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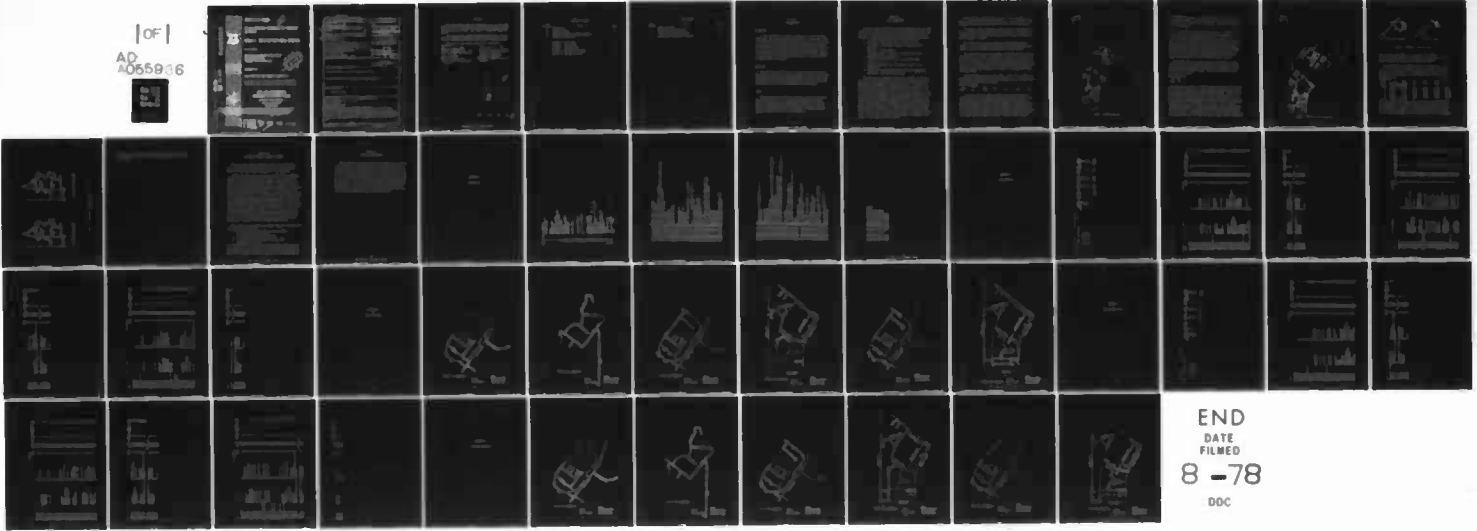
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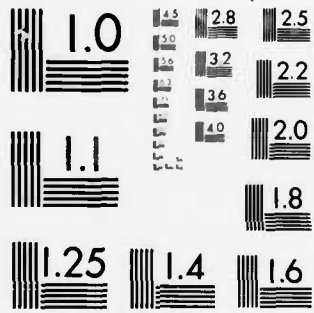
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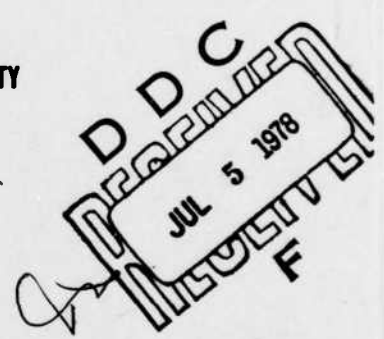
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# Refuse-Collection Scheduling For Selected Locations

## Volume I: Offutt Air Force Base, Nebraska

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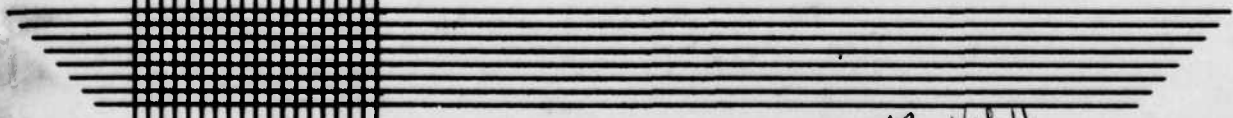
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FINAL REPORT FOR PERIOD JANUARY 1976-APRIL 1977

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### CIVIL AND ENVIRONMENTAL ENGINEERING DEVELOPMENT OFFICE

(AIR FORCE SYSTEMS COMMAND)  
TYNDALL AIR FORCE BASE  
FLORIDA 32403



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report presents maps and schedules produced by the Air Force Refuse-Collection Scheduling Program for dumpster-type refuse collection at Offutt Air Force Base, Nebraska. The data required for scheduling and the difficulties encountered in dumpster-type collection are discussed briefly. The total mileage of the three trips required to collect refuse was reduced from 40.3 to 39.7 miles.		

PREFACE

This report documents work performed during the period January 1976 through April 1977 by the University of New Mexico under contract F29601-76-C-0015 with DET 1 (CEEDO) HQ ADTC, Air Force Systems Command, Tyndall Air Force Base, Florida 32403. Capt. Robert F. Olfenbuttel managed the program.

This report has been reviewed by the Information Officer and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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## SECTION I INTRODUCTION

### BACKGROUND

From 1973 through 1975, a study was conducted at the Civil Engineering Research Facility (CERF) to evaluate the usefulness of the IBM Vehicle Scheduling Program for scheduling refuse collection at Air Force bases. This study indicated that reductions in manpower and total mileage of up to 20 percent could be obtained in some cases. The large amount of human effort required to put the final routes in a useable form resulted in the development of the current CERF Refuse-Collection Scheduling Program (RCSP). This program produces a printed schedule and maps which can be used directly by the driver of the collection vehicle or in reports.

### OBJECTIVE

The objective of this effort was to utilize RCSP to determine optimum refuse-collection schedules for four Air Force bases. These test bases provide the necessary diversity of refuse-scheduling problems so as to determine the program's range of applicability. With the program's capabilities determined, its potential for Air Force wide implementation can be evaluated.

### SCOPE

This report presents the results of the scheduling efforts for dumpster-type refuse collection at one of the test bases—Offutt Air Force Base, Nebraska. The data required for scheduling are discussed briefly and the difficulties encountered with widely separated pickup locations, which are typical of dumpster-type collection, are presented. The original and RCSP routes are presented on maps and as printed schedules.

SECTION II  
DATA REQUIREMENTS

The data available for Offutt Air Force Base included two maps, one showing the three collection routes on base and the other showing the location of the sanitary landfill relative to the base. There are 48 refuse-container locations. In addition to the maps, the following information was provided:

1. speed limits on base vary from 10 to 30 miles per hour,
2. the speed limit on Highway 73-75 is 55 miles per hour,
3. an average of 6 cubic yards of refuse is collected at each container,
4. there are no one-way streets,
5. the average speed of the refuse-collection vehicles during collection is 6 miles per hour,
6. the average stopped time at each pickup location is 185 seconds,
7. the average unloading time at the sanitary landfill is 15 minutes, and
8. two Dempster tilt-frame trucks with 30-cubic-yard, demountable, selfloading, compactable units are used.

The speed limits on individual streets are not indicated, so 15 miles per hour was used in populated areas and 25 or 30 miles per hour was used in uninhabited areas, depending on the length of the road. The error in time introduced by incorrect choice of on-base speed limits can be bounded. The maximum on-base travel amounts to almost 6 miles for RCSP route 1. If all on-base speed limits were 30 miles per hour, the travel time would be 12 minutes, but if all on-base speed limits were 10 miles per hour (the lowest indicated for Offutt Air Force Base), the travel time would be 36 minutes. The speed limits used by RCINPT fall between these values, so the error caused by incorrect speed limits in the time schedule for the on-base part of the trip must be less than 24 minutes. If a vehicle deviates by more than 24 minutes from the route 1 schedule, the error must come from some source other than the speed limits; e.g., the stop time may be in error. The on-base travel for routes 2 and 3 is about 4 miles each, so the maximum error from speed limits in each of these routes is about 18 minutes.

No provision is made in RCSP for compaction. The vehicle capacity is taken to be the maximum total refuse collected on any trip. Since 17 containers are serviced on one trip, the vehicle capacity was taken to be 102 cubic yards.

To reduce the extent of maps drawn by RCSP, the path from the Nelson Drive gate to the landfill was given to RCSP with an altered scale. The mileage is treated correctly, but that portion of each trip is not drawn to the same scale as the remainder of the map.

RCSP consists of four computer programs: the data-checking program (RCINPT), the section-assignment program (PHASE2), the route-traversing program (PHASE3), and the route-map and schedule-generating program (PHASE4).

The RCINPT data consist of three records: street name, size of output map, and description of input map. The actual data cards for Offutt Air Force Base are listed in Appendix A. A reduced copy of the output map is shown in Figure 1. The actual size of this map is 15 by 20 inches (indicated by the output-map size data card). As mentioned previously, two streets with different scales were entered; this caused a warning message to be printed for the corresponding map description cards.

Data for PHASE2 consist of only four cards: a title card, the vehicle capacity card, the time limits card, and an output-map size card. The data cards for Offutt Air Force Base are as follows:

OFFUTT AFB. NEB.

	102.					
3.08		15.	4.			
0.	6.	7.5	0.	8.	10.	10.

The choice of the first segment in RCINPT for the map description can affect the quality of the sectioning performed by PHASE2, since PHASE2 starts building the first section around the first segment. The problem can be shown by assuming that the collection region boundary is rectangular with its length several times its width. If the first segment is chosen from the center of the rectangle or from the middle of a long edge, the sections will start filling the center of the region. As later sections are assigned, they will fall to one side or the other of the center. The last section may be two

