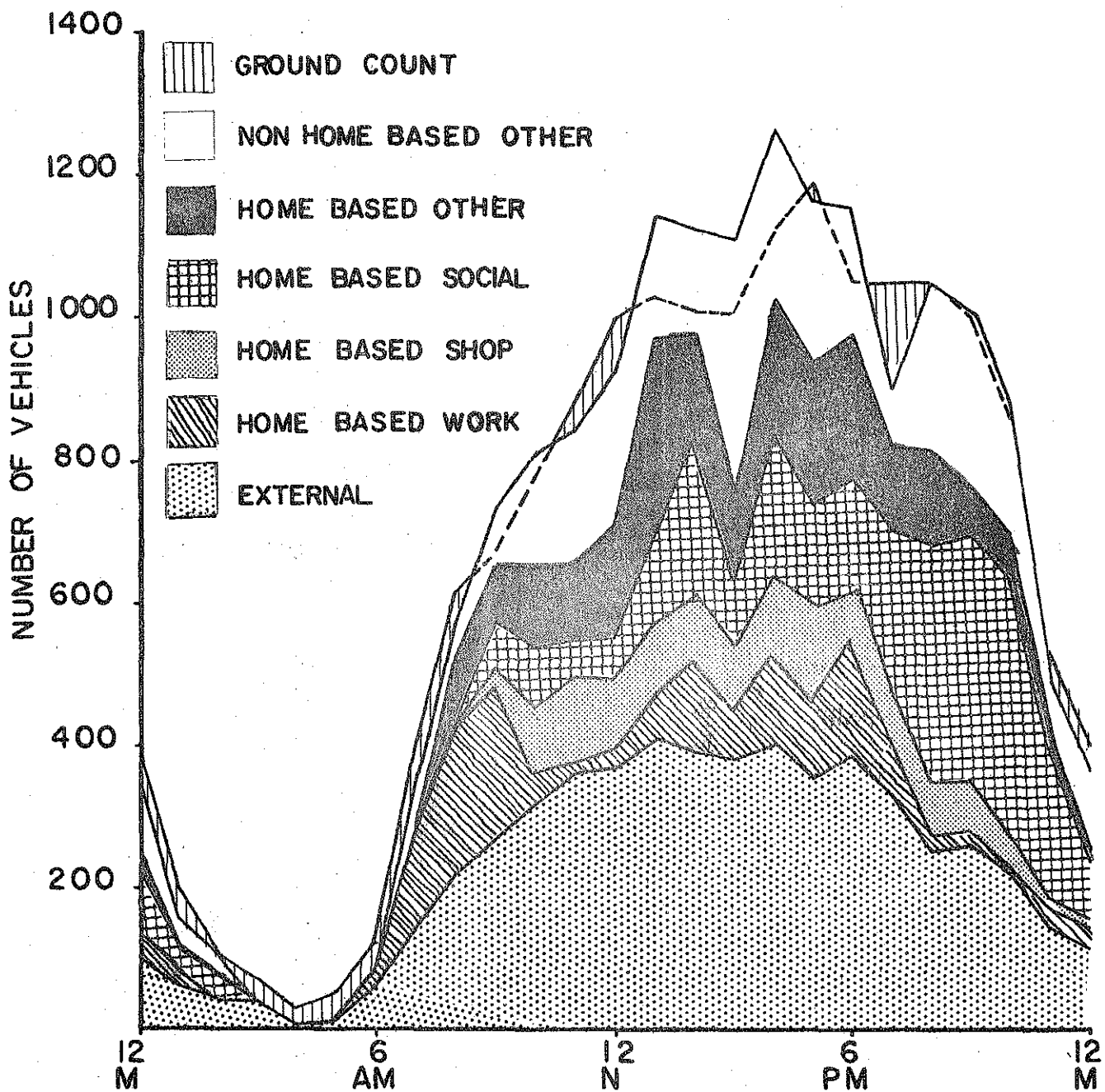
Figure XVII

-75-

TABLE XXI

ADJUSTED TOTAL INTERNAL AUTO-DRIVER TRIPS

TRIP PURPOSE	UNADJUSTED TRIPS	PERCENT	FACTOR	ADJUSTED TRIPS	PERCENT
HB WORK	7,088	18.74	1.00	7,088	11.49
HB BUS	1,509	3.99	1.89	2,852	4.62
HB SHOP	5,978	15.80	1.40	8,369	13.56
HB SCHOOL	47	0.12	1.89	89	0.14
HB SOC-REC.	7,880	20.83	1.67	13,160	21.33
HB MODE-CHGE	12	0.03	1.89	23	0.04
HB EAT-MEAL	1,483	3.92	1.89	2,803	4.54
HB MEDICAL	276	0.73	1.89	522	0.85
HB SERVE PAS.	3,758	9.93	1.89	7,103	11.51
HB Total	28,031	74.09		42,009	68.08
NHB WORK	2,011	5.32	2.01	4,042	6.55
NHB BUS	831	2.20	2.01	1,670	2.71
NHB SHOP	2,359	6.24	2.01	4,742	7.68
NHB SCHOOL	11	0.03	2.01	22	0.04
NHB SOC-REC.	2,777	7.34	2.01	5,582	9.05
NHB MODE-CHGE	0	0.00	2.01	0	0.00
NHB EAT-MEAL	157	0.42	2.01	316	0.51
NHB MEDICAL	32	0.08	2.01	64	0.10
NHB SERVE PAS	1,621	4.28	2.01	3,258	5.28
NHB Total	9,799	25.91		19,696	31.92
TOTAL	37,830	100.00		61,705	100.00

Trucks

The screenline truck comparisons are shown in Table XXII.
As has been the case in most previous MDSH screenline
truck comparisons, a very low degree of agreement was
reached between the internal record and the ground count.
The external records were assumed to be fully reported.

The methods used to adjust these internal truck trips
was to apply a single factor to bring it up to the count.
A more extensive breakdown of adjustment factor for these
trips was rejected as documented in the Screenline Accuracy
Check. Application of this factor to the total truck file
resulted in an adjustment of the 1,887 total truck trips
to 2,838 trips.

TABLE XXII
TRUCK SCREENLINE COMPARISON

TRUCKS	UNADJUSTED	FACTOR	ADJUSTED
Internal	898	2.06	1,849
External	989	1.00	989
Total	1,887		2,838
Ground Count	2,838		2,838
