Implementation

Telecommunications Link

WA-RD 109.1

Final Report
February 1987

Washington State Department of Transportation
Planning, Research and Public Transportation Division
Research Office
in cooperation with the
United States Department of Transportation
Federal Highway Administration

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO. WA-RD-109.1	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
4. TITLE AND SUBTITLE TELECOMMUNICATIONS LINK IMPLEMENTATION		5. REPORT DATE February 1987
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Professor Nancy L. Nihan		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS University of Washington Seattle, Washington		10. WORK UNIT NO.
		11. CONTRACT OR GRANT NO. Y-3399-1
12. SPONSORING AGENCY NAME AND ADDRESS Washington State Department of Transportation Kern Jacobson Planning and Operations Engineer District 1		13. TYPE OF REPORT AN PERIOD COVERED Final
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

This study was conducted in cooperation with U. S. Department of Transportation Federal Highway Administration

16. ABSTRACT

The Telecom Link established between the University of Washington and the WSDOT Traffic Systems Management Center (TSMC) was updated during this project in order to handle the shift made by the TSMC from a 1700 loop surveillance system to a 2200 loop system. Special computer programs were also written to provide specialized summary statistics for key stations. The new software allowed statistics for key stations to be collected and summarized during data transfer. The entire transfer retrieval system was streamlined during the Telecom II project to reduce costs. Finally, freeway incident analysis was performed with a volume/occupancy data set to demonstrate the use of the new system for TSM research.

17. KEY WORDS Freeway Surveillance and Control, Ramp Metering, Transportation System Management, Telecommunications, Data Transfer, Data Management.	18. DISTRIBUTION STATEMENT

19. SECURITY CLASSIF. (of this report) Unclassified	20. SECURITY CLASSIF. (of this page) Unclassified	21. NO. OF PAGES 52	22. PRICE

DOT FORM 310-022 (11-86) 1216

TELECOMMUNICATIONS LINK IMPLEMENTATION

by

Nancy L. Nihan
Principal Investigator

Washington State Transportation Center
University of Washington
Seattle, Washington

Washington State Department of Transportation
Technical Monitor
Kern Jacobson
Planning and Operations Engineer
District 1

Final Report

Research Project Y-3399
Task 1

Prepared for

Washington State Transportation Commission
Department of Transportation
and in cooperation with
U.S. Department of Transportation
Federal Highway Administration

February 1987

The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Washington State Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification or regulation.

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ABSTRACT

The Telecom Link established between the University of Washington and the WSDOT Traffic Systems Management Center (TSMC) was updated during this project in order to handle the shift made by the TSMC from a 1700 loop surveillance system to a 2200 loop system. Special computer programs were also written to provide specialized summary statistics for key stations. The new software allowed statistics for key stations to be collected and summarized during data transfer. The entire transfer retrieval system was streamlined during the Telecom II project to reduce costs. Finally, freeway incident analysis was performed with a volume/occupancy data set to demonstrate the use of the new system for TSM research.

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SUMMARY

Introduction

This report covers the twelve month period beginning August, 1985. The activities were performed under a Washington State Department of Transportation (WSDOT) contract for Research Project Y-3399-1, executed by the Department of Civil Engineering of the University of Washington under the supervision of Dr. Nancy Nihan. This project extended the work of Research Project Y-2811-2, as described in "Telecommunications Link: Traffic Systems Management Center and University of Washington".

Objective

The previous report identified a need for specialized summary statistic information which could be collected from data transmitted on the Telecom Link. Special computer programming would be needed to implement this. In addition the Traffic Systems Management Center shifted to a 2200 loop surveillance system, necessitating changes in the storage and retrieval software. Finally, the utility of telecom data in assessing the severity of freeway incidents was to be demonstrated.

Description

Despite delays caused by changes in both the TSMC's computer system and the UW's Cyber operating system, automatic transmission and storage of both volume and lane occupancy data was fully operational on February 18, 1986. The system also automatically extracted summary volume information each day. An additional utility program was written to input this summary information into standard analysis software such as Minitab, SPSS and Lotus. New retrieval software was used to prepare a volume and occupancy data set for use in an incident analysis. A method for using time-series regression analysis to estimate delay caused by incidents from volume and occupancy data was demonstrated.

Recommendations

It is recommended that automatic transmissions and storage be continued. It is also recommended that the incident analysis methods be applied to a comprehensive classification of incident severity.

CONCLUSIONS AND RECOMMENDATIONS

We have demonstrated that automatic transmission and storage of TSMC volume data is possible and practical. It is recommended that this activity be continued by funding the purchase of modems and continued rental of the data line. Alternatively, data transmission and storage could be done on WSDOT's computer in Olympia.

We have also demonstrated a method for using freeway volume and occupancy data to assess the severity of incidents. It is recommended that this research be pursued to develop a method for grading the potential severity of incidents as on aid to efficient use of incident correction resources.

PROCEDURES

The core of the Telecom project is the system for storing and retrieving freeway data. Basically, 5-minute volume and lane occupancy data for each loop in the TSMC's FLOW system is stored on temporary disk files each day. When the data file for a 24 hour period is complete it is transmitted via the Telecom Link to temporary disk files on the UW's Cyber computer system. These files are then copied to permanent storage tapes and additionally, summary information is extracted from the volume file. Figure 1 displays this process. This process is automatic and does not require an operator. The data on tape can be retrieved using the appropriate member of the FREELD family of programs. Details on the use of these programs is given in the Appendix. The first phase of Telecom II involved developing the automatic transmission and storage system and also refining the data retrieval programs.

The second phase involved demonstrating the system's utility in collecting summary data for planning purposes. A utility program was written to extract this information from the daily volume data files and another program was written to format the daily summary data for input to standard analysis software.

The third phase involved demonstrating the utility of the database for studying freeway incidents. Representative incidents were identified from the TSMC's radio log and appropriate volume and occupancy data read from the data tapes. Time-series regression techniques were then used to estimate the speed reduction caused by incidents. From the speed reductions and volume data, delay due to the incidents was then calculated.

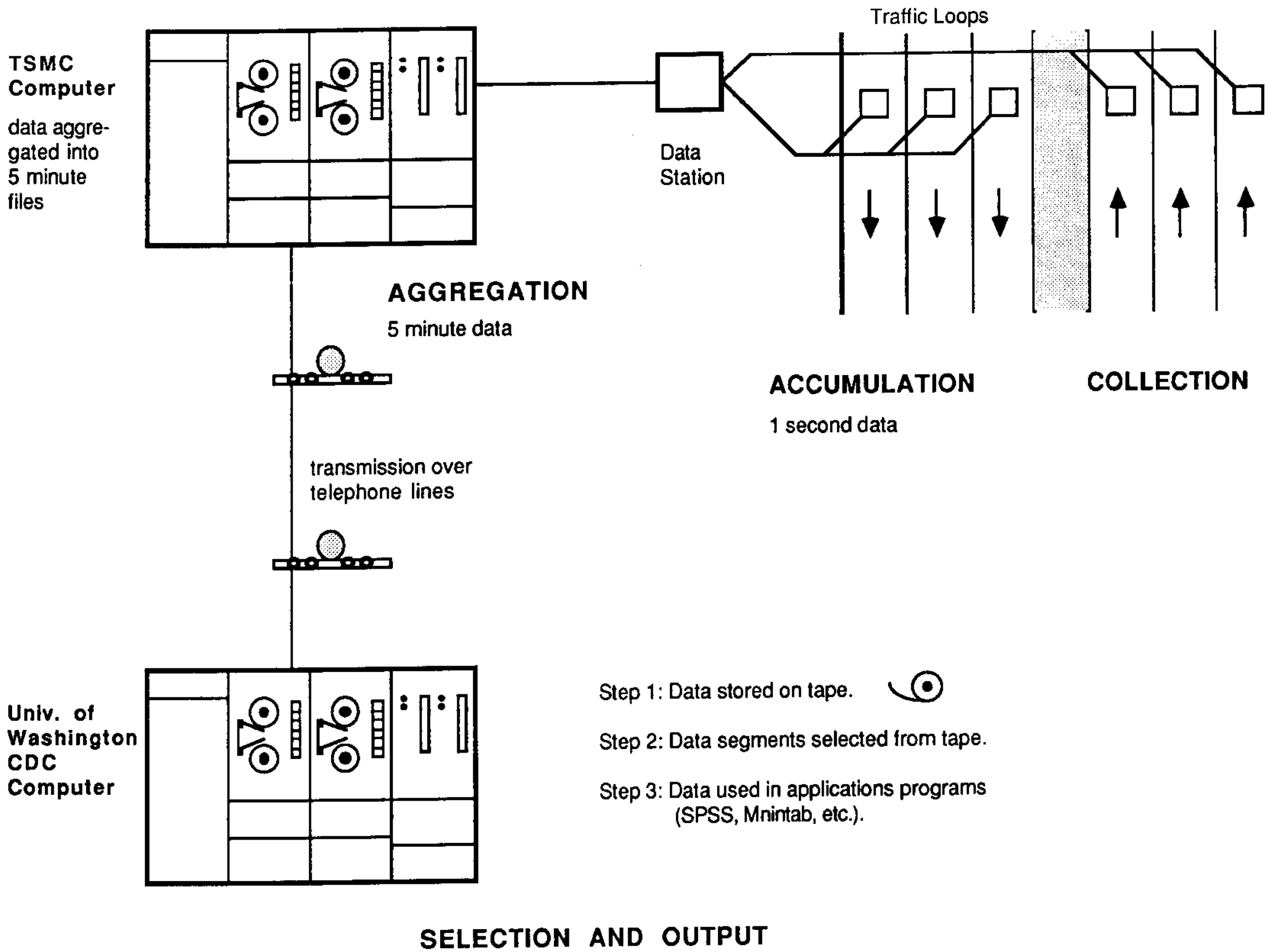

Figure 1. Automatic Collection, Transmission and Storage of Freeway Data.

REVIEW OF PREVIOUS WORK

The first data storage efforts relevant to the Telecom project began with the initiation of the FLOW ramp metering system by District 1, Washington State Department of Transportation, in the summer of 1981. As an adjunct to the ramp metering, the system stored 5-minute volume counts for all active detectors on computer tape. In 1982 and 1983 Thomas Ashbrook, working under Professor Nancy L. Nihan at the University of Washington, developed a database schema and a set of utility programs which could load this volume data into UWRIM, the University's relational database manager (Ashbrook, 1983). Ashbrook's system was later used by Nihan and Gary Davis to support time-series analyses of freeway data (Davis and Nihan, 1984; Nihan and Davis, 1984). It is well-known though that volume data alone is not sufficient to characterize Level-of-Service, (LOS), so in the summer of 1983 Nihan and Ashbrook began exploring methods to store lane occupancy data as well. This involved establishing a telecommunication link between WSDOT's FLOW System computer and the University of Washington's Cyber system. This phase of the project is described in Nihan's report to WSDOT (Nihan, 1985).

DISCUSSION

This discussion will consider separately the three phases of the project; (1) system development and fine-tuning, (2) summary statistics and (3) incident analysis.