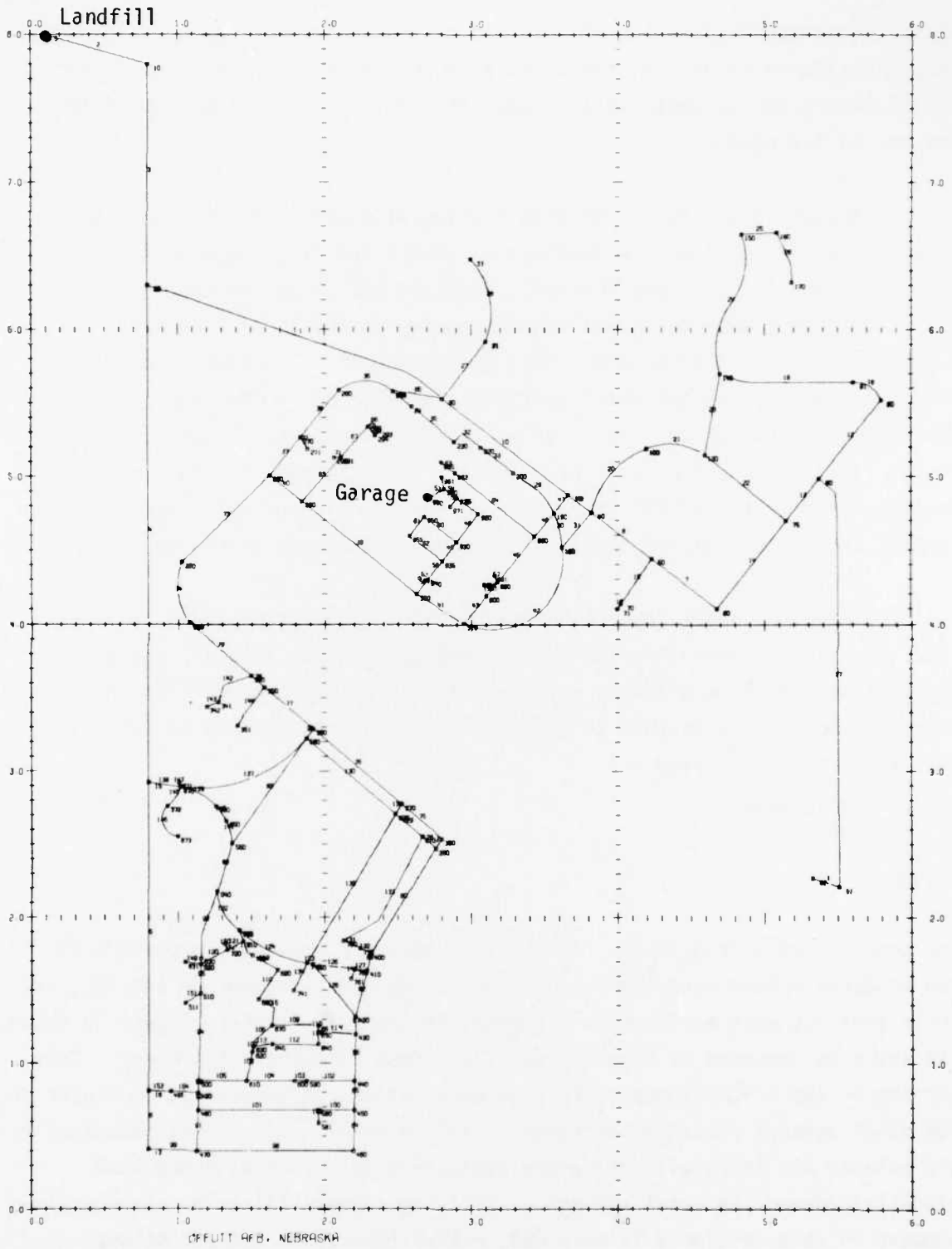


Figure 1. RCINPT Output Map

widely separated pieces, one at each end of the collection region. To avoid this undesirable situation, the first segment should be chosen from a short end of the region so that sections will fill out the collection region from one end to the other.

In actual cases, few collection regions will occur in long, thin rectangles, but it still may be possible to select the first segment so that the sectioning will proceed compactly from one end of the region to the other. At one time, the street segment ending at the landfill was the first map description card in RCINPT. This caused the first section to occupy the center of the map and the third section to consist of two distant pieces—one including segments at the bottom of the map and the other including segments at the right side of the map. By placing a segment from the right side of the map first in the RCINPT data, more compact sectioning was effected by PHASE2. The output map of the final sectioning is shown in Figure 2.

The required input data to PHASE3 consist of only two cards: a title card and a card giving the node numbers assigned to the landfill and garage. Two optional cards were added, each reassigning a street segment to another section (sections correspond to trips). These data cards were as follows for Offutt Air Force Base:

OFFUTT	AFB,	NEB
5	980	
66	3	
151	2	

Two segments were reassigned. In one case poor map reduction procedure placed two adjacent refuse containers on different segments (segment 66 and 70), and these segments were assigned to different sections by PHASE2. Figure 3a shows the segments (bounded by squares) and the refuse containers (circles). This portion of the original map would have been better represented as in Figure 3b. The other segment reassignment (segment 151 to section 2) was not necessary but did balance all trips with 16 refuse containers each. It also may have slightly reduced the total mileage by allowing segment 151 to be reached along segment 95 when section 2 is serviced, rather than along segment 94 when section 3 is serviced. Since segment 94 contains no refuse, it probably would not be necessary to traverse it to reach any section 3 refuse after the reassignment.

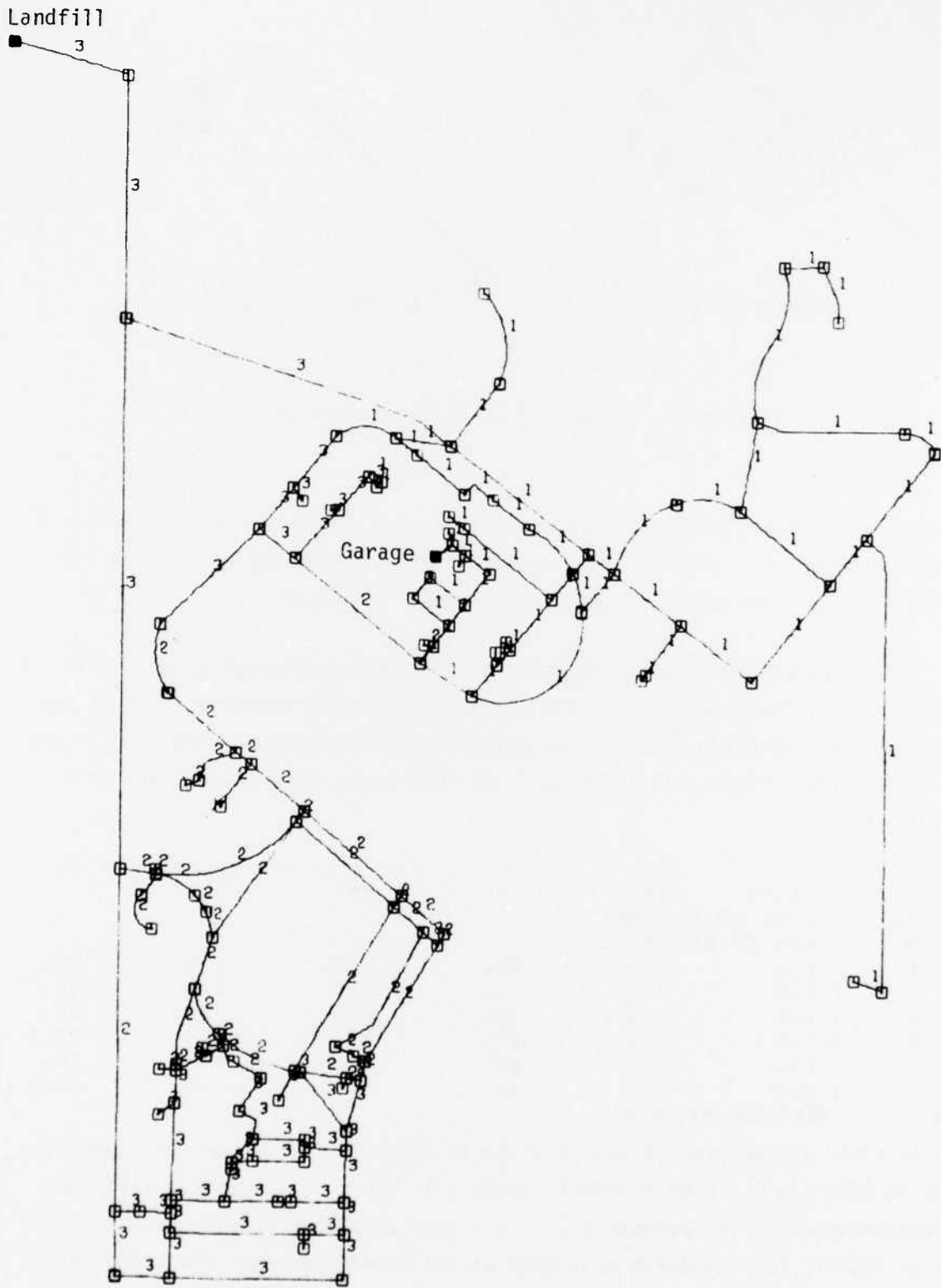


Figure 2. PHASE2 Section-Assignment Map

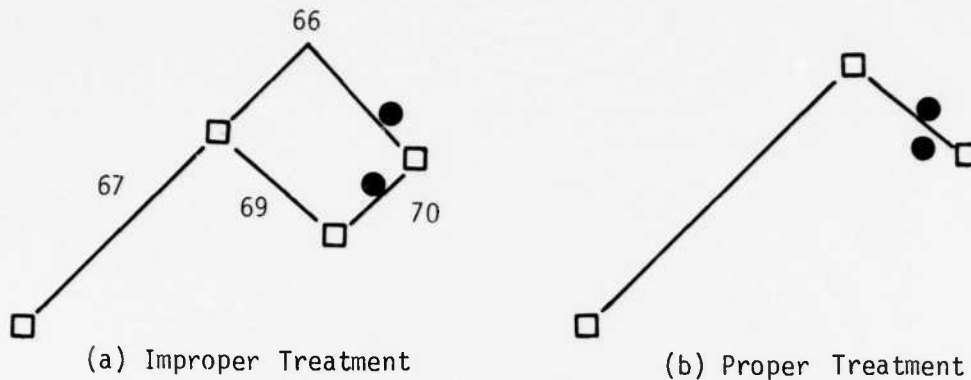


Figure 3. Treatment of Adjacent Containers

Figure 4 shows these segments, with x indicating refuse containers, and their section assignments. Segment 95 is automatically reassigned to section 2 by PHASE3 following the user-initiated reassignment of segment 151.

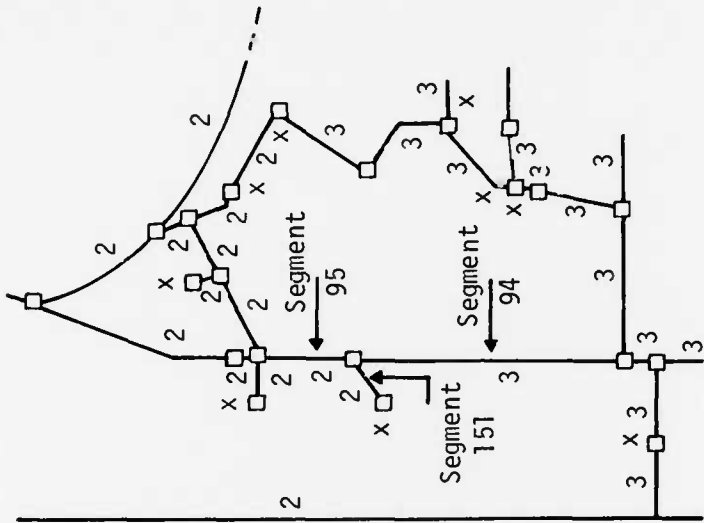
There are two records for PHASE4. The first record consists of a title card, a card giving the unit of refuse measurement, two time-limit cards, and a vehicle identification card. The second record consists of cards specifying map boundaries. These data cards were as follows for Offutt Air Force Base:

```

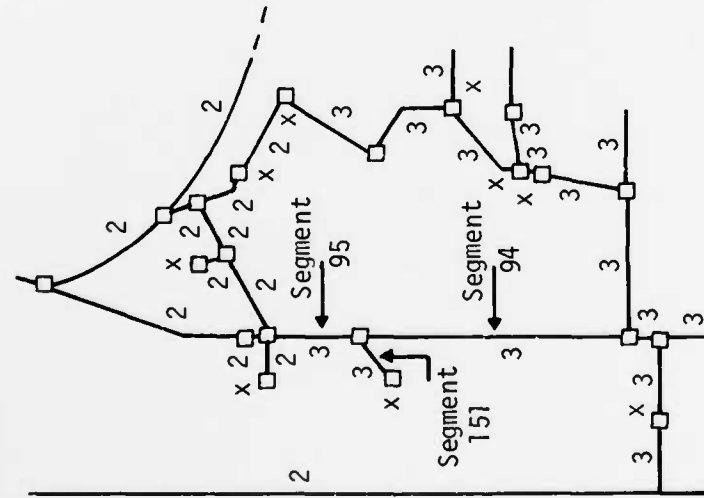
OFFUTT AFB. NEB
CUBIC YARDS
  3.08          15.          2.          2.          7.75          6.
  30.          11.75        15.          10.          15.          14.5
  102.          30 CU YD VEHICLE
7/8/9          (END OF RECORD)
  1  1 1.6          4.0          12.          3.8          6.8          15.
  1  1 3.5          6.5          12.          2.1          6.7          18.4
  2  1 1.6          4.0          12.          3.8          5.8          10.
  2  1 0.6          3.0          12.          0.3          4.2          19.5
  3  1 1.6          4.0          12.          3.8          5.8          10.
  3  1 0.6          3.0          12.          0.3          4.2          19.5
7/8/9          (END OF RECORD)

```

The schedule produced by PHASE4 is given in Appendix B with the corresponding maps in Appendix C. (The original schedule is given in Appendix D with the corresponding maps in Appendix E.) Since some driveways were used as map input to RCINPT, the schedules have some street names missing. The schedules must be used with the maps to discern the routes since the maps are inadequate



(a) Original Assignments



(b) Effect of Reassignment

Figure 4. Reassignment of Segment 151 to Section 2

by themselves because quite often the segments containing the pickup locations were so short that the dashed line indicating collection appears as a solid line on the maps.