Percent Comparison	66.5		100.00

Taxis

As was previously discussed in the Screenline Accuracy
Check, taxi-trips were not factored. There will be 26
total taxi-trips.

III. Summary and Conclusions

The trip adjustment, shown to be needed by the accuracy
checks, has been described. The resulting factors are
shown in Table XXIII. A summary of the total trip
adjustment is given in Table XXIV.

The foregoing analysis supports the screenline adjust-
ment factors developed to account for the underreported
trip data. It was concluded that the use of these
adjustment factors would successfully approximate the
actual travel patterns for the Iron Mountain-Kingsford-
Norway Study Area.

TABLE XXIII

ADJUSTMENT FACTORS

Internal Survey	Factors
HB Work	1.00
HB Shopping	1.40
HB Social-Recreation	1.67
HB Other	1.89
NHB Other	2.01
Trucks	2.06
Taxi	1.00
External Survey	1.00

TABLE XXIV

TOTAL TRIP ADJUSTMENTS

	Unfactored Total Trips	Factored Total Trips
Auto-Driver	37,830	61,705
Trucks	1,887	2,838
Taxi	26	26
Total	39,743	64,569

APPENDIX

APPENDIX

CENSUS TRACT - O-D TRACT
EQUIVALENCE TABLE

CITY OF IRON MOUNTAIN

Census Tract	O-D Tract
3	3
4	4
5	5,9
6	10
7	11
8	12
9N,11	13
9P	14
10	15

CITY OF KINGSFORD

Census Tract	O-D Tract
12	16
13	17
14	18
15	19

CITY OF NORWAY

Census Tract	O-D Tract
20	22,7
21	23
22	24

BREITUNG TOWNSHIP

Census Tract	O-D Tract
16	20
17	1,8
18N	2,21

NORWAY TOWNSHIP

Census Tract	O-D Tract
18P	25
19N	6,26

O-D TRACT - O-D ZONE
EQUIVALENCE TABLE

O-D TRACT	ZONES
1	10-22
2	23-24
3	25-33
4	34-35
5	36-41
6	42
7	43
8	44-45
9	46-50
10	51-55
11	56-60
12	61-65
13	66-73
14	74-78
15	79-85
16	86-93
17	94-103
18	104-107
19	108-111
20	112-118
21	119-127
22	128-136
23	137-144
24	145-153
25	154-157
26	158-162