System Development and Fine-Tuning

At the beginning of Telecom II, in August, 1985 the TSMC was preparing to expand their FLOW system to include a total of 2200 loop detectors plus ramp-meters on the SR520 eastbound onramps at Montlake and Lake Washington Boulevards. This meant that the software and database schema developed in Telecom I would also need modification. First, a new database schema which employed the new station and loop numbering was developed from information supplied by the TSMC. This new schema also allowed volume and lane occupancy data to be combined in one UWRIM relation. Next the tape reading software developed in Telecom I was modified to incorporate the new expanded data sources. Experience with the old software had also suggested several improvements which would make data retrieval cheaper. These changes were also made. Details on the use of this software can be found in the Appendix. Figure 2 shows some typical data as it is organized in UWRIM. Note that both volume and lane occupancy data are available from one source.

Since February 18, 1986 automatic transmission and storage of both volume and lane occupancy data has been routine. Daily transmission and storage currently costs about $1.50 for a volume file and $2.50 for an occupancy file. Data retrieval costs depend on the amount of data needed, and to some extent, the data file's location on tape. As a benchmark, the data used in Figure 7 (page 19) which required 12 hours of data for one station on 3 consecutive days cost about $5.00 to retrieve.

DATE	TIME	STATIONS	LOOPNUM	LOOPVAL	LOOPOCC
86/06/30	1755	118	348	60	5.990000
86/06/30	1755	119	349	36	32.00000
86/06/30	1755	119	350	40	38.42000
86/06/30	1800	116	341	73	4.890000
86/06/30	1800	116	342	79	4.520000
86/06/30	1800	117	343	159	22.91000
86/06/30	1800	117	344	177	20.50000
86/06/30	1800	118	345	36	4.330000
86/06/30	1800	118	346	84	6.170000
86/06/30	1800	118	347	40	4.880000
86/06/30	1800	118	348	71	7.290000
86/06/30	1800	119	349	56	30.18000
86/06/30	1800	119	350	68	32.25000
86/06/30	1805	116	341	84	6.970000
86/06/30	1805	116	342	95	6.750000
86/06/30	1805	117	343	141	19.21000
86/06/30	1805	117	344	154	20.38000
86/06/30	1805	118	345	31	4.040000
86/06/30	1805	118	346	113	8.710000
86/06/30	1805	118	347	36	4.340000
86/06/30	1805	118	348	68	7.360000
86/06/30	1805	119	349	71	25.46000
86/06/30	1805	119	350	88	28.65000
86/06/30	1810	116	341	137	10.51000
86/06/30	1810	116	342	142	10.29000
86/06/30	1810	117	343	174	15.48000
86/06/30	1810	117	344	182	15.12000
86/06/30	1810	118	345	23	2.100000
86/06/30	1810	118	346	101	8.450000
86/06/30	1810	118	347	34	3.680000
86/06/30	1810	118	348	70	6.550000
86/06/30	1810	119	349	23	42.25000
86/06/30	1810	119	350	22	53.52000
86/06/30	1815	116	341	145	11.80000
86/06/30	1815	116	342	152	10.44000
86/06/30	1815	117	343	151	22.08000
86/06/30	1815	117	344	163	20.28000
86/06/30	1815	118	345	36	3.820000
86/06/30	1815	118	346	101	7.270000
86/06/30	1815	118	347	46	4.700000
86/06/30	1815	118	348	82	8.280000
86/06/30	1815	119	349	60	22.82000
86/06/30	1815	119	350	52	31.30000
86/06/30	1820	116	341	125	11.22000
86/06/30	1820	116	342	153	11.56000
86/06/30	1820	117	343	157	22.52000
86/06/30	1820	117	344	168	20.15000
86/06/30	1820	118	345	26	2.210000
86/06/30	1820	118	346	114	8.530000
86/06/30	1820	118	347	43	3.910000
86/06/30	1820	118	348	65	7.080000
86/06/30	1820	119	349	47	28.31000
86/06/30	1820	119	350	49	32.97000

Figure 2. Typical Combined Volume and Occupancy Data in UWRIM.

Summary Statistics

Discussion with members of WSDOT's Planning Office revealed interest in using the FLOW System database to obtain daily volume and peak hour information for selected locations. Tests revealed that this could be done most easily <u>as part of the automatic transmission and storage process</u>. A utility program was developed that allowed the user to specify a set of stations for which total daily volume, morning peak hour volume and afternoon peak hour volume would be computed on a daily basis. Figure 3 shows the locations of the summary stations used in this research. Each day the summary program computes the relevant information for the user-specified list of stations and enters it in a summary file. Figure 4 shows a typical entry to this file. In this way daily summaries were available in human assimilable form. Another utility program was developed which would read this daily summary file and arrange the data in a column form for easy entry into statistical or spreadsheet software such as Minitab, SPSS or Lotus. Figure 5 illustrates the use of Minitab to compute average daily traffic (ADT) and average weekday traffic (AWDT) for the month of April, 1986.

The summary statistic program costs about $4.50 a day to run. We have found that this cost is about the same over a range of 1 to 40 key stations. A summary file containing one month's data for a set of key stations costs about $1.00 to arrange in column form and about $1.50 to compute ADT and AWDT using Minitab. In contrast, using UWRIM and the FREELD programs to retrieve the data after storage costs about $5.00 <u>per station</u>.

In conclusion, the FLOW system database could quite readily be used to generate daily, monthly or yearly traffic summary data. The easiest approach to doing this requires identifying user needs and then developing small utility programs to extract the needed information before it is stored on tape, although similar programs could also be used to retrieve the informa-

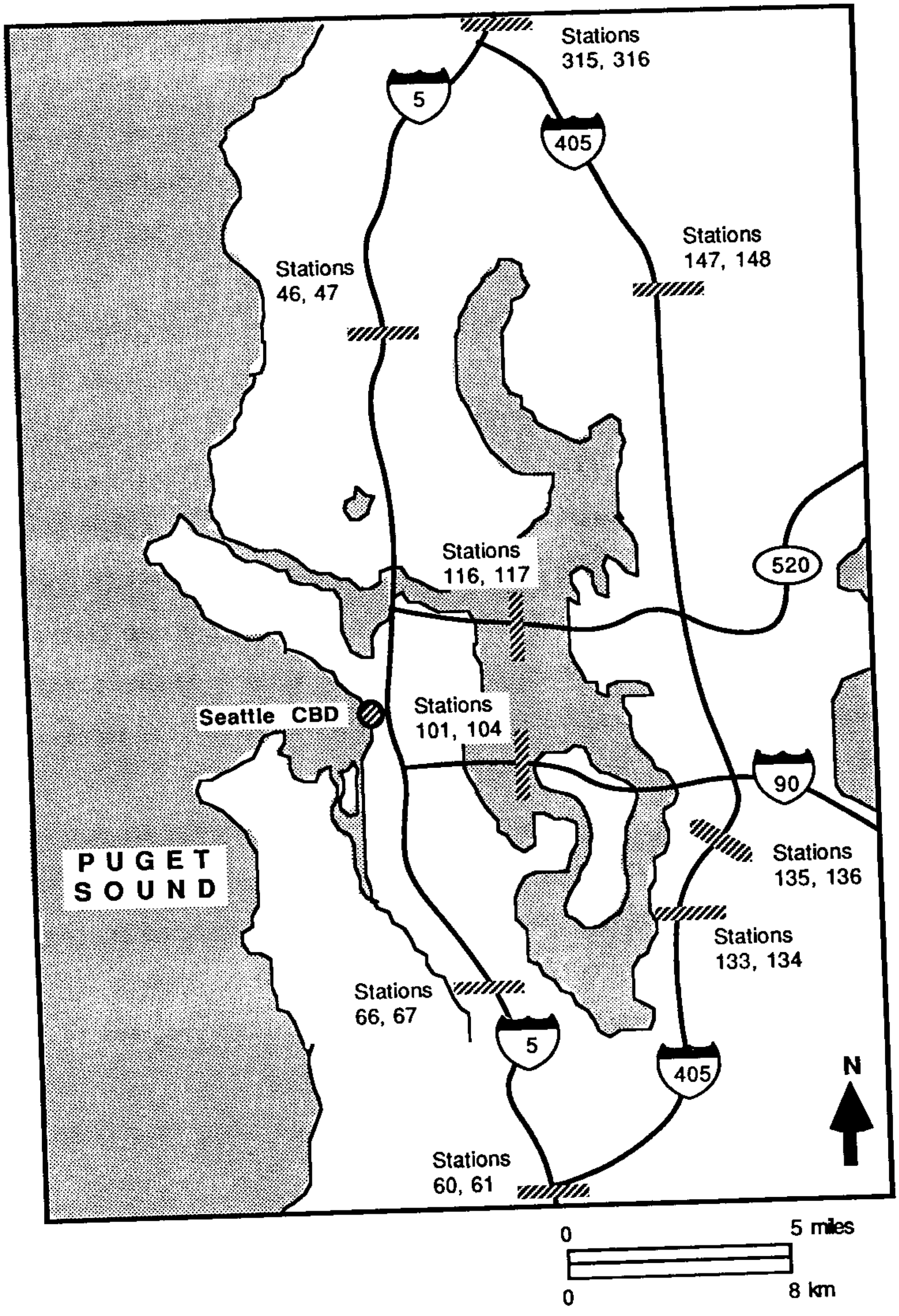

Figure 3. Key Station Locations for Which Summary Statistics Were Computed.

DATE: 04/05/86 20 STATIONS

STATION NUMBER	DESCRIPTION	DAILY TOTAL	MORNING PH TOTAL	AFTERNOON PH TOTAL
315	SR5 164SW SB	42006	2556	3494
316	SR5 164SW NB	43439	3496	3458
46	SR5 NE120 SB	82138	5336	5620
47	SR5 NE120 NB	51601	3363	4034
147	SR405 NE160 SB	12572	817	1012
148	SR405 NE160 NB	12305	880	910
101	SR90 TOLLPLAZA WB	4908	410	351
103	SR90 TLPLZA WB+RV	4908	410	351
102	SR90 TOLLPLAZA EB	4116	315	375
104	SR90 TLPLZA EB+RV	12270	584	1004
116	SR520 TOLLPLAZA WB	24388	1314	1413
117	SR520 TOLLPLAZA EB	34741	2007	1986
66	SR5 S.RYAN SB	59499	3079	3547
67	SR5 S.RYAN NB	40088	2211	2705
135	SR405 COAL CP SB	18031	1259	1363
136	SR405 COAL CP NB	19237	1348	1440
133	SR405 PLSURE PT SB	0	0	0
134	SR405 PLSURE PT NB	0	0	0
60	SR5 S.170 SB	30386	1869	2478
61	SR5 S.170 NB	30610	2263	2318