SECTION III  
EVALUATION OF COMPUTER-GENERATED SCHEDULE

Both the original schedule and the RCSP schedule require three trips. The original route is 40.3 miles; the RCSP is 39.7 miles. Since the new route is not appreciably shorter, implementation is not recommended.

RCSP was written to perform house-to-house, refuse-collection scheduling. However, there are three problem areas when RCSP is used for dumpster-type collection: names missing on the printed schedule, missing indication of collection on the maps, and poor distance minimization. Blank spaces appear in the printed schedule where driveways and unnamed paths are used. The collection points must be represented by street segments. If these segments are drawn longer than about half an inch on the final maps, the true locations of the collection point may be unclear, but if the segments are drawn shorter than half an inch, the dashed line representing collection may appear solid. The distance minimization algorithm used by PHASE3, the traversal program, was intended for street networks where almost every street required collection. Except for compromises to reduce the number of U-turns, the algorithm solves a *Chinese postman* type problem; dumpster collection requires a *traveling salesman* algorithm to produce the minimum distance. The Chinese postman problem requires that the shortest path which contains every segment in a street network at least once be found. The traveling salesman problem requires that the shortest path which connects a given set of points on a street network be found.

RCSP, however, may be worthwhile for dumpster collection if the following conditions exist simultaneously:

1. 10 or more trips are required by the existing schedule to service all collection locations,
2. each vehicle makes two trips per day, and
3. the garage and landfill are distant from each other (perhaps 10 miles or more).

If these conditions exist, a reduction in mileage may result from a more efficient selection of the two trips for each vehicle by PHASE4. RCSP might also be worthwhile when routes are set up for the first time; the minimum number of trips will be produced, but the total mileage may not be the minimum possible.

SECTION IV  
SCHEDULE IMPLEMENTATION

When implementing RCSP routes, the two most important preliminary verifications are that (1) the maximum refuse quantity collected on one trip was correctly determined, and (2) the vehicle involved is almost always capable of completing its route without overfilling. Since there are 48 refuse containers, each vehicle must be capable of servicing 16 containers. A problem may arise if some containers collected on one trip contain more than 6 cubic yards of refuse. There is no way to determine this with the data currently available, so verification of the RCSP routes requires implementation of the schedule first. It is assumed that access to Highway 73-75 is available from the Sherman Turnpike gate; if this assumption is incorrect, RCSP should be rerun with the appropriate change in the map description.

APPENDIX A

RCINPT DATA

OFFUTT AFB, NEBRASKA			
1	HIGHWAY 73 - 75		
2	NELSON DRIVE		
3			
4	RUNWAY		
5	RONNER ROAD		
6	LAWSON DR		
7	FAIRCHILD CIRCLE		
8	ROAD TO RAPCON CENTER		
9	ROAD TO BLDG 324		
10	SERVICE ROAD		
11	SAC ROAD		
12	SHERMAN TURNPIKE		
13	CUSTER ROAD		
14	SOUTH ROAD		
15			
16	GRANTS PASS		
17			
18			
19	LINCOLN HIGHWAY		
20			
21	WASHINGTON SQUARE		
22	LOT		
23			
24	LINCOLN HIGHWAY		
25	SHERMAN TURNPIKE		
26	DRIVEWAY TO BLDG 18		
29	TRAVIS DR		
30	ROAD TO SARPY CC NTY LAND FILL		
35	LOT TO BLDG 64		
37	CHAPEL LOT		
39	DRIVEWAY TO BLDG 132		
47	LOT BEHIND BLDG 167		
50	TIGER DRIVE		
76	GARAGE		
7/A/9	(END OF RECORD)	0.	8.
0.	6.	0.	20.
7/A/9	(END OF RECORD)	0.	10.
.1	400.		
	2.5		

4 82 5 1.0 81/(5.33,2.26) (5.51,2.2)  
 30 5 313 0.0 10/40 (.1,8) (.8,7.8)  
 1 10 200 0.0 20/ 55 (.) (.8,6.3)  
 1 20 85 0.0 15 53 0.0 16 10 0.0 17/ 55 (.) (.8,.4)  
 2 60 14 0.0 50 13 0.0 40 5 0.0 35 27 0.0 30 54 0.0 20/30 (4.68,4.1) R66  
 2 90 17 0.0 80 9 0.0 75 19 0.0 60/30 (5.8,5.52)  
 3 50 9 0.0 70 1 1.0 71/(.) (4.4,1)  
 4 81 71 0.0 80/ 30 (.) R67  
 5 91 6 0.0 90/(5.61,5.64) LC  
 5 140 23 0.0 91/(4.7,5.7) R4  
 29 100 15 0.0 40/(4.2,5.19) RC  
 29 120 10.5 0.0 100/(4.6,5.15) RC  
 29 120 18 0.0 75  
 6 120 13 0.0 140  
 6 150 25 0.0 140/(4.85,6.65) LS  
 7 160 6 0.0 150/(5.09,6.66)  
 8 170 9 1.0 160/(5.19,6.32) R3  
 9 31 11 0.0 30/(3.10,5.92)  
 9 33 15 3.0 31/(3.6,4.8) LC  
 10 200 10 0.0 190 6 0.0 180/(3.29,5.03) LC (3.62,4.52)  
 29 40 8 0.0 180  
 10 230 6 0.0 220 7 2.1 200/(2.89,5.24) L2  
 10 250 4 0.1 240 9 0.0 230/(2.47,5.58)  
 10 260 10 0.0 250/(2.10,5.59) LC  
 10 280 8 0.0 270 10 0.0 260/(1.63,5.01)  
 10 300 25 0.0 290 7 0.0 280/(2.63,4.20)  
 10 310 9 0.0 300/(2.95,4.00) LC  
 10 310 26 0.0 180/(.) RC  
 50 310 6 0.0 900 3 0.0 890 10 0.0 880 5 0.0 190 4 0.0 35  
 51 920 6 0.0 930 4 0.0 935 4 0.0 940 3 0.0 300/(3.05,4.75)  
 52 961 2 1.0 960 3 0.0 980 / (2.8,5) L2 (2.72,4.85)  
 53 960 3 0.0 970 5 0.0 920/(.)  
 68 901 2 1.0 900/(3.09,4.27)  
 69 891 2 1.0 890/(3.16,4.33)  
 67 941 2 1.0 940/(2.45,4.31)  
 64 971 2 1.0 970/(2.86,4.80)  
 60 930 7 0.0 950 4 2.0 955 7 0.0 935/(.) RR  
 61 965 3 0.2 963 18 0.0 880 / (2.8,5.1)

62 250 9 0.0 30  
55 293 3 1.0 292 7 0.0 291 10 0.0 290/(2.38,5.31) R2  
58 294 2 1.0 292/(2.35,5.28)  
58 293 1 0.0 294  
57 295 1 1.0 291/(2.07,5.13)  
56 271 2 1.0 270/(1.89,5.19)  
11 320 21 0.0 280/(1.03,4.42)  
11 330 11 0.0 320/ 25 (1.08,4.00) LC  
11 380 9 0.0 370 20 0.0 360 11 0.0 350 3 0.0 340 14 0.0 330/ 25 (2.80,2.53)  
12 400 21 0.0 390 2 0.0 380/(2.32,1.74)  
12 420 8 0.0 410 3 0.0 400/(2.21,1.31) LC  
12 460 7 0.0 450 5 0.0 440 8 0.0 430 3 0.0 420/(2.20,0.39)  
13 540 8.5 0.0 550 22 0.0 560 2 0.0 360/(1.27,2.17) L8.5  
13 470 7 0.0 480 3 0.0 490 2 0.0 500 15 0.0 510 5 0.0 520 1 0.0 530 12 0.0 540/+  
(1.13,0.39) L37  
14 460 26 0.0 470 8 0.0 17  
15 450 6 0.0 580 20 0.0 480/(,)  
16 440 8 0.0 590 2 0.2 600 8 0.0 610 8 0.0 500/(,)  
17 670 5 0.0 630 1 2.0 620 5 0.0 610/(1.64,1.25) R4  
17 670 8 2.0 660 1 0.0 650 2 1.0 640 8 0.0 645/(, ) LR (1.64,1.12)  
17 645 3 0.0 630/(,)  
17 430 6 0.0 650/(,)  
17 680 6 0.0 670/(1.55,1.43) L3  
17 690 5 0.0 680/(1.68,1.63)  
17 730 2 0.0 710 3 0.0 700 5 1.1 690/(1.2,1.90) R4  
19 520 5 0.0 720 3 0.0 710/(, ) LC  
18 540 8 0.0 730/(, ) RC  
19 750 1 0.0 740 13 0.0 730/(1.92,1.67) LC  
19 750 12 0.0 420/(, ) LC  
20 750 7 0.0 760 2 0.0 410/(, ) RC  
25 390 3 0.0 810 6 0.0 820 20 0.0 560/(, )  
22 780 3 2.0 770 2 0.0 400/(2.13,1.83)  
22 780 23 1.1 810/(, ) R7  
21 741 5 1.0 740 29 0.0 820 3 0.0 370/(1.79,1.49)  
25 870 24 0.0 560/(1.02,2.88) RC  
25 870 5 0.0 15  
24 870 7 0.0 860 3 1.0 850 4 0.0 550/(, ) LC  
26 341 8 0.0 340/(1.28,3.46) L3  
26 342 2 1.0 341/(1.20,3.43)

27 351 8 1.0 350/(1.41.3.30) L2  
28 872 4 0.0 870/(0.93.2.75) RC  
28 873 7 1.0 872/(1.00.2.54) LC  
31 871 1 1.0 870/(1.01.2.91)  
35 761 1 1.0 760/(2.18.1.57)  
36 831 2 1.0 520/(1.05.1.68)  
37 721 1 1.0 720/(1.32.1.81)  
39 511 3 1.0 510/(1.05.1.40)  
47 581 2 1.0 580/(1.96.0.58)  
49 16 4 0.0 491 5 1.0 490  
7/8/9 (END OF RECORD)  
7/8/9 (END OF RECORD)