INTERVIEW ADDRESS SAMPLING RATE

Sample data was obtained during the summer of 1968 by home interviews conducted as part of the Iron Mountain - Kingsford - Norway Origin and Destination Study. A variable sampling rate was used to obtain this data based on the number of Dwelling Units in a tract and varied from 20% in heavily populated areas to 100% in rural areas. A total of 1,837 interviews were conducted. This is a 24.68% sample of the study area's 7,442 dwelling units. A complete list of tract sampling rates follows:

TRACT NUMBER	% SAMPLE
1	100%
2	100%
3	20%
4	20%
5	20%
6	100%
7	100%
8	100%
9	20%
10	20%
11	20%
12	20%
13	20%
14	20%
15	20%
16	20%
17	20%
18	20%
19	20%
20	20%
21	20%
22	20%
23	20%
24	20%
25	100%
26	20%

TRACT	SAMPLES	VACANTS	INCOMPLETES	COMPLETES	TOTAL DWELLING UNITS
1	290	27	21	242	295
2	31	3	1	27	36
3	74	1	1	72	371
4	58	3	1	54	288
5	43	5	1	37	219
6	21	2	2	17	26
7	12		1	11	16
8	18	1	3	14	18
9	40	1	3	36	201
10	70	6	10	54	351
11	89	3	9	77	444
12	79	4	5	70	402
13	31	6	4	21	154
14	60	4	8	48	303
15	89	5	11	73	460
16	87	2	10	75	435
17	104	1	7	96	524
18	80	2	7	71	402
19	77	2	9	66	381
20	74	6	9	59	373
21	68	2	8	58	346
22	49	4	8	37	245
23	80	4	5	71	411
24	92	7	12	73	453
25	79	5	1	73	78
26	42	4	1	37	210
TOTAL	1837	110	158	1569	7442

app. 4

IRON MOUNTAIN - KINGSFORD - NORWAY

STUDY AREA

O-D TRACT	O-D ZONE	OCCUPIED DWELLING UNITS	TOTAL PASSENGER CARS	TOTAL PERSONS
1	10	29	49	92
	11	21	27	55
	12	21	28	61
	13	31	49	100
	14	12	26	51
	15	10	22	39
	16	1	2	4
	17	19	31	54
	18	65	107	220
	19	14	23	63
	20	10	14	31
	21	22	34	89
	22	12	17	42
		267	429	901
2	23	6	7	23
	24	26	42	103
		32	49	126
3	25	0	0	0
	26	0	0	0
	27	0	0	0
	28	25	51	91
	29	30	41	56
	30	10	5	15
	31	30	30	81
	32	102	163	381
	33	168	178	417
		365	468	1,041
4	34	258	283	693
	35	15	30	61
		273	313	754
5	36	5	10	16
	37	84	120	251
	38	78	78	209
	39	16	16	31
	40	5	5	21
	41	5	16	31
		193	245	559
6	42	24	29	85
7	43	16	19	57