DATE: 04/06/86 20 STATIONS

STATION NUMBER	DESCRIPTION	DAILY TOTAL	MORNING PH TOTAL	AFTERNOON PH TOTAL
315	SR5 164SW SB	45809	2333	4677
316	SR5 164SW NB	40753	3910	3889
46	SR5 NE120 SB	74063	4655	5540
47	SR5 NE120 NB	44840	2910	3663
147	SR405 NE160 SB	12573	1105	1570
148	SR405 NE160 NB	11297	771	1004
101	SR90 TOLLPLAZA WB	5345	415	520
103	SR90 TLPLZA WB+RV	5345	415	520
102	SR90 TOLLPLAZA EB	5604	344	562
104	SR90 TLPLZA EB+RV	15104	927	1377
116	SR520 TOLLPLAZA WB	21905	1433	2351
117	SR520 TOLLPLAZA EB	32612	2109	3116
66	SR5 S.RYAN SB	56946	3295	3099
67	SR5 S.RYAN NB	37642	2322	2878

Figure 4. Typical Daily Entries into Summary Statistics File.

```
MTB > NOTE RECODE WEEKENDS IN DATA COLUMNS AS MISSING
MTB > LET K1=1
MTB > EXEC 'WKDY' 60

   END OF EXECUTION OF STORED INSTRUCTIONS
MTB > NOTE DESCRIPTIVE STATISTICS FOR WEEKDAY TOTALS
MTB > DESC C1-C20
```

	S315TOT	S316TOT	S46TOT	S47TOT	S147TOT	S148TOT	S101TOT	S103TOT
N	48	48	65	65	56	56	62	62
NMISS	32	32	15	15	24	24	18	19
MEAN	47593	44817	83847	81551	28066	21868	5381	19540
MEDIAN	46300	44649	84572	83258	29017	23389	2639	18814
TMEAN	46733	44837	84225	82096	28356	22306	4845	19177
STDEV	7302	4566	7992	8024	8374	5239	5209	6160
SEMEAN	1054	659	991	995	1119	700	662	792
MAX	86565	57710	103227	104066	47785	38420	19508	36617
MIN	37261	32316	58613	49023	1916	1185	818	8747
Q3	48762	47820	88710	85923	34163	24380	6903	19756
Q1	43804	42501	81268	80026	23626	19882	2334	16640

	S102TOT	S104TOT	S116TOT	S117TOT	S66TOT	S67TOT	S135TOT	S136TOT
N	62	62	61	61	65	65	65	65
NMISS	18	18	19	19	15	15	15	15
MEAN	17941	31422	50089	67513	108104	79851	52650	52862
MEDIAN	17643	34130	55167	71551	111779	83583	55354	55332
TMEAN	17850	31670	52362	68873	109417	81327	53303	53437
STDEV	3725	5810	10359	13112	19460	14802	8685	9281
SEMEAN	473	738	1326	1679	2414	1836	1077	1027
MAX	30885	42539	59049	86475	144200	102906	68862	71708
MIN	8402	14885	1866	3504	15189	7473	24152	25859
Q3	19275	36125	56676	74740	118644	87407	57685	57490
Q1	16265	26925	51651	65259	102541	79871	52799	52582

	S133TOT	S134TOT	S60TOT	S61TOT
N	0	0	65	65
NMISS	80	80	15	15
MEAN	*	*	68033	63798
MEDIAN	*	*	72167	63777
TMEAN	*	*	69775	63874
STDEV	*	*	12017	10432
SEMEAN	*	*	1491	1294
MAX	*	*	91578	88975
MIN	*	*	31667	39055
Q3	*	*	75883	71635
Q1	*	*	67665	56358

```
MTB > NOTE HISTOGRAMS FOR WEEKDAY TOTALS
MTB > HIST C1-C20
```

Figure 5. Using Minitab to Compute ADT and AWDT.

tion from the tape archives. Generally, a user with a repeated need for specific information would incur lower long run costs by developing specialized data retrieval software.

Incident Analysis

Although several researchers have studied the detection of freeway incidents using loop detector data (e.g. Ahmed, 1983; Kurkjian, et al., 1980) no work appears available on using such data to assess the severity of incidents. A method for quantifying the costs imposed by incidents is a necessary first step to rational allocation of incident correction resources. Davis and Nihan (1984) described how time-series intervention analysis could be employed to estimate changes in freeway volume and lane occupancy. From these changes, the effect on average speed and level-of-service can then be calculated. Here we will demonstrate how time-series methods can be used to estimate the delay caused by incidents.

Inspection of the TSMC's radio log revealed that on June 30, 1986 two incidents occurred on the eastbound lanes of the Evergreen Point floating bridge. The first was reported at 3:43 PM and consisted of two disabled vehicles at midbridge. These were removed by 4:05 PM. The second was reported at 5:50 PM and consisted of a disabled semi at the eastern hi-rise. This was removed by 6:03 PM. Using the FREELD programs, 5-minute volume and lane occupancy data for both the eastbound and westbound stations located at the bridge's toll plaza was read for the period running from 2:00 PM to 7:00 PM on 6/30/86. These 5-minute measurements formed 8 time series, one volume and one lane occupancy series for each of two lanes at each of the two stations. The data for the westbound station was combined across lanes to form one volume series and one lane occupancy series to be used as regression covariables. An incident indicator series was formed with values of 1 for the 5-minute intervals from 3:40 PM to 4:05 PM and 5:50 PM to 6:05 PM but 0 for all other intervals. Four linear regressions were run, one for each volume and lane occupancy series for each eastbound lane. The independent variables were the incident indicator and the appropriate covariable, i.e., westbound volume for volume regressions, westbound occupancy for occupancy regressions. From the regression coefficients, average volume, lane occupancy and speeds were computed using methods described in Nihan and Davis (1984). These are displayed in Table 1. The reciprocal of the speed change was then multiplied by the length of the bridge and the volume during the incident periods to obtain vehicle hours of delay. These results also appear in Table 1. Figure 6 shows time-series of approximate speeds for each eastbound lane during this period.

Overall, the two incidents reduce speeds by on average of 28.7 mph in the right hand lane and 24.1 mph in the left hand lane. This reduction caused a total delay of 255.2 vehicle-hours. More importantly, we have shown how relatively straight foreward statistical methods can be used to quantify the costs due to incidents given time-series data of volume and lane occupancy. In a further study, this method could be used to grade the severity of incidents by location and type as a guide for more effective dispatching of incident removal resources.

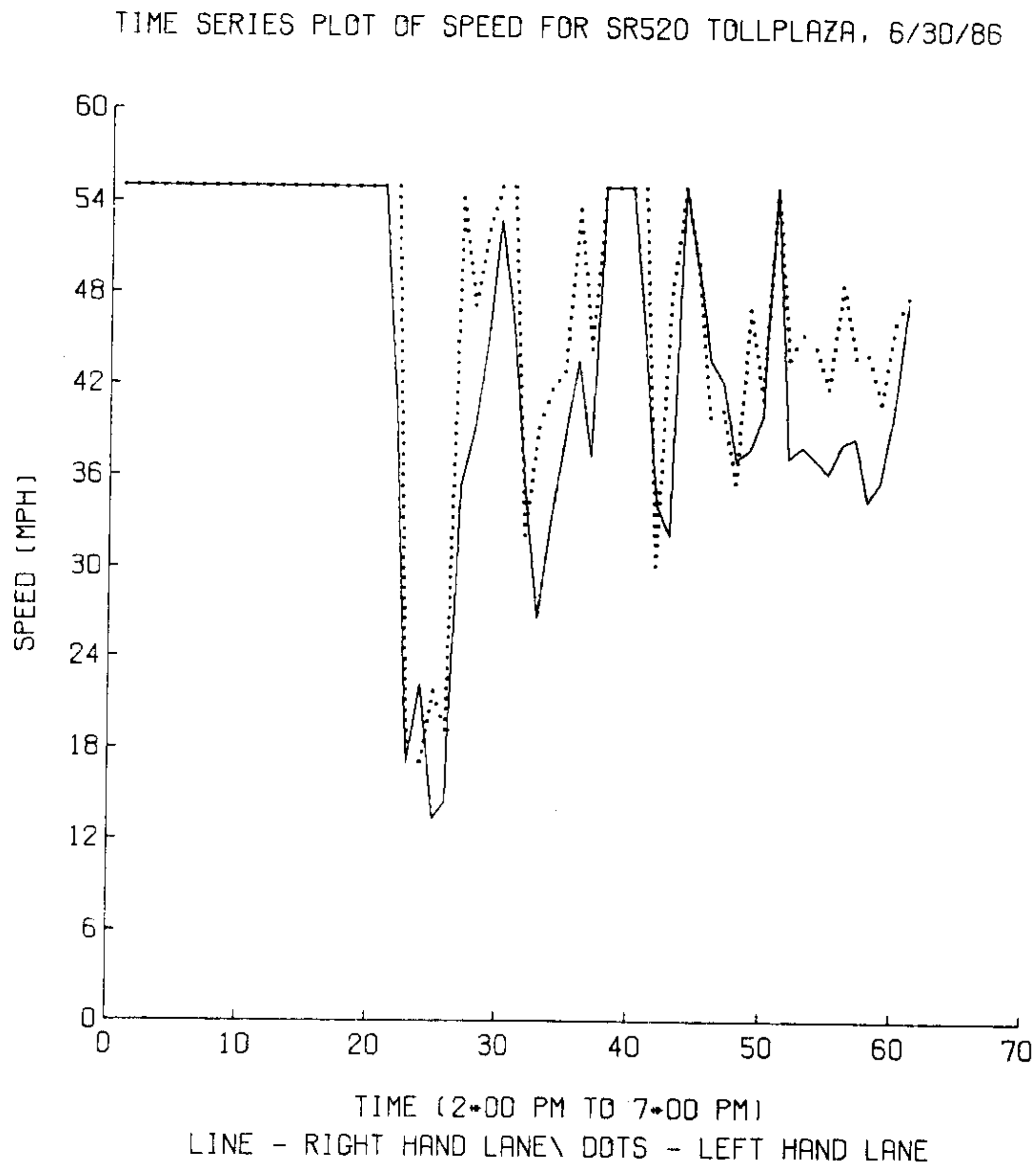

Figure 6. Speeds on Eastbound Evergreen Point Bridge, June 30, 1986.

TABLE 1

	Right Hand Lane		Left Hand Lane	
	Non-Incident	Incident	Non-Incident	Incident
Volume (Vehs)	143.7	112.6	174.7	138.4
Occupancy (%)	15.1	26.3	20.2	32.9
Speed (MPH)	52.0	23.2	47.0	22.9
Speed Difference (MPH)	28.7		24.1	
Delay (VH)	106.3		148.8	

APPLICATIONS

The freeway data system has already been used in general research projects. Nihan and Davis (1984) used volume data to estimate impacts of the flow system ramp controls and Nihan is currently using both volume and occupancy data to estimate changes in mainline level of service caused by the SR520 ramp metering project. The SR 520 impact study is being performed under a WSDOT contract for Research Project Y-2811-22. Figure 7 shows a volume-occupancy plot made for this study. Davis and Nihan (1986) have also used freeway volume data to test algorithms for the sequential estimation of origin destination patterns.

Future possible research projects that would require this data set include topics such as the cost-effectiveness of the FLOW system, estimation of missing values for the state highway data base, incident analyses, testing the effectiveness of different ramp control strategies, use of on-line forecasts for determining metering rates, etc. Any future studies requiring performance measures of the freeway system would most likely require access to this data system.