APPENDIX B

RCSP SCHEDULE

FINAL ROUTE SUMMARY OFFUTT AFB, NEBRASKA

ROUTE	VEHICLE IDENTIFICATION	VEHICLE CAPACITY (CUBIC YARDS)	SECTION(S) TRIP1 TRIP2 )	DISTANCE (MILES)	TIME (HR:MIN)	HOUSEHOLDS SERVICED	REFUSE QUANTITY (CUBIC YARDS)
1	30 CU YD VEHICLE	102.0	1	14.4	1:39	16	96.0
2	30 CU YD VEHICLE	102.0	2	12.3	1:33	16	96.0
3	30 CU YD VEHICLE	102.0	3	13.0	1:33	16	96.0
TOTALS				39.7	4:45	48	288.0



ACTION	SPEED (MPH)	TYPE (HR:MIN)	DISTANCE (PILES)	HOUSEHOLDS SERVICED	LOAD (PCT)
DRIVE ON	15	8853	.2		94
DRIVE ON	30	8854	.4		94
DRIVE ON	55	8856	1.5		94
DRIVE ON	40	8859	2.4		94
UNLOAD		8859 TO 9814			
DRIVE ON	40	9818	2.4		
DRIVE ON	55	9819	1.5		
DRIVE ON	30	9821	.6		
DRIVE ON	15	9821	.2		
DRIVE ON	15	9822	.1		
DRIVE ON	15	9822	.1		
DRIVE ON	15	9822	.1		
DRIVE ON	15	9823	.0		
ROAD TO BLDG #24					
NELSON DRIVE					
HIGHWAY 73 - 75					
ROAD TO SARPY COUNTY LAND FILL					
ROAD TO SARPY COUNTY LAND FILL					
ROAD TO SARPY COUNTY LAND FILL					
HIGHWAY 73 - 75					
NELSON DRIVE					
TIGER DRIVE					
SERVICE ROAD					
TO GARAGE					

ROUTE 2 OFFUTT AFB, NEBRASKA 30 CU YO VEHICLE

ACTION	SPEED (MPH)	TIME (HR:MIN)	DISTANCE (MILES)	HOUSEHOLDS SERVICED	LOAD (PCT)
LEAVE GARAGE		7845			
DRIVE ON	15	7845	.0		
DRIVE ON	15	7845	.1		
DRIVE ON	15	7846	.1		
PICK UP ON	6	7849	.0	1	5
DRIVE ON	15	7849	.0		5
DRIVE ON	15	7849	.0		5
DRIVE ON	15	7850	.2		5
DRIVE ON	15	7851	.2		5
DRIVE ON	25	7851	.2		5
DRIVE ON	15	7851	.1		5
PICK UP ON	6	7855	.0	1	11
DRIVE ON	15	7855	.1		11
DRIVE ON	25	7855	.0		11
PICK UP ON	6	7859	.1	1	17
DRIVE ON	15	7859	.1		17
DRIVE ON	25	8800	.2		17
DRIVE ON	15	8800	.0		17
DRIVE ON	15	8800	.0		17
PICK UP ON	6	8808	.2	2	29
PICK UP ON	6	8814	.0	2	41
DRIVE ON	15	8814	.0		41
DRIVE ON	15	8814	.0		41
PICK UP ON	6	8817	.0	1	47
DRIVE ON	15	8817	.0		47
DRIVE ON	15	8818	.1		47
DRIVE ON	15	8818	.1		47
DRIVE ON	15	8818	.0		47
PICK UP ON	6	8821	.0	1	52
DRIVE ON	15	8821	.0		52
DRIVE ON	15	8822	.0		52
PICK UP ON	6	8825	.0	1	58
DRIVE ON	15	8825	.0		58
DRIVE ON	15	8825	.0		58
PICK UP ON	6	8828	.0	1	64
DRIVE ON	15	8828	.0		64
DRIVE ON	15	8829	.0		64
DRIVE ON	15	8829	.1		64
DRIVE ON	15	8829	.0		64
PICK UP ON	6	8835	.0	2	76
DRIVE ON	15	8835	.1		76
DRIVE ON	15	8836	.1		76
DRIVE ON	15	8836	.1		76
DRIVE ON	15	8836	.0		76
PICK UP ON	6	8840	.0	1	82
DRIVE ON	15	8840	.1		82

ACTION	SPEED (MPH)	TIME (HR:MIN)	DISTANCE (PILES)	HOUSEHOLDS SERVICED	LOAD (PCT)
PICK UP ON	6	8:43	.0	1	88
DRIVE ON	15	8:43	.0		88
DRIVE ON	15	8:43	.0		88
PICK UP ON	6	8:47	.1	1	94
DRIVE ON	15	8:47	.1		94
DRIVE ON	15	8:47	.0		94
DRIVE ON	55	8:50	2.2		94
DRIVE ON	40	8:53	2.4		94
UNLOAD		8:53 TO 9:08			
DRIVE ON	40	9:12	2.4		
DRIVE ON	55	9:13	1.5		
DRIVE ON	30	9:15	.6		
DRIVE ON	15	9:16	.2		
DRIVE ON	15	9:16	.1		
DRIVE ON	15	9:16	.1		
DRIVE ON	15	9:17	.1		
DRIVE ON	15	9:17	.0		

TC TO LINCOLN HIGHWAY  
TC  
TO  
TO LINCOLN HIGHWAY  
TO HIGHWAY 73 - 75  
TO ROAD TO SARPY COUNTY LAND FILL  
ROAD TO SARPY COUNTY LAND FILL

SHERMAN TURNPIKE  
HIGHWAY 73 - 75  
ROAD TO SARPY COUNTY LAND FILL  
TC LAND FILL

ROAD TO SARPY COUNTY LAND FILL  
HIGHWAY 73 - 75  
NELSON DRIVE  
TIGER DRIVE  
SERVICE ROAD

TO GARAGE

ROUTE	ACTION	OFFUTT AFB, NEBRASKA	30 CU YO VEHICLE	SPEED (MPH)	TIME (HR:MIN)	DISTANCE (MILES)	HOUSEHOLDS SERVICED	LOAD (PCT)
	LEAVE GARAGE				7845			
	DRIVE ON			15	7845	.0		
	DRIVE ON			15	7845	.1		
	DRIVE ON			15	7846	.0		
	DRIVE ON			15	7846	.1		
	PICK LP ON 60TH SIDES			6	7852	.0	2	11
	DRIVE ON			15	7852	.1		11
	DRIVE ON			15	7853	.1		11
	DRIVE ON	SERVICE ROAD		15	7853	.2		11
	DRIVE ON			15	7853	.1		11
	PICK LP ON			6	7854	.1		17
	DRIVE ON			15	7857	.0	1	17
	DRIVE ON			6	8000	.0		17
	PICK LP ON			6	8000	.0	1	23
	DRIVE ON			15	8001	.1		23
	DRIVE ON			6	8004	.0	1	29
	DRIVE ON			15	8004	.0		29
	DRIVE ON	SERVICE ROAD		15	8004	.1		29
	DRIVE ON			15	8005	.1		29
	PICK LP ON			6	8008	.0	1	35
	DRIVE ON			15	8008	.0		35
	DRIVE ON	SERVICE ROAD		15	8008	.1		35
	DRIVE ON	SAC ROAD		15	8009	.2		35
	DRIVE ON	SAC ROAD		15	8009	.2		35
	DRIVE ON	WASHINGTON SQUARE		25	8110	.4		35
	DRIVE ON	WASHINGTON SQUARE		15	8111	.2		35
	PICK LP ON	WASHINGTON SQUARE		6	8114	.0	1	41
	DRIVE ON	WASHINGTON SQUARE		15	8114	.0		41
	DRIVE ON	LINCOLN HIGHWAY		15	8115	.1		41
	DRIVE ON	SHERMAN TURNPIKE		15	8115	.1		41
	DRIVE ON	GRANTS PASS		15	8115	.1		41
	PICK LP ON 80TH SIDES			6	8122	.0	2	52
	DRIVE ON	GRANTS PASS		15	8122	.1		52
	DRIVE ON	GRANTS PASS		15	8122	.0		52
	PICK LP ON 80TH SIDES			6	8128	.0	2	64
	DRIVE ON			15	8128	.0		64
	PICK LP ON 80TH SIDES			6	8135	.1	2	76
	DRIVE ON			15	8135	.0		76
	PICK LP ON			6	8139	.0	1	82
	DRIVE ON	GRANTS PASS		15	8139	.1		82
	DRIVE ON	CUSTER ROAD		15	8139	.1		82
	DRIVE ON	CUSTER ROAD		15	8139	.0		82
	PICK LP ON	LOT BEHIND BLOG 167		6	8140	.2	1	88
	DRIVE ON	LOT BEHIND BLOG 167		15	8143	.0		88
	DRIVE ON	CUSTER ROAD		15	8143	.0		88
	PICK LP ON			6	8144	.2	1	94
	DRIVE ON			15	8144	.0		94
	DRIVE ON	HIGHWAY 73 - 75		15	8147	.0		94
	DRIVE ON	HIGHWAY 73 - 75		15	8148	.0		94
	DRIVE ON	TO ROAD TO SARPY COUNTY LANO FILL		55	8150	2.6		94

ACTION	SPEED (MPH)	TIME (HR:MIN)	DISTANCE (FILES)	HOUSEHOLDS SERVICED	LOAD (PCT)
DRIVE ON	40	8:54	2.4		94
UNLOAD		8:54 TO 9:09			
DRIVE ON	40	9:13	2.4		
DRIVE ON	55	9:14	1.5		
DRIVE ON	30	9:15	.6		
DRIVE ON	15	9:16	.2		
DRIVE ON	15	9:17	.1		
DRIVE ON	15	9:17	.1		
DRIVE ON	15	9:17	.1		
DRIVE ON	15	9:17	.0		