O-D TRACT	O-D ZONE	OCCUPIED DWELLING UNITS	TOTAL PASSENGER CARS	TOTAL PERSONS
8	44	6	10	18
	45	11	12	48
		17	22	66
9	46	33	44	93
	47	0	0	0
	48	22	22	65
	49	93	87	267
	50	49	49	136
		197	202	561
10	51	0	0	0
	52	71	107	190
	53	83	95	321
	54	125	101	327
	55	42	30	101
		321	333	939
11	56	22	17	67
	57	67	84	145
	58	145	201	496
	59	173	223	507
	60	28	50	105
		435	575	1,320
12	61	22	38	104
	62	120	125	311
	63	109	174	349
	64	114	185	354
	65	11	11	11
		376	533	1,129
13	66	30	41	71
	67	18	24	47
	68	12	12	36
	69	24	24	36
	70	18	18	30
	71	0	0	0
	72	18	30	30
	73	6	12	24
		126	161	274
14	74	82	106	206
	75	29	41	135
	76	12	12	59
	77	130	147	389
	78	29	35	77
		282	341	866

app. 6

O-D TRACT	O-D ZONE	OCCUPIED DWELLING UNITS	TOTAL PASSENGER CARS	TOTAL PERSONS
15	79	24	12	54
	80	54	12	77
	81	119	95	369
	82	131	155	339
	83	65	42	196
	84	18	12	36
	85	24	30	60
		435	358	1,131
16	86	0	0	0
	87	68	79	198
	88	85	113	244
	89	34	40	108
	90	0	0	0
	91	0	0	0
	92	0	0	0
	93	238	329	720
		425	561	1,270
17	94	238	298	790
	95	76	124	276
	96	65	97	211
	97	0	0	0
	98	5	11	11
	99	5	5	11
	100	5	16	11
	101	27	38	60
	102	32	49	108
	103	65	92	206
		518	730	1,684
18	104	111	116	376
	105	88	72	304
	106	100	122	304
	107	94	111	293
		393	421	1,277
19	108	101	129	281
	109	96	113	321
	110	90	107	332
	111	84	96	270
		371	445	1,204
20	112	29	41	99
	113	17	29	64
	114	12	17	46
	115	81	105	250
	116	134	174	378
	117	12	17	35
	118	58	70	168
		343	453	1,040

app. 7

O-D TRACT	O-D ZONE	OCCUPIED DWELLING UNITS	TOTAL PASSENGER CARS	TOTAL PERSONS
21	119	64	98	232
	120	52	41	104
	121	6	12	23
	122	6	12	29
	123	145	179	481
	124	0	0	0
	125	29	23	64
	126	12	17	46
	127	23	52	75
		337	434	1,054
22	128	12	24	36
	129	24	24	43
	130	24	12	49
	131	18	49	91
	132	24	24	67
	133	6	6	12
	134	18	6	43
	135	0	0	0
	136	97	122	334
		223	267	675
23	137	22	33	66
	138	66	88	154
	139	55	55	121
	140	33	39	105
	141	61	66	127
	142	39	50	121
	143	55	77	110
	144	61	94	187
		392	502	991
24	145	69	97	212
	146	63	69	120
	147	57	80	172
	148	11	6	17
	149	80	109	258
	150	46	63	178
	151	69	115	252
	152	17	29	69
	153	6	6	34
		418	574	1,312

O-D TRACT	O-D ZONE	OCCUPIED DWELLING UNITS	TOTAL PASSENGER CARS	TOTAL PERSONS
25	154	11	15	30
	155	12	22	42
	156	29	40	102
	157	21	30	67
		73	107	241
26	158	98	113	257
	159	5	5	5
	160	62	87	200
	161	26	21	67
	162	0	0	0
		191	226	529
TOTAL		7,048	8,797	21,086

O-D Tract	Age 5-19
1	272
2	36
3	270
4	140
5	110
6	19
7	10
8	23
9	135
10	245
11	330
12	270
13	30
14	225
15	235
16	280
17	530
18	405
19	310
20	255
21	285
22	150
23	200
24	320
25	75
26	150