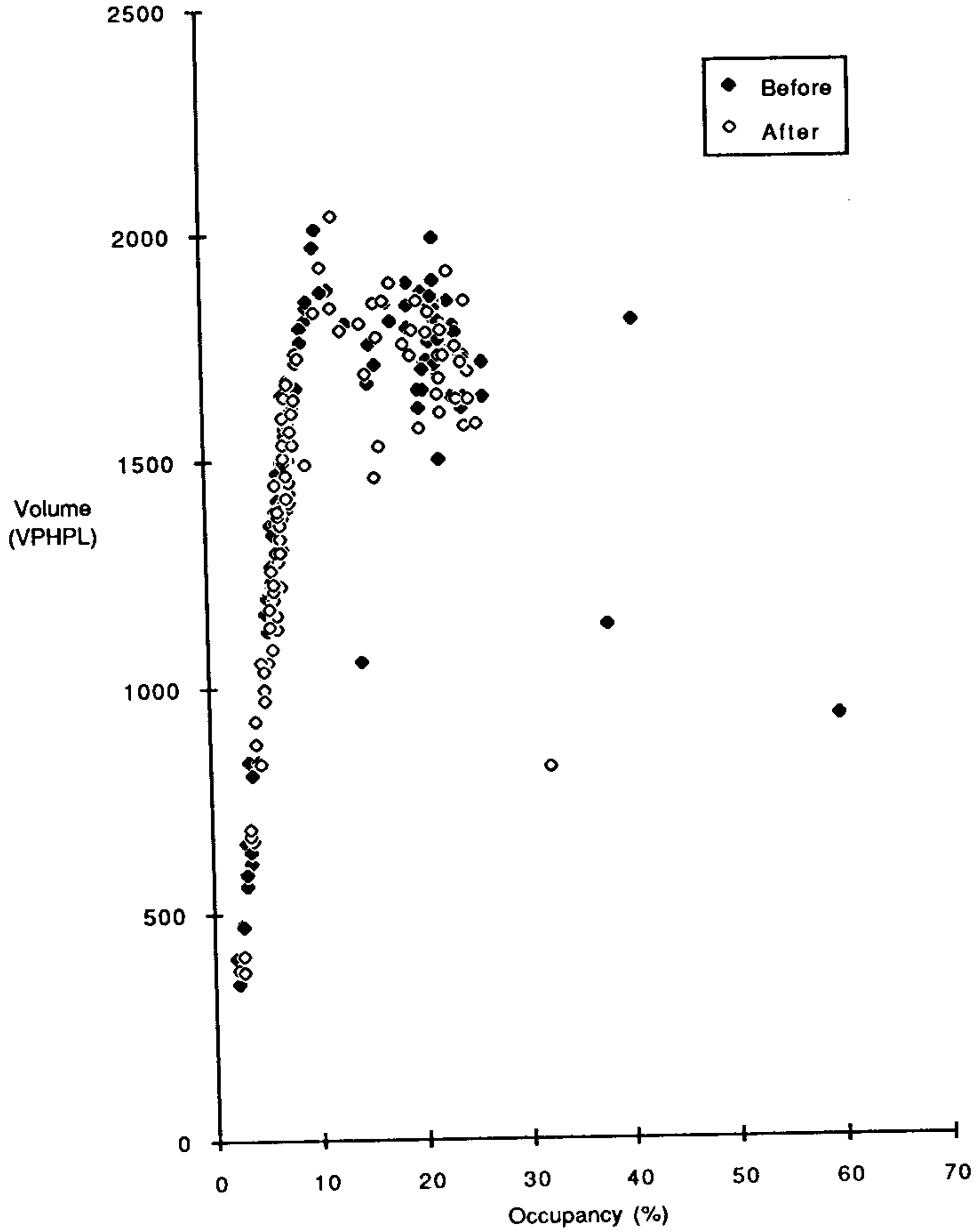

Figure 7. Volume-occupancy Plot Generated Using Telecom Data.

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APPENDIX A

USER'S GUIDE

TELECOMMUNICATIONS LINK:

TRAFFIC SYSTEMS MANAGEMENT CENTER AND UNIVERSITY OF WASHINGTON

INTRODUCTION

The Freeway Information System (FIS) is maintained cooperatively by the Washington State Department of Transportation through the Traffic Systems Management Center (TSMC) and the Department of Civil Engineering at the University of Washington. The available data is arranged in two subsets. Five-minute volume data 24-hours a day is available for dates from July 1, 1981 to August 31, 1985. This data has been copied from TSMC tapes and can be retrieved using the FREELD2 program. Both 5-minute volume and occupancy data is available from February 18, 1986 to July 10, 1986. This data has been stored via the Telecom Link and since it is in a different format, must be retrieved with the FREELD3 and FREELD4 programs for volume and occupancy respectively. The FREELD programs read the data off of tape and store it as UWRIM database files. With UWRIM, a relational database manager, the user can then prepare the data for input into applications software or for transfer to another computer system. It is recommended that users have some familiarity with the Cyber computer system and UWRIM. This can be obtained from the NOS User's Guide (Document N10) and the UWRIM Primer (Document N509) available from the Academic Computer Center.

GETTING STARTED

Before accessing the FIS, a user needs an account on the University's Cyber computer system and permission to access the FIS tapes. User accounts can be established by contacting the Production and Accounts Office at the ACC, telephone number 543-8925. Once the user has been issued a user number, tape access can be obtained by calling the Department of Civil Engineering, 543-7331.

READING THE TAPES

All FREELD programs can be run either interactively or in batch mode. The procedure is similar for all three FREELD programs. For instance, to use FREELD2, log onto the Cyber and then enter the following commands:

```
F > GET, FILESET=SURFS/UN=GEKE000
F > GF,FREEDB1
F > GF,FREEDB2
F > GF,FREEDB3
F > GF, FREELD2
F > PUBLIC, UWLIB
F > PUBLIC, UWRMLIB
F > LIBRARY, UWLIB, UWRMLIB
F > LABEL, TAPE1, VSN ='XXX',LB=KU,F=L,PO=R,D=GE,CV=AS
```

where 'xxx' would be replaced by the Volume Serial Number of the appropriate data tape. A list of available tapes is given in Appendix A2. After the tape has been mounted enter

```
F > FREELD2
```

and you will be prompted for ranges of dates, times and stations. Dates should be entered in the form "year/month/day"; e.g. 82/04/23 denotes April 23, 1982. Times should be entered as four-digit integers. For instance, 0005 denotes the five-minute interval ending five minutes after midnight, 1025 denotes the five-minute interval ending at 10:25 AM and 1745 denotes the five-minute interval ending at 5:45 PM. Lists of the available stations are given in Appendix A1. Figure 1A shows a sample interactive session. Note that only contiguous groups of dates, stations or times can be loaded with any single run of a FREELD program. To enter additional data from the same tape simply enter

```
F > FREELD2
```

and you will be prompted for additional dates, times and stations. To use FREELD3 or FREELD4 use the commands:

```
F > GET, FILESET=SURFS/UN=GEKEOOO
F > GF, NEWDB1
F > GF, NEWDB2
f > GF, NEWDB3
F > GF, FREELD3
F > PUBLIC, UWLIB
F > PUBLIC, UWRMLIB
F > LIBRARY, UWLIB, UWRMLIB
F > LABEL, TAPE1,VSN = 'XXX', LB=KL, F=I, D=GE, PO=R, R
```

and after the tape has been mounted

```
F > FREELD3
```

You will then be prompted to dates, times and stations.

Retrieving large data sets is expensive, and the user can save both computer money and his or her own time by using a batch job rather than an interactive one. The NOS User's Guide explains how to create and submit batch jobs. Figure 2A shows a batch job file which reads volume data from tape VOL21 using FREELD3, then reads occupancy data from tape OCC02 using FREELD4 and finally combines this data in the UWRIM relation FREECOM.

After using the FREELD programs the user's data is stored in three local files either FREEDB1, FREEDB2 and FREEDB3 or NEWDB1, NEWDB2 and NEWDB3, which can be interpreted by UWRIM. If a user is working with more than one database it is advised that these local files be permanently saved under different names as shown in Figure 2A.

```
F > GET,FILESET=SURFS/UN=GEKE000
F > GF,FREEDB1
F > GF,FREEDB2
F > GF,FREEDB3
F > GF,FREELD2
F > PUBLIC,UWLIB
F > PUBLIC,UWRMLIB
F > LIBRARY,UWLIB,UWRMLIB
F > LABEL,TAPE1,VSN=VOL06,LB=KU,F=L,D=GE,PO=R,CV=AS

A TAPE REQUEST HAS BEEN ISSUED

F > FREELD2

WHAT IS THE START DATE
?83/05/21

WHAT IS THE END DATE
?83/05/21

WHAT IS THE START TIME
?0005

WHAT IS THE END TIME
?2400

FROM STATION NUMBER
?23

TO STATION NUMBER
?30

THE DATA IS BEING LOADED

83/05/21 IS BEING LOADED

F>
```

Figure 1A. Example Interactive Session Using FREELD2.

SAMPLE BATCH JOB WHICH LOADS VOLUME DATA FROM THE TAPE VOL21, OCCUPANCY DATA FROM TAPE OCC02 AND THEN COMBINES THE DATA INTO THE UWRIM RELATION FREECOM

```
/JOB
RMLOAD,T1000.
/ACCOUNT
GET,FILESET=SURFS/UN=GEKE000.
PUBLIC,UWRMLIB.
PUBLIC,UWLIB.
LIBRARY,UWRMLIB,UWLIB.
GF,NEWDB1.
GF,NEWDB2.
GF,NEWDB3.
LABEL,TAPE1,VSN=VOL21,LB=KL,F=I,D=GE,PO=R,R.
FREELD3.
UNLOAD,TAPE1.
GF,FREELD4.
LABEL,TAPE1,VSN=OCC02,LB=KL,F=I,D=GE,PO=R,R.
FREELD4.
UWRIM.
RENAME,I062501=NEWDB1.
RENAME,I062502=NEWDB2.
RENAME,I062503=NEWDB3.
ARCPUT,I062501,I062502,I062503.
/EOR
86/06/25
86/06/25
0500
0900
116
119
/EOR
86/06/25
86/06/25
0500
0900
116
119
/EOR
OPEN NEWDB
UNION FREEDAT WITH FREEOCC FORMING FREECOM
QUIT
/EOR
```

Figure 2A. Sample Batch Job.

THE FREEDB DATABASE, AND UWRIM

The TSMC's data collection system consists of 2200 individual magnetic detection loops embedded in the pavement. Each of these loops records data from one freeway lane or ramp. The loops are organized into the stations listed in Appendix A1, with each station generally containing more than one loop. In order to keep track of what loops correspond to what stations, the FREELD programs load relations STATDOC and LOOPDOC into the database from files stored in the SURFS fileset. The actual data is then loaded into relations called FREEDAT and FREEOCC from the computer tapes. FREEDAT contains volume data, FREEOCC contains occupancy data. Figure 3A shows a partial listing of a typical FREEDAT relation.