ROAD TO SARPY COUNTY LAND FILL TO LAND FILL

ROAD TO SARPY COUNTY LAND FILL TO HIGHWAY 73 - 75

HIGHWAY 73 - 75 TO NELSON DRIVE

NELSON DRIVE TO TIGER DRIVE

TIGER DRIVE TO SERVICE ROAD

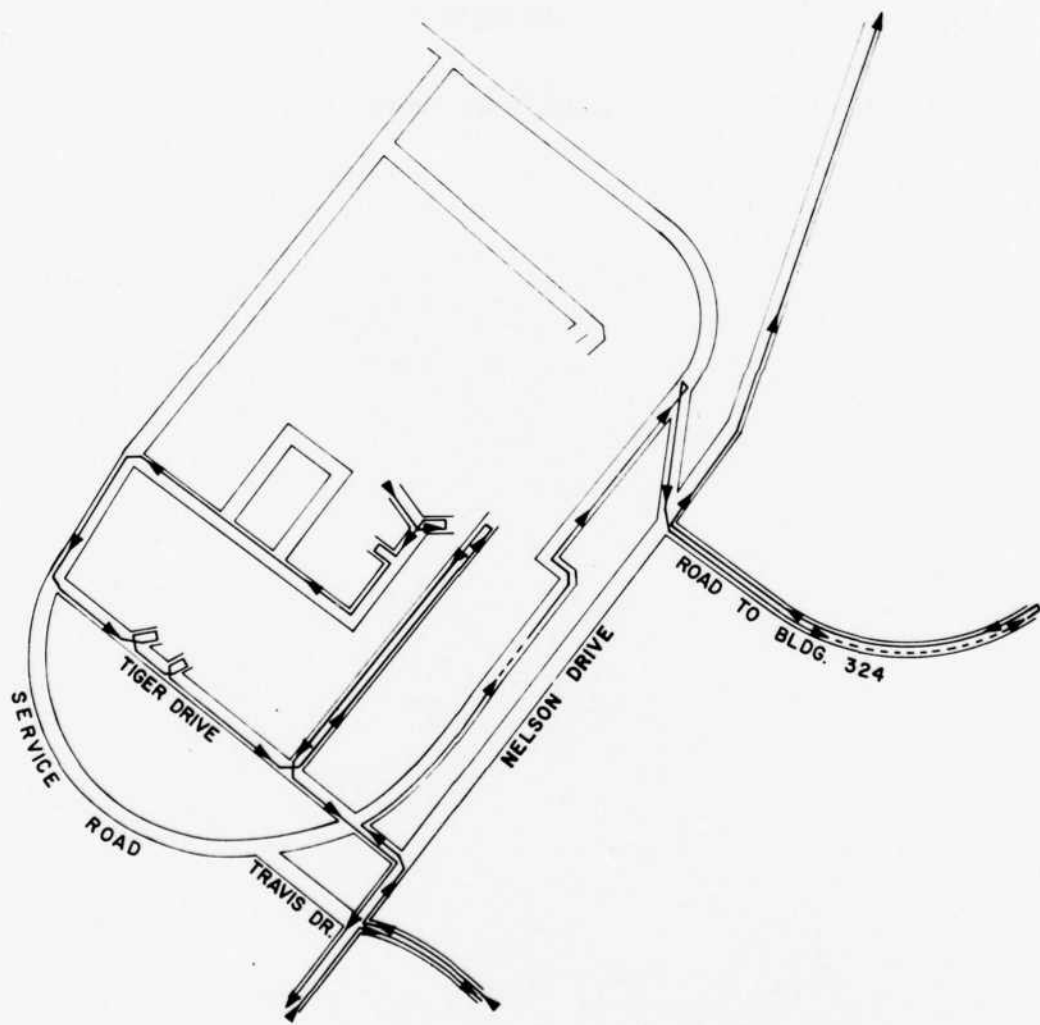
SERVICE ROAD TO

TO

TO GARAGE

APPENDIX C

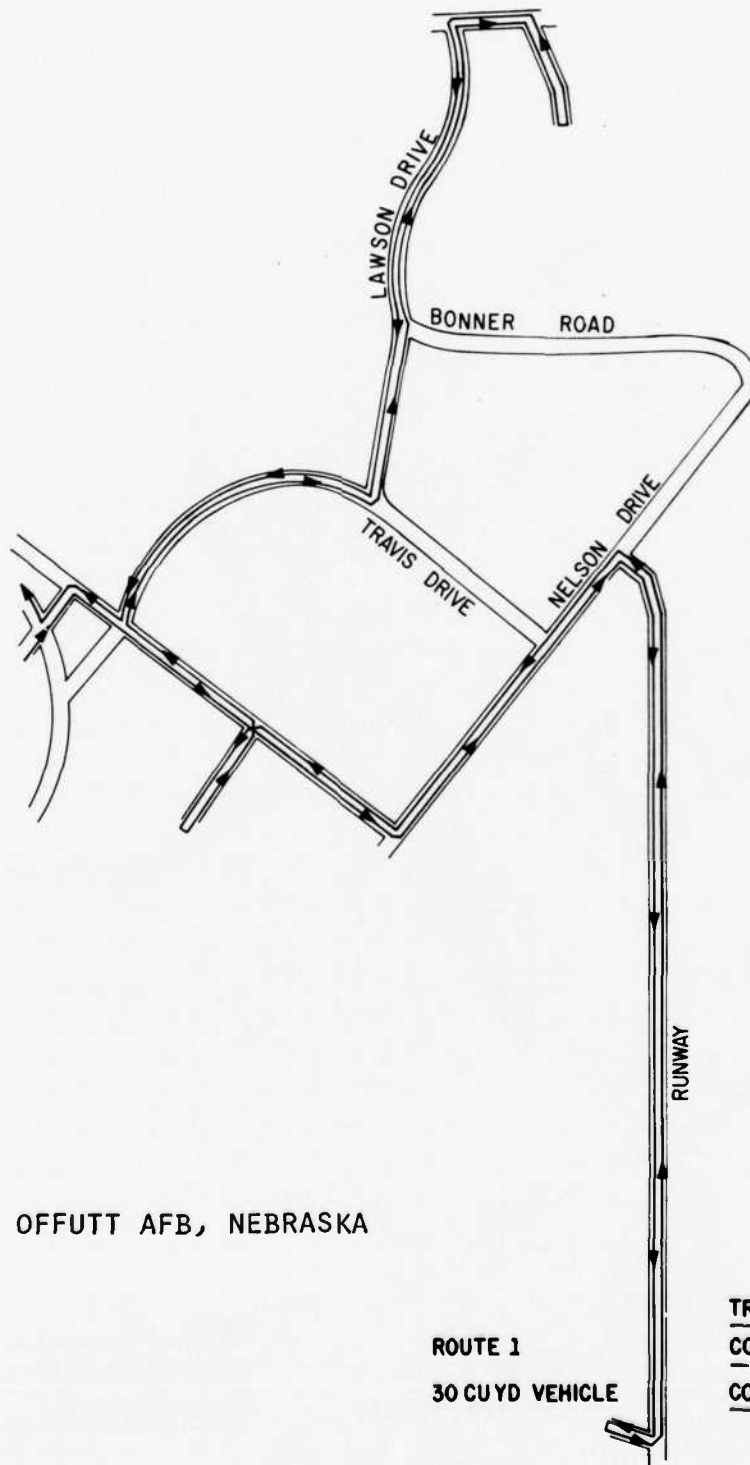
RCSP ROUTE MAPS



OFFUTT AFB, NEBRASKA

ROUTE 1  
30 CU YD VEHICLE

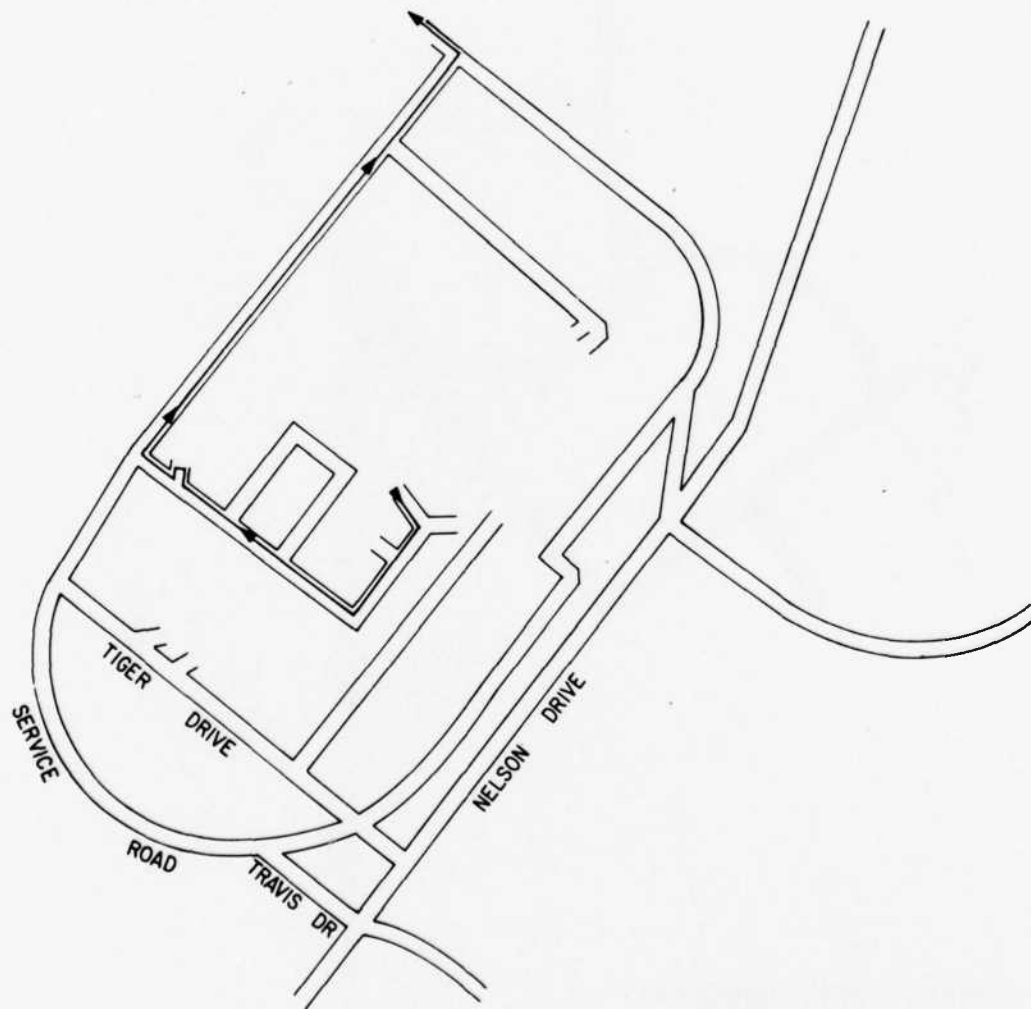
TRAVEL  
 ————> COLLECT BOTH SIDES  
 - - - - - COLLECT RIGHT SIDE  
 . . . . . COLLECT LEFT SIDE