App. 10   5,310   TOTAL

INCOME   IRON MOUNTAIN-KINGSFORD-NORWAY

TRACT	0-2999	3-4999	5-6999	7-8999	9-9999	10-11999	12-13999	14-15999	over 16	un-known	un-employed	total	sampl
1	51	30	47	38	20	21	9	7	7	11	1	231	242
2	5	5	7	1	2	3	3		1			27	27
3	135	70	65	45	10	20	10	5				360	360
4	70	50	35	65	20	20				2		260	270
5	50	15	45	20	5	15		5	5	25		160	185
6	4	4	2	3		1		1	2			17	17
7	4		3		1		1		1	1		10	11
8	4	1	1	1	2	1			3	1		13	14
9	70	25	35	35	10						5	180	180
10	90	35	25	60	20	15	5		10		10	270	270
11	110	20	35	60	45	30	5	20	25	30	5	355	385
12	40	70	50	75	25	35	15	20	15		5	350	350
13	30	10	35	10			5		10	5		100	105
14	80	45	35	25	20	10	15	5		5		235	240
15	135	40	65	25	20	30	10	5	10	20	5	345	365
16	55	75	65	40	30	45	25	15	20	5		370	375
17	85	45	90	85	30	50	30	15	15	30	5	450	480
18	115	45	70	65	20	25	5	5			5	355	355
19	130	45	40	60	10	25	5			10	5	320	330
20	85	70	70	30	20	10	5				5	295	295

app. 11

INCOME   IRON MOUNTAIN-KINGSFORD-NORWAY

TRACT	0-2999	3-4999	5-6999	7-8999	9-9999	10-11999	12-13999	14-15999	over 16	un-known	un-employed	total	sample
21	50	40	50	65	30	10	5		5	30	5	260	290
22	60	30	35	35	15	5			5			185	185
23	110	65	40	60	25	35	15		5			355	355
24	70	65	95	55	30	20	5	10		10	5	355	365
25	15	13	16	17	1	4	3	3	1			73	73
26	65	40	35	15		5	5	5		15		170	185
TOTAL	1718	953	1091	990	411	435	181	121	140	200	61	6101	6309

app. 12

IRON MOUNTAIN – KINGSFORD – NORWAY CORDON LINE REPORT

INTERNAL SURVEY

| | PASSENGER CAR & TAXI | | TRUCK | |
HOUR	INBOUND	OUTBOUND	INBOUND	OUTBOUND
1	70	11		
2	19	1		
3	35		4	2
4	29			2
5		5	2	2
6	18	6	2	8
7	12	131	6	32
8	31	150	10	40
9	20	106	4	52
10	29	136	8	52
11	58	115	18	42
12	62	109	22	32
13	123	38	28	22
14	49	142	26	26
15	96	149	32	28
16	169	124	34	26
17	213	90	84	14
18	195	156	54	28
19	216	185	28	14
20	181	211	14	16
21	137	133	20	6
22	224	911	18	2
23	140	47	10	4
24	118	41	2	2
TOTAL	2244	2177	426	452

app. 13

IRON MOUNTAIN - KINGSFORD - NORWAY   CORDON LINE REPORT

app. 14

HOUR	PASSENGER CAR AND TAXI			SINGLE - UNIT TRUCK			COMBINATION TRUCK		
	INBOUND	OUTBOUND	THRU TRIPS	INBOUND	OUTBOUND	THRU TRIPS	INBOUND	OUTBOUND	THRU TRIPS
1	54	26	24	5	3	3	1		3
2	29	15	15	3		1	1	4	2
3	36	7	10	2		1	1	4	2
4	5		7		2	1	1	3	4
5	4	10	6	1	3	1	4	4	4
6	33	72	32	6	10	10		4	4
7	26	136	66	7	33	35	3	8	6
8	56	125	89	8	28	38	4	4	7
9	77	122	136	12	57	41	6	4	8
10	60	129	174	18	53	46		5	6
11	78	119	199	21	34	30	2	4	7
12	106	146	202	30	23	52		3	9
13	115	136	199	26	26	37	2	2	8
14	108	164	185	31	26	30	8	7	11
15	125	146	172	37	27	33	4		9
16	220	142	198	57	25	29	9	2	8
17	169	144	164	49	28	34	5		4
18	214	213	136	37	26	32	7	1	6
19	167	222	119	30	16	22			4
20	180	214	89	20	15	14	5		3
21	270	183	70	19	9	7	4	3	4
22	226	108	65	20	4	19		3	1
23	125	102	45	4	4	5	2		2
24	130	86	40	12	4	2	1		2
TOTAL	2613	2767	2442	455	456	523	70	65	124