The organization of the data in FREEDAT may not be appropriate for a given data use. Using the relational operations described in the UWRIM Reference Manual, new relations containing more useful data organizations can be created. Figure 4A shows a batch computer job which creates a new relation called STAT30 generated from the FREEDAT relation shown in Figure 3A. The actual traffic counts stored in the LOOPVAL attribute in FREEDAT are now stored as separate attributes, one for each loop making up Station 30. Figure 5A shows a partial listing of this new relation.

Once the data have been organized appropriately, it is easy to generate data files which can provide input to the University's applications programs. UWRIM's REPORT module allows the user to define formats for outputting data to printers, CRT screens, or local files. Data written to a local file can then be saved permanently for repeated use by applications programs. Figure 6A shows a set of UWRIM commands which define a report format called STATOUT and then use this format to write the STAT30 relation to a file called ST30OUT. Figure 7A shows a partial listing of this file. The contents of

ST30OUT can be input directly into most of the University's statistical and graphics software, including MINITAB, SPSS, SIMPLOT, and ASPEX.

DATE	TIME	STATIONS	LOOPNUM	LOOPVAL
82/05/10	1600	23	68	71
82/05/10	1600	23	69	115
82/05/10	1600	23	70	117
82/05/10	1600	23	71	125
82/05/10	1600	24	72	78
82/05/10	1600	24	73	124
82/05/10	1600	24	74	137
82/05/10	1600	24	75	165
82/05/10	1600	25	76	0
82/05/10	1600	25	77	1
82/05/10	1600	25	78	2
82/05/10	1600	25	79	28
82/05/10	1600	26	80	129
82/05/10	1600	26	81	151
82/05/10	1600	26	82	137
82/05/10	1600	26	83	115
82/05/10	1600	27	84	58
82/05/10	1600	27	85	0
82/05/10	1600	27	86	4
82/05/10	1600	27	87	0
82/05/10	1600	27	88	127
82/05/10	1600	28	89	124
82/05/10	1600	28	90	163
82/05/10	1600	28	91	160
82/05/10	1600	28	92	166
82/05/10	1600	29	93	39
82/05/10	1600	29	94	0
82/05/10	1600	29	95	0
82/05/10	1600	29	96	8
82/05/10	1600	29	97	0
82/05/10	1600	30	98	105
82/05/10	1600	30	99	147
82/05/10	1600	30	100	153
82/05/10	1600	30	101	171
82/05/10	1605	23	68	71
82/05/10	1605	23	69	111
82/05/10	1605	23	70	139
82/05/10	1605	23	71	145
82/05/10	1605	24	72	59
82/05/10	1605	24	73	130
82/05/10	1605	24	74	143

Figure 3A. Form of Data Stored in FREEDAT Relation after Being Read by the FREELD Program.

```
/JOB
RLKRNCH, T1000
/ACCOUNT
GET, DEMDAT1, DEMDAT2, DEMDAT3
PUBLIC,UWRMLIB.
LIBRARY,UWRMLIB.
UWRIM.
REPLACE,FREEDB1=DEMDAT1.
REPLACE,FREEDB2=DEMDAT2.
REPLACE,FREEDB3=DEMDAT3.
/EOR
OPEN FREEDB=DEMDAT
PROJECT T2 FROM STATDOC USING STATIONS, LOOP1, +
LOOP2, LOOP3, LOOP4 WHERE STATIONS EQ 30
PROJECT T2 FROM FREEDAT USING ALL +
WHERE STATIONS EQ 30
JOIN T1 USING STATIONS WITH T2 USING STATIONS +
FORMING T3
RENAME STATIONS TO STAT2 IN T3
PROJECT FREEL1 FROM T3 USING DATE, TIME, STATIONS, LOOPVAL +
WHERE LOOPNUM EQA LOOP1
RENAME LOOPVAL TO LOOPCT1 IN FREEL1
PROJECT FREEL2 FROM T3 USING DATE, TIME, STATIONS, LOOPVAL +
WHERE LOOPNUM EQA LOOP2
RENAME LOOPVAL TO LOOPCT2 IN FREEL2
PROJECT FREEL3 FROM T3 USING DATE, TIME, STATIONS, LOOPVAL +
WHERE LOOPNUM EQA LOOP3
RENAME LOOPVAL TO LOOPCT3 IN FREEL3
PROJECT FREEL4 FROM T3 USING DATE, TIME, STATIONS, LOOPVAL
WHERE LOOPNUM EQA LOOP4
RENAME LOOPVAL TO LOOPCT4 IN FREEL4
UNION FREEL1 WITH FREEL2 FORMING T4 USING DATE, TIME, STATIONS, +
LOOPCT1, LOOPCT2
UNION FREEL3 WITH T4 FORMING T5 USING DATE, TIME, STATIONS, +
LOOPCT1, LOOPCT2, LOOPCT3
UNION FREEL4 WITH T5 FORMING STAT30 USING DATE, TIME, STATIONS, +
LOOPCT1, LOOPCT2, LOOPCT3, LOOPCT4
REMOVE T1
REMOVE T2
REMOVE T3
REMOVE T4
REMOVE T5
LISTREL STAT30
QUIT
```

Figure 4A. Batch Job Which Creates the STAT30 Relation from the FREEDAT Relation.

DATE	TIME	STATIONS	LOOPCT1	LOOPCT2	LOOPCT3	LOOPCT4
82/05/10	1600	30	105	147	153	171
82/05/10	1605	30	123	157	157	175
82/05/10	1610	30	131	163	156	181
82/05/10	1615	30	112	155	167	181
82/05/10	1620	30	118	170	169	183
82/05/10	1625	30	116	166	157	184
82/05/10	1630	30	117	168	150	176

Figure 5A. Form of Data after Being Rearranged Using UWRIM Relational Algebra.

```
R > REPORTS
R > DEFINE STATOUT FOR STAT30
R > LAYOUT
R > LOOPCT1   1   1   I   6
R > LOOPCT2   1   10  I   6
R > LOOPCT3   1   20  I   6
R > LOOPCT4   1   30  I   6
R > END
R > OUTPUT   ST30OUT
R > PRINT STATOUT FROM STAT30 SORTED BY TIME
```

Figure 6A. UWRIM Commands to Generate an Output File.

13	38	18	7
15	29	19	7
12	29	22	17
10	24	18	16
10	26	29	14
8	25	22	12
7	29	19	4
4	20	21	5
6	21	14	7
9	17	10	3
5	13	11	7
5	19	12	3
11	14	14	4
10	15	13	4
3	16	10	2
5	12	11	1
5	14	7	3
5	15	11	5
4	17	13	4
1	15	8	2
6	9	12	1
3	12	8	1
6	16	6	4
2	13	4	3
3	14	6	5
6	9	7	3
5	9	7	3
6	9	3	3
3	8	1	4
4	8	0	1

Figure 7A. Sample Output File Created Using UWRIM's Report Module.

This User Guide may leave some of your questions unanswered. If so, contact:

Gary Davis
Civil Engineering, FX-10
University of Washington
(206) 543-7310

Appendix A1

LIST OF STATIONS FOR OLD FORMAT TAPES
(FREELD2)

AND NEW FORMAT TAPES
(FREELD3 AND FREELD4)

STATIONS	ROUTE	PLACE	MILE	TY	QUEST
1	SR 5	LK CITY SB	170.7000	RM	ES12.4
2	SR 5	LK CITY SB	170.7000	SB	ES12.4
3	SR 5	OREGON	162.3500	SB	ES 2
4	SR 5	OREGON	162.3500	NB	ES 2
5	SR 5	SPOKANE	163.0300	SB	ES 3
6	SR 5	SPOKANE	163.0300	NB	ES 3
7	SR 5	HOLGATE	163.9500	SB	FC 2
8	SR 5	HOLGATE	163.9500	NB	FC 2
9	SR 5	DEARBORN	164.6600	SB	ES 4
10	SR 5	DEARBORN	164.6600	SB	ES 4
11	SR 5	DEARBORN	164.6600	NB	ES 4
12	SR 5	DEARBORN	164.6600	NB	ES 4
13	SR 5	YESLER	165.1300	SB	ES 6
14	SR 5	YESLER	165.1300	SB	ES 6
15	SR 5	NE 145TH	174.5000	RM	ES18.8
16	SR 5	NE 145TH	174.5000	SB	ES18.8
17	SR 5	SENECA	165.4900	SB	FC 5
18	SR 5	SENECA	165.4900	SB	FC 5
19	SR 5	SENECA	165.4900	NB	FC 5
20	SR 5	SENECA	165.4900	NB	FC 5
21	SR 5	8TH AVE	165.8000	SB	ES 7
22	SR 5	8TH AVE	165.8000	NB	ES 7
23	SR 5	DENNY	166.3400	SB	ES 8
24	SR 5	DENNY	166.3400	NB	ES 8
25	SR 5	MERCER	167.0000	SB	ES 9
26	SR 5	MERCER	167.0000	NB	ES 9
27	SR 5	GALER	167.3500	SB	ES 9.6
28	SR 5	GALER	167.3500	NB	ES 9.6
29	SR 5	NEWTON	167.6400	SB	ES10
30	SR 5	NEWTON	167.6400	NB	ES10
31	SR 5	ROANOKE	168.1000	SB	FC11
32	SR 5	ROANOKE	168.1000	NB	FC11
33	SR 5	HAMLIN	168.3300	SB	ES10.2
34	SR 5	HAMLIN	168.3300	NB	ES10.2
35	SR 5	SHIP CANAL	168.8400	SB	SIGNCB
36	SR 5	SHIP CANAL	168.8400	NB	SIGNCB
37	SR 5	NE 42ND	169.1800	NB	ES10.4
38	SR 5	RAVENNA	170.2300	SB	ES12
39	SR 5	RAVENNA	170.2300	NB	ES12
41	SR 5	NE 80TH	171.2400	NB	ES14
42	SR 5	NE 85TH	171.5800	SB	ES15
44	SR 5	NE 100TH	172.1600	SB	ES15.4
45	SR 5	NE 100TH	172.1600	NB	ES15.4
46	SR 5	NE 120TH	173.3000	SB	ES17
47	SR 5	NE 120TH	173.3000	NB	ES17
48	SR 5	NE 137TH	174.1600	SB	ES18.4
49	SR 5	NE 137TH	174.1600	NB	ES18.4
50	SR 5	NE 145TH	174.5800	NB	ES19
51	SR 5	NE 155TH	175.1100	SB	ES20
52	SR 5	NE 155TH	175.1100	NB	ES20
53	SR 5	NE 162ND	175.5000	SB	ES21
54	SR 5	NE 162ND	175.5000	NB	ES21
55	SR 5	NE 175TH	176.1200	NB	ES22