OFFUTT AFB, NEBRASKA

ROUTE 1  
30 CUYD VEHICLE

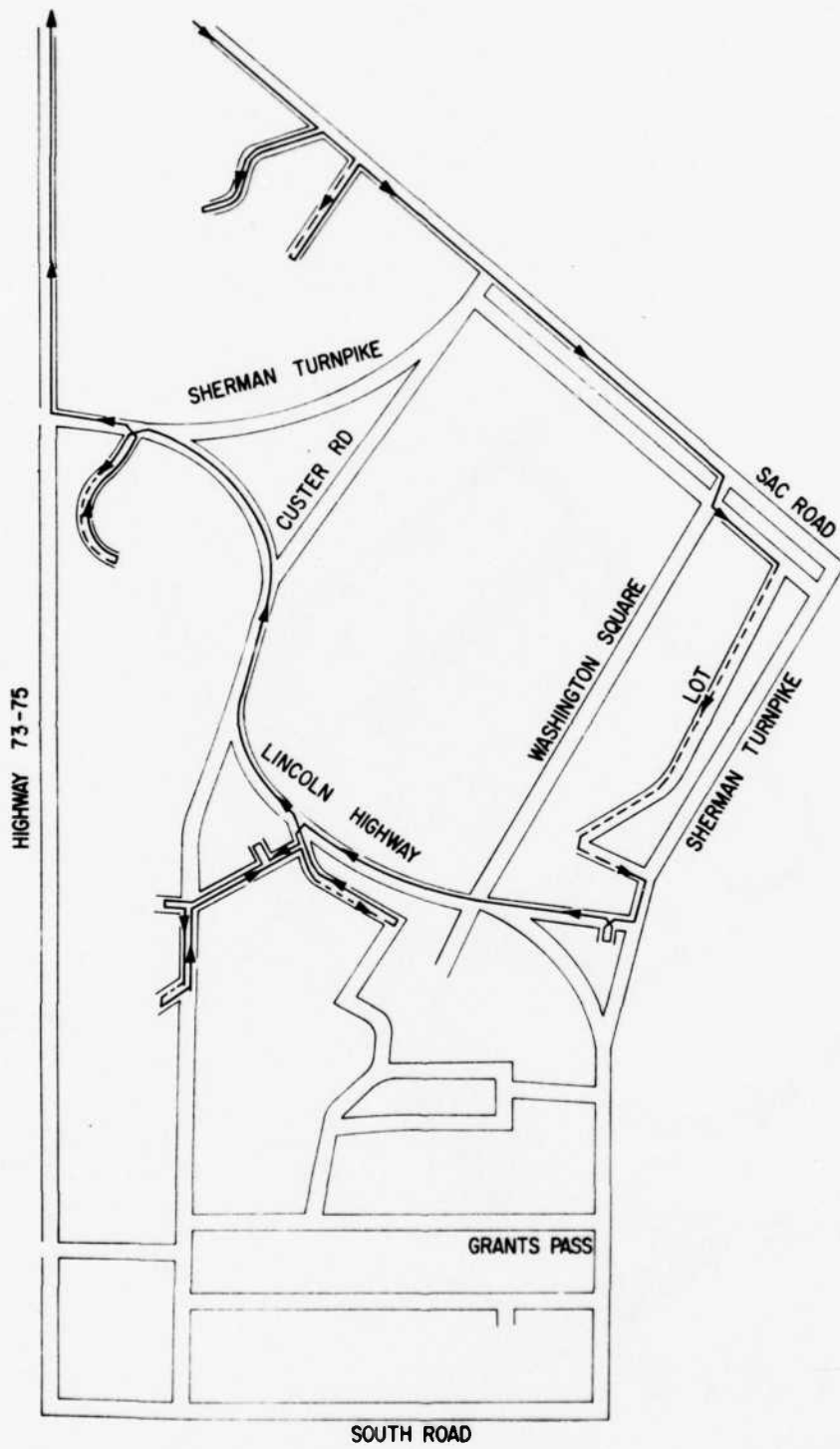
TRAVEL  
COLLECT BOTH SIDES  
COLLECT RIGHT SIDE



OFFUTT AFB, NEBRASKA



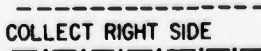
ROUTE 2  
30 CUYD VEHICLE

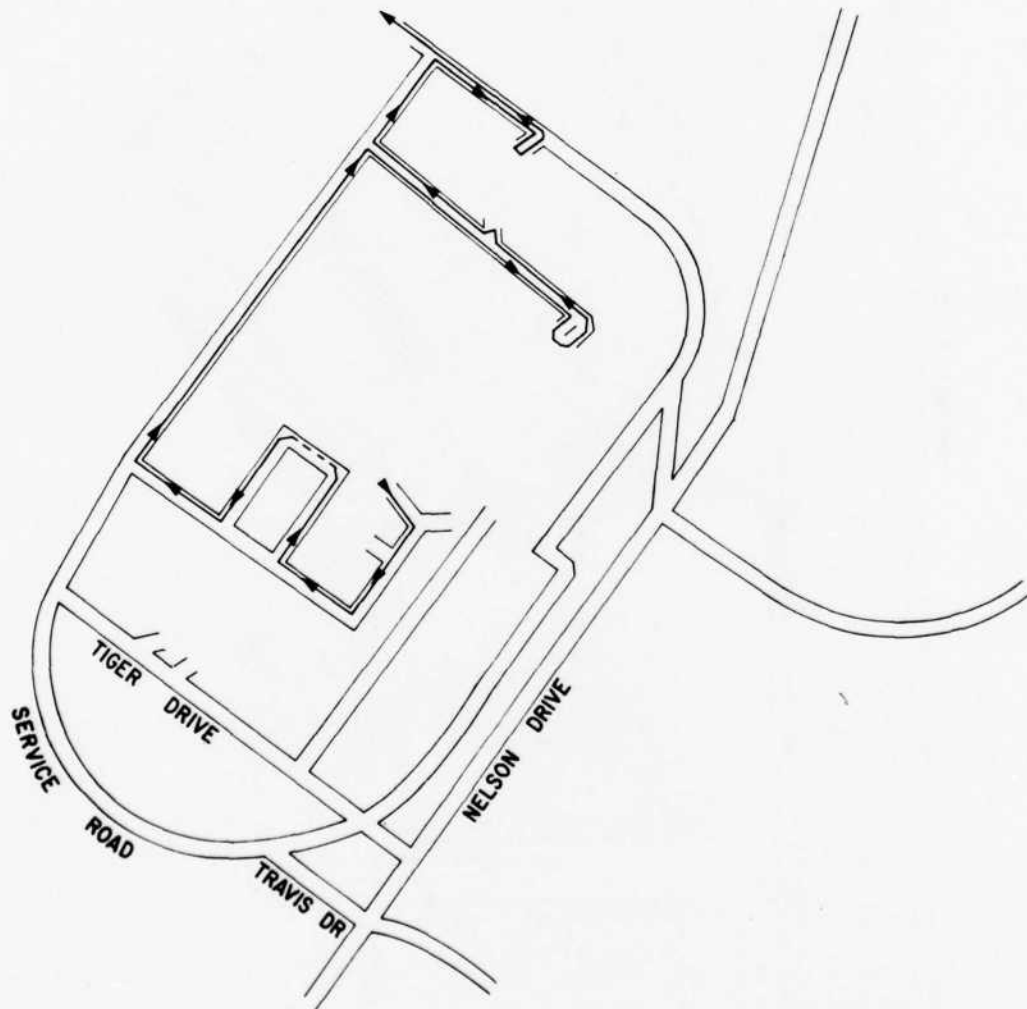
TRAVEL →  
 COLLECT BOTH SIDES — — — — —  
 COLLECT RIGHT SIDE - - - - -






OFFUTT AFB, NEBRASKA

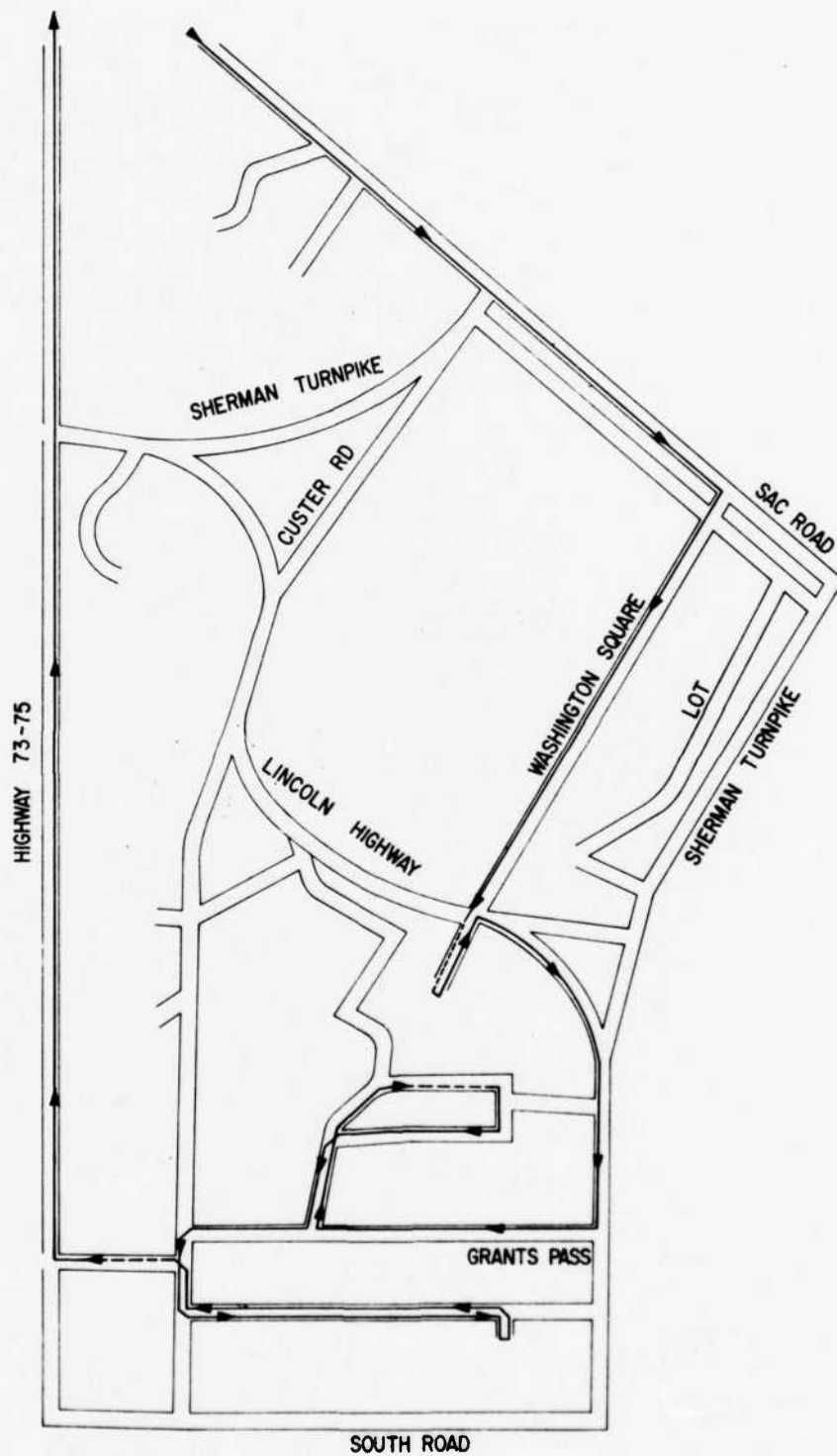
ROUTE 2  
30 CU YD VEHICLE

TRAVEL   
 COLLECT BOTH SIDES   
 COLLECT RIGHT SIDE 



ROUTE 3  
30 CU YD VEHICLE

TRAVEL   
 COLLECT BOTH SIDES   
 COLLECT RIGHT SIDE 



OFFUTT AFB, NEBRASKA

ROUTE 3  
30 CU YD VEHICLE

TRAVEL  
 COLLECT BOTH SIDES  
 COLLECT RIGHT SIDE

APPENDIX D

ORIGINAL ROUTE SCHEDULE

FINAL ROUTE SUMMARY OFFUTT AFB, NEB

ROUTE	VEHICLE IDENTIFICATION	VEHICLE CAPACITY (CUBIC YARDS )	SECTION(S) TRIP1 TRIP2 )	DISTANCE (MILES)	TIME (HR:MIN)	HOUSEHOLDS SERVICED (CUBIC YARDS )	REFUSE QUANTITY (CUBIC YARDS )
1	30 CU YC VEHICLE	102.0	1	14.0	1:34	15	90.0
2	30 CU YD VEHICLE	102.0	2	13.3	1:38	17	102.0
3	30 CU YD VEHICLE	102.0	3	13.0	1:34	16	96.0
TOTALS				40.3	4:46	48	288.0

ROUTE 1 OFFUTT AER. NEB 30 CU YO VEHICLE

ACTION	SPEED (MPH)	TIME (HR:MIN)	CISTANCE (PILES)	HOUSEHOLDS SERVICED	LOAD (PCT)
LEAVE GARAGE		7:45			
DRIVE ON	15	7:45	.0		
PICK UP ON	6	7:46	.0	1	5
DRIVE ON	15	7:48	.0		
DRIVE ON	15	7:48	.0		
PICK UP ON	6	7:52	.0	1	11
DRIVE ON	15	7:52	.0		
DRIVE ON	15	7:52	.0		
DRIVE ON	15	7:52	.0		
DRIVE ON	15	7:52	.1		
PICK UP ON BOTH SIDES	6	7:59	.0	2	23
DRIVE ON	15	7:59	.1		
DRIVE ON	15	7:59	.0		
PICK UP ON	6	8:02	.0	1	29
DRIVE ON	15	8:02	.0		
DRIVE ON	15	8:02	.0		
DRIVE ON	15	8:03	.1		
DRIVE ON	15	8:03	.0		
PICK UP ON	6	8:06	.0	1	35
DRIVE ON	15	8:06	.0		
DRIVE ON	15	8:06	.0		
PICK UP ON	6	8:10	.0	1	35
DRIVE ON	15	8:10	.0		
DRIVE ON	15	8:10	.1		
DRIVE ON	15	8:10	.1		
PICK UP ON BOTH SIDES	6	8:17	.0	2	52
DRIVE ON	15	8:17	.2		
DRIVE ON	15	8:18	.1		
DRIVE ON	30	8:18	.1		
PICK UP ON	6	8:21	.0	1	58
DRIVE ON	15	8:22	.1		
DRIVE ON	30	8:22	.3		
DRIVE ON	30	8:23	.5		
PICK UP ON	6	8:27	.0	1	64
DRIVE ON	15	8:27	.0		
DRIVE ON	30	8:28	.5		
DRIVE ON	30	8:28	.1		
DRIVE ON	15	8:29	.2		
DRIVE ON	15	8:30	.2		
DRIVE ON	15	8:30	.0		
PICK UP ON	6	8:34	.1	1	70
DRIVE ON	15	8:34	.1		
DRIVE ON	15	8:34	.0		
DRIVE ON	15	8:36	.3		
DRIVE ON	15	8:36	.2		
DRIVE ON	30	8:37	.2		
DRIVE ON	15	8:38	.2		

ACTION	SPEED (MPH)	TIME (HR:MIN)	DISTANCE (MILES)	HOUSEHOLDS SERVICED	LOAD (PCT)
PICK UP ON BOTH SIDES ROAD TO BLDG 324	6	8:48	.1	3	88
DRIVE ON ROAD TO BLDG 324	15	8:48	.1		88
DRIVE ON NELSON DRIVE	30	8:49	.4		88
DRIVE ON HIGHWAY 73 - 75	55	8:51	1.5		88
DRIVE ON ROAD TO SARPY COUNTY LAND FILL TO LAND FILL	40	8:54	2.4		88
UNLOAD		8:54 TO 9:09			
DRIVE ON ROAD TO SARPY COUNTY LAND FILL TO HIGHWAY 73 - 75	40	9:13	2.4		
DRIVE ON HIGHWAY 73 - 75	55	9:15	1.5		
DRIVE ON NELSON DRIVE	30	9:16	.6		
DRIVE ON TIGER DRIVE	15	9:17	.2		
DRIVE ON SERVICE ROAD	15	9:17	.1		
DRIVE ON TO	15	9:17	.1		
DRIVE ON TO	15	9:18	.1		
DRIVE ON TO GARAGE	15	9:18	.0		

ROUTE 2 OFFUTT AFB, NEB 30 CU YD VEHICLE

ACTOR		SPEED (MPH)	TIME (HR:MIN)	DISTANCE (PILES)	HOUSEHOLDS SERVICED	LCAO (PCT)
LEAVE GARAGE			7:45			
DRIVE ON	TO	15	7:45	.0		
DRIVE ON	TO	15	7:45	.1		
DRIVE ON	TO SERVICE ROAD	15	7:46	.1		
DRIVE ON	TO	15	7:47	.4		
PICK UP ON BOTH STOPS	TO	6	7:57	.1	3	17
DRIVE ON	TO	15	7:58	.1		17
DRIVE ON	TO	15	8:01	.0	1	23
DRIVE ON	TO	15	8:02	.2		23
PICK UP ON	TO	6	8:05	.0	1	29
DRIVE ON	TO SERVICE ROAD	15	8:05	.0		29
DRIVE ON	TO	15	8:05	.1		29
DRIVE ON	TO	15	8:06	.1		29
PICK UP ON	TO	6	8:09	.0	1	35
DRIVE ON	TO	15	8:09	.0		35
DRIVE ON	TO	15	8:09	.1		35
PICK UP ON	TO	6	8:12	.0	1	41
DRIVE ON	TO	15	8:12	.0		41
PICK UP ON	TO	6	8:16	.0	1	47
DRIVE ON	TO SERVICE ROAD	15	8:16	.1		47
DRIVE ON	TO SAC ROAD	15	8:16	.1		47
DRIVE ON	TO	15	8:17	.2		47
DRIVE ON	TO	25	8:17	.2		47
PICK UP ON	TO ORIVEWAY TO BLDG 418	15	8:18	.1		47
DRIVE ON	TO	6	8:21	.0	1	52
DRIVE ON	TO SAC ROAD	15	8:21	.1		52
PICK UP ON	TO	25	8:21	.0		52
DRIVE ON	TO	6	8:25	.1	1	58
DRIVE ON	TO SAC ROAD	15	8:25	.1		58
DRIVE ON	TO CUSTER ROAD	25	8:25	.1		58
DRIVE ON	TO SHERMAN TURNPIKE	15	8:25	.0		58
DRIVE ON	TO LINCOLN HIGHWAY	15	8:26	.2		58
PICK UP ON	TO	6	8:29	.0	1	64
DRIVE ON	TO LINCOLN HIGHWAY	15	8:29	.0		64
DRIVE ON	TO	15	8:29	.0		64
DRIVE ON	TO	6	8:33	.1	1	70
DRIVE ON	TO LINCOLN HIGHWAY	15	8:33	.1		70
DRIVE ON	TO	15	8:34	.1	1	70
DRIVE ON	TO	6	8:37	.0	1	76
DRIVE ON	TO CUSTER ROAD	15	8:37	.0		76
DRIVE ON	TO	15	8:37	.1		76
DRIVE ON	TO LINCOLN HIGHWAY	15	8:38	.1		76
DRIVE ON	TO LINCOLN HIGHWAY	15	8:38	.0		76
DRIVE ON	TO CHAPEL LOT	15	8:38	.0		76
PICK UP ON	TO	6	8:41	.0	1	82
DRIVE ON	TO LINCOLN HIGHWAY	15	8:41	.0		82
DRIVE ON	TO CUSTER ROAD	15	8:41	.0		82
PICK UP ON	TO	6	8:44	.0	1	88

ACTGN	SPEED (MPH)	TIME (HR:MIN)	DISTANCE (PILES)	HOUSEHOLDS SERVICED	LOAD (PCT)
DRIVE ON	15	8:44	.0		88
DRIVE ON	15	8:45	.0		88
PICK UP ON	6	8:48	.0	1	94
DRIVE ON	15	8:48	.0		94
DRIVE ON	15	8:48	.1		94
PICK UP ON	6	8:52	.0	1	100
DRIVE ON	15	8:52	.0		100
DRIVE ON	15	8:52	.1		100
DRIVE ON	15	8:53	.1		100
DRIVE ON	55	8:55	2.6		100
DRIVE ON	40	8:59	2.4		100
UNLOAD		8:59 TO 9:14			
DRIVE ON	40	9:18	2.4		
DRIVE ON	55	9:19	1.5		
DRIVE ON	30	9:20	.6		
DRIVE ON	15	9:21	.2		
DRIVE ON	15	9:22	.1		
DRIVE ON	15	9:22	.1		
DRIVE ON	15	9:22	.1		
DRIVE ON	15	9:22	.0		
TO LINCOLN HIGHWAY					
TO DRIVEWAY TO BLOG 132					
CUSTER ROAD					
DRIVEWAY TO BLOG 132					
DRIVEWAY TO BLOG 132					
CUSTER ROAD					
CUSTER ROAD					
TO CUSTER ROAD					
TO SOUTH ROAD					
TO HIGHWAY 73 - 75					
ROAD TO SARPY COUNTY LAND FILL					
ROAD TO SARPY COUNTY LAND FILL					
ROAD TO SARPY COUNTY LAND FILL					
ROAD TO SARPY COUNTY LAND FILL					
HIGHWAY 73 - 75					
NELSON DRIVE					
TIGER DRIVE					
SERVICE ROAD					
TO GARAGE					

ROUTE	ACTION	OFFUTT AFB, NEB	30 CU YD VEHICLE	SPEED (MPH)	TIME (HR:MIN)	DISTANCE (MILES)	HOUSEHOLDS SERVICED	LCAD (PCT)
	LEAVE GARAGE				7845			
	DRIVE ON			15	7845	.0		
	DRIVE ON			15	7845	.1		
	DRIVE ON			15	7846	.1		
	DRIVE ON			15	7847	.2		
	DRIVE ON			15	7847	.2		
	DRIVE ON			25	7849	.4		
	DRIVE ON			15	7849	.2		
	PICK UP ON			6	7853	.0	1	5
	DRIVE ON			15	7853	.0		5
	DRIVE ON			15	7853	.0		5
	PICK UP ON			6	7857	.0	1	11
	DRIVE ON			15	7857	.0		11
	DRIVE ON			15	7857	.0		11
	DRIVE ON			15	7857	.0		11
	DRIVE ON			15	7857	.0		11
	DRIVE ON			6	8803	.0	2	23
	PICK UP ON			6	8811	.2	2	35
	PICK UP ON			15	8811	.0		35
	DRIVE ON			15	8812	.2		35
	DRIVE ON			15	8812	.1		35
	DRIVE ON			15	8813	.1		35
	DRIVE ON			15	8813	.0		35
	DRIVE ON			6	8819	.0	2	47
	PICK UP ON			6	8820	.1		47
	DRIVE ON			15	8826	.1	2	58
	PICK UP ON			15	8826	.0		58
	DRIVE ON			6	8830	.0	1	64
	DRIVE ON			15	8830	.1		64
	DRIVE ON			6	8836	.0	2	76
	DRIVE ON			15	8836	.0		76
	DRIVE ON			15	8837	.1		76
	PICK UP ON			6	8843	.0	2	88
	DRIVE ON			15	8843	.1		88
	DRIVE ON			15	8843	.0		88
	DRIVE ON			15	8843	.0		88
	PICK UP ON			6	8847	.0	1	94
	DRIVE ON			15	8847	.0		94
	DRIVE ON			15	8847	.2		94
	DRIVE ON			15	8846	.1		94
	DRIVE ON			15	8848	.1		94
	DRIVE ON			15	8851	2.8		94
	DRIVE ON			40	8854	2.4		94
	UNLOAD				8854			
	DRIVE ON			40	9809	2.4		
	DRIVE ON			55	9813	1.5		
	DRIVE ON			30	9816	.5		