STATIONS	ROUTE	PLACE	MILE	TY	QUEST
56	SR 5	NE 185TH	176.7300	SB	ES23
57	SR 5	NE 185TH	176.7300	NB	ES23
58	SR 5	NE 195TH	177.2100	SB	ES23.2
59	SR 5	NE 195TH	177.2100	NB	ES23.2
60	SR 5	S. 170TH	153.5100	SB	DS21
61	SR 5	S. 170TH	153.5100	NB	DS21
62	SR 5	S. 154TH	155.3800	SB	DS20
63	SR 5	S. 154TH	155.3800	NB	DS20
64	SR 5	DUWAMISH	156.5000	SB	DS19
65	SR 5	DUWAMISH	156.5000	NB	DS19
66	SR 5	S. RYAN	158.4300	SB	DS18
67	SR 5	S. RYAN	158.4300	NB	DS18
68	SR 5	SW 212TH	179.9600	SB	DS17
69	SR 5	SW 212TH	179.9600	NB	DS17
70	SR 5	SWAMP CREE	182.0300	SB	DS16
71	SR 5	SWAMP CREE	182.0300	NB	DS16
72	SR 5	SENECA	165.4900	RV	FC 5
73	SR 5	SENECA	165.4900	RV	FC 5
74	SR 5	8TH AVENUE	165.8000	RV	ES 7
75	SR 5	8TH AVENUE	165.8000	RV	ES 7
76	SR 5	DENNY WAY	166.3400	RV	ES 8
77	SR 5	DENNY WAY	166.3400	RV	ES 8
78	SR 5	MERCER	167.0000	RV	ES 9
79	SR 5	MERCER	167.0000	RV	ES 9
80	SR 5	GALER	167.3500	RV	ES 9.6
81	SR 5	GALER	167.3500	RV	ES 9.6
82	SR 5	NEWTON	167.6400	RV	ES10
83	SR 5	NEWTON	167.6400	RV	ES10
84	SR 5	ROANOKE	168.1000	RV	FC11
85	SR 5	ROANOKE	168.1000	RV	FC11
86	SR 5	HAMLIN	168.3300	RV	ES10.2
87	SR 5	HAMLIN	168.3300	RV	ES10.2
88	SR 5	NE 42ND	169.1800	RV	ES10.4
89	SR 5	NE 42ND	169.1800	RV	ES10.4
90	SR 5	RAVENNA	170.2300	RV	ES12
91	SR 5	RAVENNA	170.2300	RV	ES12
92	SR 5	NE 80TH	171.2400	RV	ES14
93	SR 5	NE 80TH	171.2400	RV	ES14
94	SR 5	NE 85TH	171.5800	RV	ES15
95	SR 5	NE 85TH	171.5800	RV	ES15
96	SR 5	NE 100TH	172.1600	RV	ES15.4
97	SR 5	NE 100TH	172.1600	RV	ES15.4
98	SR 5	SW 224TH	179.0100	SB	DS 25
99	SR 5	SW 224TH	179.0100	NB	DS 25
101	SR 90	TOLL PLAZA	5.950000	WB	DS 27
102	SR 90	TOLL PLAZA	5.950000	EB	DS 27
103	SR 90	TOLL PLAZA	5.950000	RV	DS 27
104	SR 90	TOLL PLAZA	5.950000	RV	DS 27
105	SR 90	TOLL PLAZA	5.950000	RV	DS 27
106	SR 90	TOLL PLAZA	5.950000	RV	DS 27
107	SR 90	RICHARD RD	10.70000	WB	DS 22
108	SR 90	RICHARD RD	10.70000	EB	DS 22
109	SR 90	EASTGATE	12.43000	WB	DS 23

STATIONS	ROUTE	PLACE	MILE	TY	QUEST
110	SR 90	EASTGATE	12.430000	EB	DS 23
111	SR 90	188TH SE	14.65000	WB	DS 24
112	SR 90	188TH SE	14.65000	EB	DS 24
116	SR520	TOLL PLAZA	4.170000	WB	DS 26
117	SR520	TOLL PLAZA	4.170000	EB	DS 26
121	SR405	S. 154TH	.5800000	SB	DS 1
122	SR405	S. 154TH	.5800000	NB	DS 1
123	SR405	SR 167	1.680000	SB	DS 2
124	SR405	SR 167	1.680000	NB	DS 2
125	SR405	CEDAR RIV.	3.410000	SB	DS 3
126	SR405	CEDAR RIV.	3.410000	NB	DS 3
127	SR405	PARK ST	5.120000	SB	DS 4
128	SR405	PARK ST	5.120000	NB	DS 4
129	SR405	S.OF NE 30	6.290000	SB	DS 5
130	SR405	S.OF NE 30	6.290000	NB	DS 5
131	SR405	N.OF NE 30	6.770000	SB	DS 6
132	SR405	N.OF NE 30	6.770000	NB	DS 6
133	SR405	S.OF 112TH	9.040000	SB	DS 7
134	SR405	S.OF 112TH	9.040000	NB	DS 7
135	SR405	COAL CREEK	10.55000	SB	DS 8
136	SR405	COAL CREEK	10.55000	NB	DS 8
137	SR405	N. OF I90	11.96000	SB	DS 9
138	SR405	N. OF I90	11.96000	NB	DS 9
139	SR405	MAIN ST	13.30000	SB	DS 10
140	SR405	MAIN ST	13.30000	NB	DS 10
141	SR405	NE 14TH	14.27000	SB	DS 11
142	SR405	NE 14TH	14.27000	NB	DS 11
143	SR405	NE 53RD	16.47000	SB	DS 12
144	SR405	NE 53RD	16.47000	NB	DS 12
145	SR405	SCL KIRK	19.39000	SB	DS 13
146	SR405	SCL KIRK	19.39000	NB	DS 13
147	SR405	JUANITA RD	22.68000	SB	DS 14
148	SR405	JUANITA RD	22.68000	NB	DS 14
149	SR405	DAMSON RD	28.98000	SB	DS 15
150	SR405	DAMSON RD	28.98000	NB	DS 15
151	SR 5	GALER	167.3500	RM	ES 9.6
152	SR 5	NEWTON	167.6400	RM	ES10
153	SR 5	ROANOKE	168.1000	RM	FC11
154	SR 5	ROANOKE	168.1000	RM	FC11
155	SR 5	HAMLIN	168.3300	RM	ES10.2
156	SR 5	HAMLIN	168.3300	RM	ES10.2
157	SR 5	NE 42ND	169.1800	RM	ES10.4
158	SR 5	RAVENNA	170.2300	RM	ES12
159	SR 5	NE 80TH	171.2400	RM	ES14
160	SR 5	NE 85TH	171.5800	RM	ES15
161	SR 5	NE 100TH	172.1600	RM	ES15.4
162	SR 5	NE 100TH	172.1600	RM	ES15.4
163	SR 5	NE 175TH	176.1200	RM	ES22
168	SR 5	NE 42ND	169.1800	AL	ES10.4
200	SR 5	236TH SW-S	178.1900	ON	ES24
201	SR 5	236TH SW-S	178.1900	SB	ES24
202	SR 5	236TH SW-S	178.1900	NB	ES24
203	SR 5	NE 110TH-N	172.8800	ON	ES16.4

STATIONS	ROUTE	PLACE	MILE	TY	QUEST
204	SR 5	NE 110TH-N	172.8800	NB	ES16.4
205	SR 5	NE 175TH-S	176.0700	ON	ES21.6
206	SR 5	NE 175TH-S	176.0700	HV	ES21.6
207	SR 5	NE 175TH-S	176.0700	SB	ES21.6
208	SR 5	NE 47TH-S	169.4700	ON	ES11
209	SR 5	NE 47TH-S	169.4700	SB	ES11
210	SR 5	NE 47TH-S	169.4700	RV	ES11
211	SR 5	244TH SW-S	177.8400	ON	ES23.6
212	SR 5	244TH SW-S	177.8400	OF	ES23.6
213	SR 5	244TH SW-S	177.8400	SB	ES23.6
214	SR 5	244TH SW-S	177.8400	NB	ES23.6
215	SR 5	NE 85TH-N	171.4900	ON	ES14.4
216	SR 5	NE 85TH-N	171.4900	NB	ES14.4
220	SR 5	NE 44TH-S	169.2900	ON	ES10.6
221	SR 5	NE 44TH-S	169.2900	HV	ES10.6
222	SR 5	NE 44TH-S	169.2900	SB	ES10.6
223	SR 5	NE 205TH-S	177.6600	ON	ES23.4
224	SR 5	NE 205TH-S	177.6600	HV	ES23.4
225	SR 5	NE 205TH-S	177.6600	SB	ES23.4
226	SR 5	NE 205TH-S	177.6600	NB	ES23.4
252	SR 5	LAKE CTY-N	170.7600	ON	ES13
253	SR 5	LAKE CTY-N	170.7600	OF	ES13
254	SR 5	LAKE CTY-N	170.7600	RV	ES13
255	SR 5	LAKE CTY-N	170.7600	SP	ES13
256	SR 5	LAKE CTY-N	170.7600	NB	ES13
227	SR 5	NE 130TH-S	173.7100	ON	ES18
228	SR 5	NE 130TH-S	173.7100	SB	ES18
229	SR 5	NE 130TH-S	173.7100	NB	ES18
230	SR 5	NE 52ND-N	169.7600	ON	ES11.4
231	SR 5	NE 52ND-N	169.7600	RV	ES11.4
232	SR 5	NE 52ND-N	169.7600	NB	ES11.4
233	SR 5	NE 110TH-S	172.8600	ON	ES16.2
234	SR 5	NE 110TH-S	172.8600	OF	ES16.2
235	SR 5	NE 110TH-S	172.8600	SB	ES16.2
236	SR 5	NE 110TH-S	172.8600	SC	ES16.2
237	SR 5	NE 47TH-N	169.4900	ON	ES11.2
238	SR 5	NE 47TH-N	169.4900	HV	ES11.2
239	SR 5	NE 47TH-N	169.4900	NB	ES11.2
240	SR 5	NE 107TH-S	172.6600	ON	ES16
241	SR 5	NE 107TH-S	172.6600	OF	ES16
242	SR 5	NE 107TH-S	172.6600	SB	ES16
243	SR 5	NE 107TH-S	172.6600	SC	ES16
244	SR 5	NE 107TH-S	172.6600	RV	ES16
245	SR 5	NE 107TH-S	172.6600	NB	ES16
246	SR 5	NE 83RD-S	171.3800	ON	ES14.2
247	SR 5	NE 83RD-S	171.3800	HV	ES14.2
248	SR 5	NE 83RD-S	171.3800	SB	ES14.2
249	SR 5	NE 56TH-S	170.0000	ON	ES11.6
250	SR 5	NE 56TH-S	170.0000	OF	ES11.6
251	SR 5	NE 56TH-S	170.0000	SB	ES11.6
252	SR 5	SB 44TH W	180.6500	ON	ES30
253	SR 5	SB 44TH W	180.6500	SB	ES30
254	SR 5	NB 44TH W	180.6600	ON	ES31

STATIONS	ROUTE	PLACE	MILE	TY	QUEST
255	SR 5	NB 44TH W	180.6600	SB	ES31

STATIONS	ROUTE		PLACE	MILE	TY	QUEST
1	SR	5	LK CITY BE	0.000000	RM	ES12.4
2	SR	5	LK CITY BE	0.000000	SB	ES12.4
3	SR	5	OREGON	162.3500	SB	ES 2
4	SR	5	OREGON	162.3500	NB	ES 2
5	SR	5	SPOKANE	163.0300	SB	ES 3
6	SR	5	SPOKANE	163.0300	NB	ES 3
7	SR	5	HOLGATE	163.9500	SB	ES 3.5
8	SR	5	HOLGATE	163.9500	NB	ES 3.5
9	SR	5	DEARBORN	164.6600	SB	ES 4
10	SR	5	DEARBORN	164.6600	SB	ES 4
11	SR	5	DEARBORN	164.6600	NB	ES 4
12	SR	5	DEARBORN	164.6600	NB	ES 4
13	SR	5	YESLER	165.1300	SB	ES 6
14	SR	5	YESLER	165.1300	SB	ES 6
15	SR	5	NE 145TH B	0.000000	RM	ES18.8
16	SR	5	NE 145TH B	0.000000	SB	ES18.8
17	SR	5	MARION	165.4900	SB	ES6.5
18	SR	5	MARION	165.4900	SB	ES6.5
19	SR	5	MARION	165.4900	NB	ES6.5
20	SR	5	MARION	165.4900	NB	ES6.5
21	SR	5	8TH AVE	165.8000	SB	ES 7
22	SR	5	8TH AVE	165.8000	NB	ES 7
23	SR	5	DENNY	166.3400	SB	ES 8
24	SR	5	DENNY	166.3400	NB	ES 8
25	SR	5	MERCER	167.0000	SB	ES 9
26	SR	5	MERCER	167.0000	NB	ES 9
27	SR	5	GALER	167.3500	SB	ES 9.6
28	SR	5	GALER	167.3500	NB	ES 9.6
29	SR	5	NEWTON	167.6400	SB	ES10
30	SR	5	NEWTON	167.6400	NB	ES10
31	SR	5	ROANOKE	168.1000	SB	ES10.1
32	SR	5	ROANOKE	168.1000	NB	ES10.1
33	SR	5	HAMLIN	168.3300	SB	ES10.2
34	SR	5	HAMLIN	168.3300	NB	ES10.2
35	SR	5	SHIP CANAL	168.8400	SB	ES10.2
36	SR	5	SHIP CANAL	168.8400	NB	ES10.2
37	SR	5	NE 42ND	169.1800	NB	ES10.4
38	SR	5	RAVENNA	170.2300	SB	ES12
39	SR	5	RAVENNA	170.2300	NB	ES12
41	SR	5	NE 80TH	171.2400	NB	ES14
42	SR	5	NE 85TH	171.5800	SB	ES15
44	SR	5	NE 100TH	172.1600	SB	ES15.4
45	SR	5	NE 100TH	172.1600	NB	ES15.4
46	SR	5	NE 120TH	173.3000	SB	ES17
47	SR	5	NE 120TH	173.3000	NB	ES17
48	SR	5	NE 137TH	174.1600	SB	ES18.4
49	SR	5	NE 137TH	174.1600	NB	ES18.4
50	SR	5	NE 145TH	174.5800	NB	ES19
51	SR	5	NE 155TH	175.1100	SB	ES20
52	SR	5	NE 155TH	175.1100	NB	ES20
53	SR	5	NE 162ND	175.5000	SB	ES21
54	SR	5	NE 162ND	175.5000	NB	ES21
55	SR	5	NE 175TH	176.1200	NB	ES22

STATIONS	ROUTE	PLACE	MILE	TY	OUEST
56	SR 5	NE 185TH	176.7300	SB	ES23
57	SR 5	NE 185TH	176.7300	NB	ES23
58	SR 5	NE 195TH	177.2100	SB	ES23.2
59	SR 5	NE 195TH	177.2100	NB	ES23.2
60	SR 5	S. 170TH	153.5100	SB	PNB16
61	SR 5	S. 170TH	153.5100	NB	PNB16
62	SR 5	S. 144TH	155.3800	SB	PNB17
63	SR 5	S. 144TH	155.3800	NB	PNB17
64	SR 5	DUWAMISH	156.5000	SB	PNB6
65	SR 5	DUWAMISH	156.5000	NB	PNB6
66	SR 5	S. RYAN	158.4300	SB	PNB18
67	SR 5	S. RYAN	158.4300	NB	PNB18
68	SR 5	SW 212TH	179.9600	SB	ES 28
69	SR 5	SW 212TH	179.9600	NB	ES 28
70	SR 5	190 ST. SW	182.0300	SB	ES 34
71	SR 5	190 ST. SW	182.0300	NB	ES 34
72	SR 5	MARION	165.4900	RV	ES6.5
73	SR 5	MARION	165.4900	RV	ES6.5
74	SR 5	8TH AVENUE	165.8000	RV	ES 7
75	SR 5	8TH AVENUE	165.8000	RV	ES 7
76	SR 5	DENNY WAY	166.3400	RV	ES 8
77	SR 5	DENNY WAY	166.3400	RV	ES 8
78	SR 5	MERCER	167.0000	RV	ES 9
79	SR 5	MERCER	167.0000	RV	ES 9
80	SR 5	GALER	167.3500	RV	ES 9.6
81	SR 5	GALER	167.3500	RV	ES 9.6
82	SR 5	NEWTON	167.6400	RV	ES10
83	SR 5	NEWTON	167.6400	RV	ES10
84	SR 5	ROANOKE	168.1000	RV	ES10.1
85	SR 5	ROANOKE	168.1000	RV	ES10.1
86	SR 5	HAMLIN	168.3300	RV	ES10.2
87	SR 5	HAMLIN	168.3300	RV	ES10.2
88	SR 5	NE 42ND	169.1800	RV	ES10.4
89	SR 5	NE 42ND	169.1800	RV	ES10.4
90	SR 5	RAVENNA	170.2300	RV	ES12
91	SR 90	W MERCER	6.270000	RV	ES924
92	SR 90	76 AVE SE	6.670000	RV	ES926
93	SR 5	NE 80TH	171.2400	RV	ES14
94	SR 5	NE 85TH	171.5800	RV	ES15
95	SR 90	I CREST WY	7.100000	RV	ES936
96	SR 90	E MERCER	8.300000	RV	ES9384
97	SR 5	NE 100TH	172.1600	RV	ES15.4
98	SR 5	SW 224TH	179.0100	SB	ES 26
99	SR 5	SW 224TH	179.0100	NB	ES 26
101	SR 90	TOLL PLAZA	5.950000	-1	PNB20
102	SR 90	TOLL PLAZA	5.950000	-1	PNB20
103	SR 90	TOLL PLAZA	5.950000	WB	PNB20
104	SR 90	TOLL PLAZA	5.950000	EB	PNB20
105	SR 90	TOLL PLAZA	5.950000	+R	PNB20
106	SR 90	TOLL PLAZA	5.950000	+R	PNB20
107	SR 90	136 AVE SE	10.70000	WB	PNB11
108	SR 90	136 AVE SE	10.70000	EB	PNB11
109	SR 90	161 AVE SE	12.43000	WB	PNB10

STATIONS	ROUTE	PLACE	MILE	TY	QUEST
110	SR 90	161 AVE SE	12.43000	EB	PNB10
111	SR 90	188TH SE	14.65000	WB	PNB14
112	SR 90	188TH SE	14.65000	EB	PNB14
113	SR 90	TOLL PLAZA	5.950000	L	PNB20
114	SR 90	M I RAMPS	-6.08000		LL
115	SR 90	I CREST WY	7.100000	IC	-WB
116	SR520	TOLL PLAZA	4.170000	WB	PNB19
117	SR520	TOLL PLAZA	4.170000	EB	PNB19
118	SR520	10TH AVE	.1900000	WB	ES521
119	SR520	10TH AVE	.1900000	EB	ES521
120	SR520	SB I-5	.1900000	WB	ES521
121	SR405	SOUTHCENTR	.5800000	SB	PNB15
122	SR405	SOUTHCENTR	.5800000	NB	PNB15
123	SR405	LONGACRES	1.680000	SB	PNB1
124	SR405	LONGACRES	1.680000	NB	PNB1
125	SR405	BENSON RD.	3.410000	SB	PNB2
126	SR405	BENSON RD.	3.410000	NB	PNB2
127	SR405	PARK DR.	5.120000	SB	PNB3
128	SR405	PARK DR.	5.120000	NB	PNB3
129	SR405	PARK DR.	5.120000	SB	+ HOV
130	SR405	PARK DR.	5.120000	NB	+ HOV
131	SR405	NE 32 ST.	6.770000	SB	PNB5
132	SR405	NE 32 ST.	6.770000	NB	PNB5
133	SR405	S.OF 112TH	9.040000	SB	PNB7
134	SR405	S.OF 112TH	9.040000	NB	PNB7
135	SR405	COAL CREEK	10.55000	SB	PNB8
136	SR405	COAL CREEK	10.55000	NB	PNB8
137	SR405	SE 20 ST.	11.96000	SB	PNB9
138	SR405	SE 20 ST.	11.96000	NB	PNB9
139	SR405	MAIN ST	13.30000	SB	PNB12
140	SR405	MAIN ST	13.30000	NB	PNB12
141	SR405	NE 14TH	14.27000	SB	PNB13
142	SR405	NE 14TH	14.27000	NB	PNB13
143	SR405	NE 60TH	16.47000	SB	PNB21
144	SR405	NE 60TH	16.47000	NB	PNB21
145	SR405	NE 114 ST.	19.39000	SB	PNB22
146	SR405	NE 114 ST.	19.39000	NB	PNB22
147	SR405	NE 160 ST.	22.68000	SB	PNB23
148	SR405	NE 160 ST.	22.68000	NB	PNB23
149	SR405	DAMSON RD	28.98000	SB	PNB24
150	SR405	DAMSON RD	28.98000	NB	PNB24
151	SR 5	GALER	167.3500	RM	ES 9.6
152	SR 5	NEWTON	1670.040	RM	ES10
153	SR 5	ROANOKE	168.1000	RM	ES10.1
154	SR 5	ROANOKE	168.1000	RM	ES10.1
155	SR 5	HAMLIN	168.3300	PM	ES10.2
156	SR 5	HAMLIN	168.3300	PM	ES10.2
157	SR 5	NE 42ND	169.1800	RM	ES10.4
158	SR 5	RAVENNA	170.2300	RM	ES12
159	SR 5	NE 80TH	171.2400	RM	ES14
160	SR 5	NE 85TH	171.5800	RM	ES15
161	SR 5	NE 100TH	172.1600	RM	ES15.4
162	SR 5	NE 100TH	172.1600	RM	ES15.4

STATIONS	ROUTE	PLACE	MILE	TY	QUEST
163	SP 5	NE 175TH	176.1200	RM	ES22
164	SIMUL	TION	.0010000		TEST
165	SIMUL	TION	.0010000		TEST
166	SIMUL	TION	.0010000		COMP
167	SIMUL	TION	.0010000		COMP
168	SR 5	NE 42ND	169.1800	AL	ES10.4
169	SR 5	NE 137TH	174.1600	OF	ES18.4
170	SR 5	NE 145TH	174.5800	ON	ES 19
171	SR 5	NE 175TH	176.1200	OF	ES 22
172	SR 90	W MERCER	6.270000	WB	ES924
173	SR 90	W MERCER	6.270000	EB	ES924
174	SR 90	76 AVE SE	6.670000	WB	ES926
175	SR 90	76 AVE SE	6.670000	EB	ES926
176	SR 90	I CREST WY	7.100000	WB	ES936
177	SR 90	I CREST WY	7.100000	EB	ES936
178	SR 90	E MERCER	8.300000	WB	ES938
179	SR 90	E MERCER	8.300000	EB	ES938
180	SR 5	224 ST SW	179.1500	NB	OFF
181	SR 5	ALBRO	179.1500	SB	ES1
182	SR 5	ALBRO	179.1500	NB	ES1
183	SR 5	YESLER	165.1300	NB	ES5
184	SR 5	YESLER	165.1300	NC	ES5
185	SR 5	YESLER	165.1300	OF	ES5
190	SR405	NE 32 ST.	6.770000	SB	+ HOV
191	SR405	NE 32 ST.	6.770000	NB	+ HOV
192	SR405	PLEASUR PT	9.040000	SB	+ HOV
193	SR405	PLEASUR PT	9.040000	NB	+ HOV
200	SR 5	236TH SW-S	178.1900	ON	ES24
201	SR 5	236TH SW-S	178.1900	SB	ES24
202	SR 5	236TH SW-S	178.1900	NB	ES24
203	SR 5	NE 110TH-N	172.8800	ON	ES16.4
204	SP 5	NE 110TH-N	172.8800	NB	ES16.4
205	SR 5	NE 175TH-S	176.0700	ON	ES21.6
206	SR 5	NE 175TH-S	176.0700	HV	ES21.6
207	SR 5	NE 175TH-S	176.0700	SB	ES21.6
208	SR 5	NE 47TH-S	169.4700	ON	ES11
209	SR 5	NE 47TH-S	169.4700	SB	ES11
210	SR 5	NE 47TH-S	169.4700	RV	ES11
211	SR 5	244TH SW-S	177.8400	ON	ES23.6
212	SR 5	244TH SW-S	177.8400	OF	ES23.6
213	SR 5	244TH SW-S	177.8400	SB	ES23.6
214	SR 5	244TH SW-S	177.8400	NB	ES23.6
215	SR 5	NE 85TH-N	171.4900	ON	ES14.4
216	SR 5	NE 85TH-N	171.4900	NB	ES14.4
218	SR 5	NE 130TH-S	171.4900	HV	ES18
219	SR 5	NE 130TH-S	171.4900	OF	ES18
220	SR 5	NE 44TH-S	169.2900	ON	ES10.6
221	SR 5	NE 44TH-S	169.2900	HV	ES10.6
222	SR 5	NE 44TH-S	169.2900	SB	ES10.6
223	SR 5	NE 205TH-S	177.6600	ON	ES23.4
224	SR 5	NE 205TH-S	177.6600	HV	ES23.4
225	SR 5	NE 205TH-S	177.6600	SB	ES23.4
226	SR 5	NE 205TH-S	177.6600	NB	ES23.4

STATIONS	ROUTE	PLACE	MILE	TY	QUEST
252	SR 5	LAKE CTY-N	170.7600	ON	ES13
253	SR 5	LAKE CTY-N	170.7600	OF	ES13
254	SR 5	LAKE CTY-N	170.7600	RV	ES13
255	SR 5	LAKE CTY-N	170.7600	SP	ES13
256	SR 5	LAKE CTY-N	170.7600	NB	ES13
227	SR 5	NE 130TH-S	173.7100	ON	ES18
228	SR 5	NE 130TH-S	173.7100	SB	ES18
229	SR 5	NE 130TH-S	173.7100	NB	ES18
230	SR 5	NE 52ND-N	169.7600	ON	ES11.4
231	SR 5	NE 52ND-N	169.7600	RV	ES11.4
232	SR 5	NE 52ND-N	169.7600	NB	ES11.4
233	SR 5	NE 110TH-S	172.8600	ON	ES16.2
234	SR 5	NE 110TH-S	172.8600	OF	ES16.2
235	SR 5	NE 110TH-S	172.8600	SB	ES16.2
236	SR 5	NE 110TH-S	172.8600	SC	ES16.2
237	SR 5	NE 47TH-N	169.4900	ON	ES11.2
238	SR 5	NE 47TH-N	169.4900	HV	ES11.2
239	SR 5	NE 47TH-N	169.4900	NB	ES11.2
240	SR 5	NE 107TH-S	172.6600	ON	ES16
241	SR 5	NE 107TH-S	172.6600	OF	ES16
242	SR 5	NE 107TH-S	172.6600	SB	ES16
243	SR 5	NE 107TH-S	172.6600	SC	ES16
244	SR 5	NE 107TH-S	172.6600	RV	ES16
245	SR 5	NE 107TH-S	172.6600	NB	ES16
246	SR 5	NE 83RD-S	171.3800	ON	ES14.2
247	SR 5	NE 83RD-S	171.3800	HV	ES14.2
248	SR 5	NE 83RD-S	171.3800	SB	ES14.2
249	SR 5	RAVENNA-S	170.0000	ON	ES11.6
250	SR 5	RAVENNA-S	170.0000	OF	ES11.6
251	SR 5	RAVENNA-S	170.0000	SB	ES11.6
261	SR 5	44TH W-S	180.6500	ON	ES30
262	SR 5	44TH W-S	180.6500	SB	ES30
263	SR 5	44TH W-S	180.6600	ON	ES31
264	SR 5	44TH W-S	180.6600	SB	ES31
265	SR 90	E BELL-WRV	9.150000	RM	ES950
266	SR 90	E BELL-WRV	9.150000	ON	ES950
267	SR 90	E BELL-WRV	9.150000	WB	ES950
268	SR 90	E BELL-WRV	9.150000	RV	ES950
269	SR 90	E BELL-WRV	9.150000	EB	ES950
270	SR405	COAL CRK-S	10.05000	RM	ES445
271	SR405	COAL CRK-S	10.05000	SB	ES445
272	SR405	COAL CRK-S	10.05000	SB	+ HOV
273	SR405	COAL CRK-S	10.05000	NB	ES445
274	SR405	COAL CRK-S	10.05000	NB	+ HOV
275	SR520	MONTLAKE-E	1.050000	RM	ES524
276	SR520	MONTLAKE-E	1.050000	ON	ES524
277	SR520	MONTLAKE-E	1.050000	WB	ES524
278	SR520	MONTLAKE-E	1.050000	WB	+ HOV
279	SR520	MONTLAKE-E	1.050000	EB	ES524
280	SR520	MONTLAKE-E	1.050000	EB	+ HOV
281	SR 5	NE 145TH-S	174.6000	RM	ES18.8
282	SR 5	NE 145TH-S	174.6000	SB	OFF
283	SR 5	NE 145TH-S	174.6000	SB	ES18.8

.TATIONS	ROUTE	PLACE	MILE	TY	QUEST
284	SR 5	NE 145TH-S	174.6000	SB	+ HOV
285	SR405	112 AVE SE	9.250000	RM	ES441
286	SR405	112 AVE SE	9.250000	SB	ES441
287	SR405	112 AVE SE	9.250000	SB	+ HOV
288	SR405	112 AVE SE	9.250000	NB	ES441
289	SR405	112 AVE SE	9.250000	NB	+ HOV
290	SR520	LK WA BLVD	1.550000	RM	ES525
291	SR520	LK WA BLVD	1.550000	WB	ES525
292	SR520	LK WA BLVD	1.550000	EB	ES525
293	SR 5	SR525-S RT	182.3000	RM	ES35
294	SR 5	SR525-S RT	182.3000	ON	ES35
295	SR 5	SR525-S RT	182.3000	SB	ES35
296	SR405	NE 44 ST-S	7.430000	RM	ES436
297	SR405	NE 44 ST-S	7.430000	SB	ES436
298	SR405	NE 44 ST-S	7.430000	SB	+ HOV
299	SR405	NE 44 ST-S	7.430000	NB	ES436
300	SR405	NE 44 ST-S	7.430000	NB	+ HOV
301	SR 5	220TH SW-S	179.2600	RM	ES27
302	SR 5	220TH SW-S	179.2600	ON	ES27
303	SR 5	220TH SW-S	179.2600	SB	ES27
304	SR 5	SR405-S LT	182.3100	RM	ES36
305	SR 5	SR405-S LT	182.3100	SB	ES36
306	SR405	NE 30 ST-S	6.550000	RM	ES432
307	SR405	NE 30 ST-S	6.550000	NB	OFF
308	SR405	NE 30 ST-S	6.550000	SB	ES432
309	SR405	NE 30 ST-S	6.550000	SB	+ HOV
310	SR405	NE 30 ST-S	6.550000	NB	ES432
311	SR405	NE 30 ST-S	6.550000	NB	+ HOV
312	SR 5	220TH SW-N	179.3000	RM	ES27.2
313	SR 5	220TH SW-N	179.3000	NB	ES27.2
314	SR 5	164TH SW-S	183.9000	RM	ES39
315	SR 5	164TH SW-S	183.9000	SB	ES39
316	SR 5	164TH SW-S	183.9000	NB	ES39
317	SR405	NE PARK-S	5.390000	RM	ES428
318	SR405	NE PARK-S	5.390000	SB	OFF
319	SR405	NE PARK-S	5.390000	SB	ES428
320	SR405	NE PARK-S	5.390000	SB	+ HOV
321	SR405	NE PARK-S	5.390000	NB	ES428
322	SR405	NE PARK-S	5.390000	NB	+ HOV
323	SR 5	128TH SW-S	186.4300	RM	ES42
324	SR 5	128TH SW-S	186.4300	SB	ES42
325	SR 5	128TH SW-S	186.4300	NB	ES42
326	SR405	SUNSET-N	4.700000	RM	ES426
327	SR405	SUNSET-N	4.700000	SB	ES426
328	SR405	SUNSET-N	4.700000	SB	+ HOV
329	SR405	SUNSET-N	4.700000	NB	ES426
330	SR405	SUNSET-N	4.700000	NB	+ HOV
331	SR 5	LK CITY-S	107.8000	RM	ES12.4
332	SR 5	LK CITY-S	170.8000	SB	ES12.4
333	SR 5	LK CITY-S	170.8000	SP	ES12.4

Appendix A2

VOLUME AND LANE-OCCUPANCY TAPES IN UNIVERSITY OF WASHINGTON TAPE LIBRARY

TAPE LIBRARY

Volume Data Old Format

VSN	DATES
Vo101	81/06/11 - 82/11/28
Vo102	81/12/02 - 81/12/19
Vo103	82/01/03 - 82/05/22
Vo104	82/05/24 - 82/10/30
Vo105	82/11/01 - 83/03/31
Vo106	83/04/01 - 84/08/30
Vo107	83/09/01 - 84/01/31
Vo108	84/02/01 - 86/06/30
Vo109	84/07/01 - 84/11/30
Vo110	84/12/01 - 85/04/30
Vo111	85/05/01 - 85/09/30

Volume Data New Format

Vo121	86/02/18 - 86/07/07

Occupancy Data New Format

Occ01	86/02/18 - 86/06/01
Occ02	86/06/03 - 86/07/07