ACTION	SPEED (MPH)	TIME (HR:MIN)	DISTANCE (MILES)	HOUSEHOLDS SERVICED	LOAD (PCT)
DRIVE ON	15	9:17	.2		
DRIVE ON	15	9:17	.1		
DRIVE ON	15	9:17	.1		
DRIVE ON	15	9:18	.1		
DRIVE ON	15	9:18	.0		

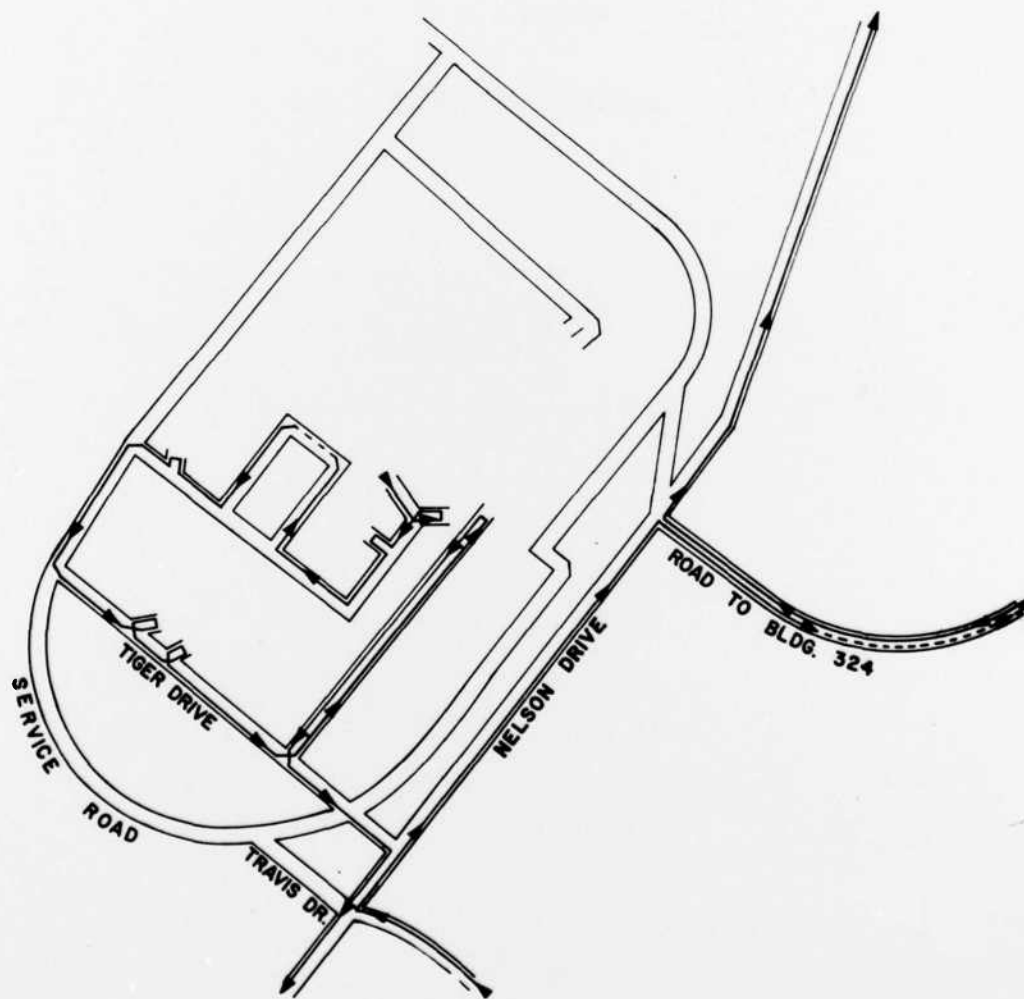
TO SERVICE ROAD  
TO  
TO  
TO GARAGE

TIGER DRIVE  
SERVICE ROAD

DRIVE ON  
DRIVE ON  
DRIVE ON  
DRIVE ON

APPENDIX E

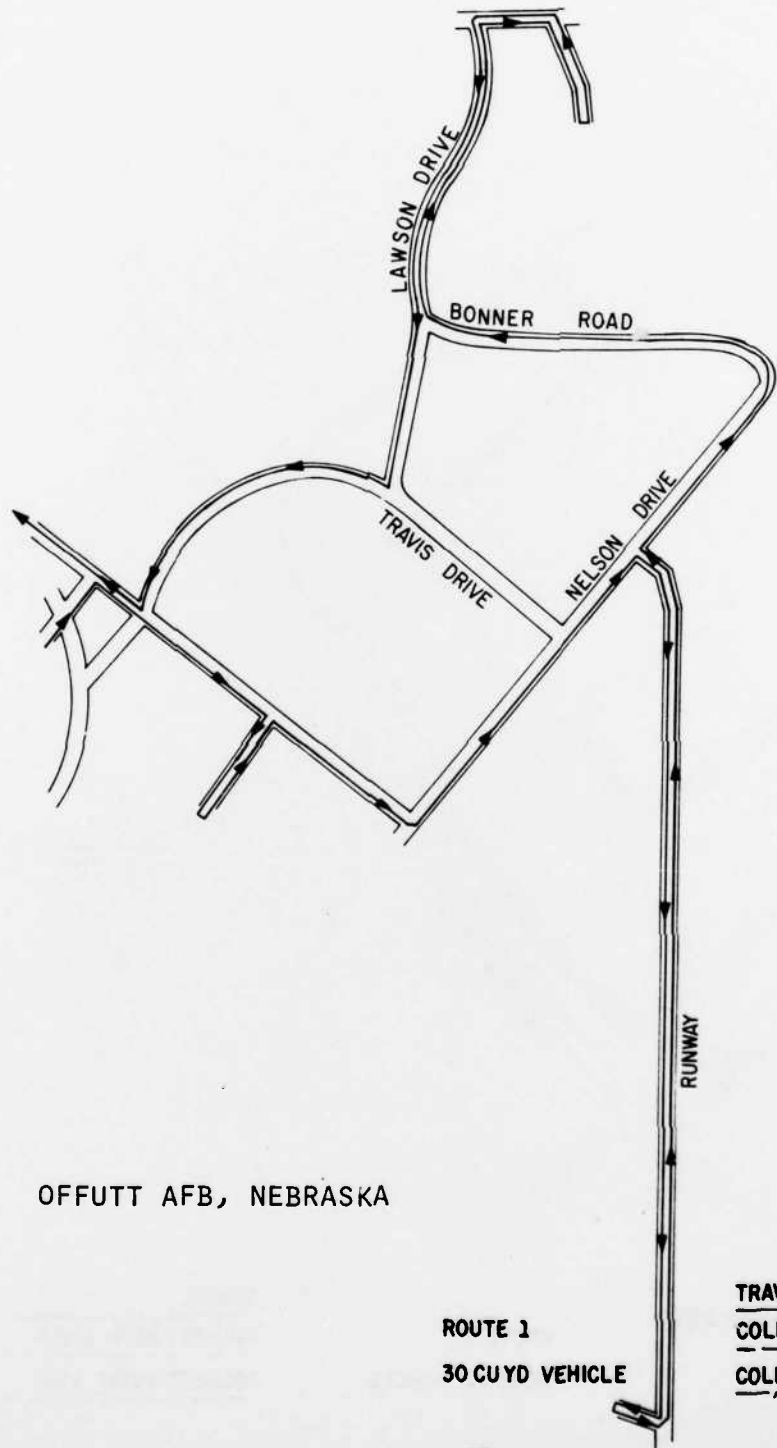
ORIGINAL ROUTE MAPS



OFFUTT AFB, NEBRASKA

ROUTE 1  
30 CU YD VEHICLE

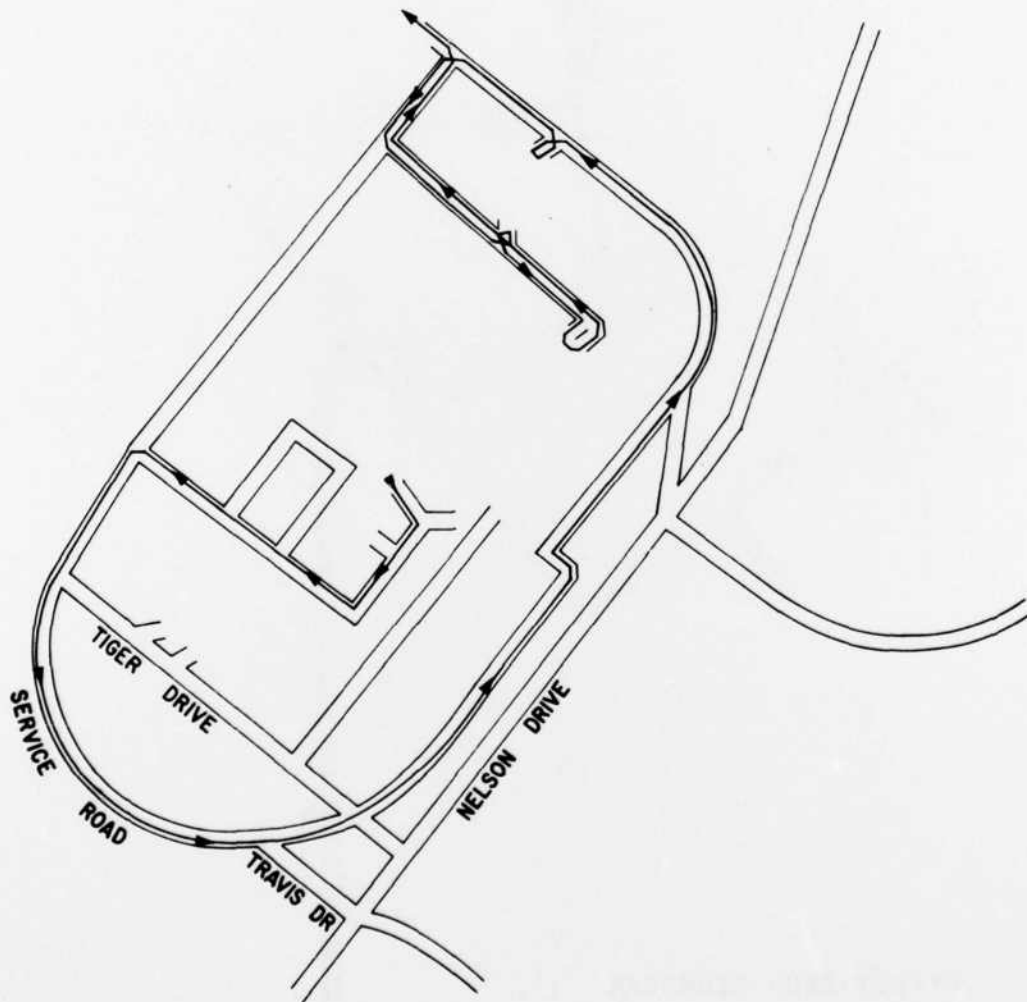
TRAVEL  
 → COLLECT BOTH SIDES  
 - - - COLLECT RIGHT SIDE  
 - - - - -



OFFUTT AFB, NEBRASKA




ROUTE 1  
30 CUYD VEHICLE

TRAVEL  
 ————→  
 - - - - -  
 - . - . -

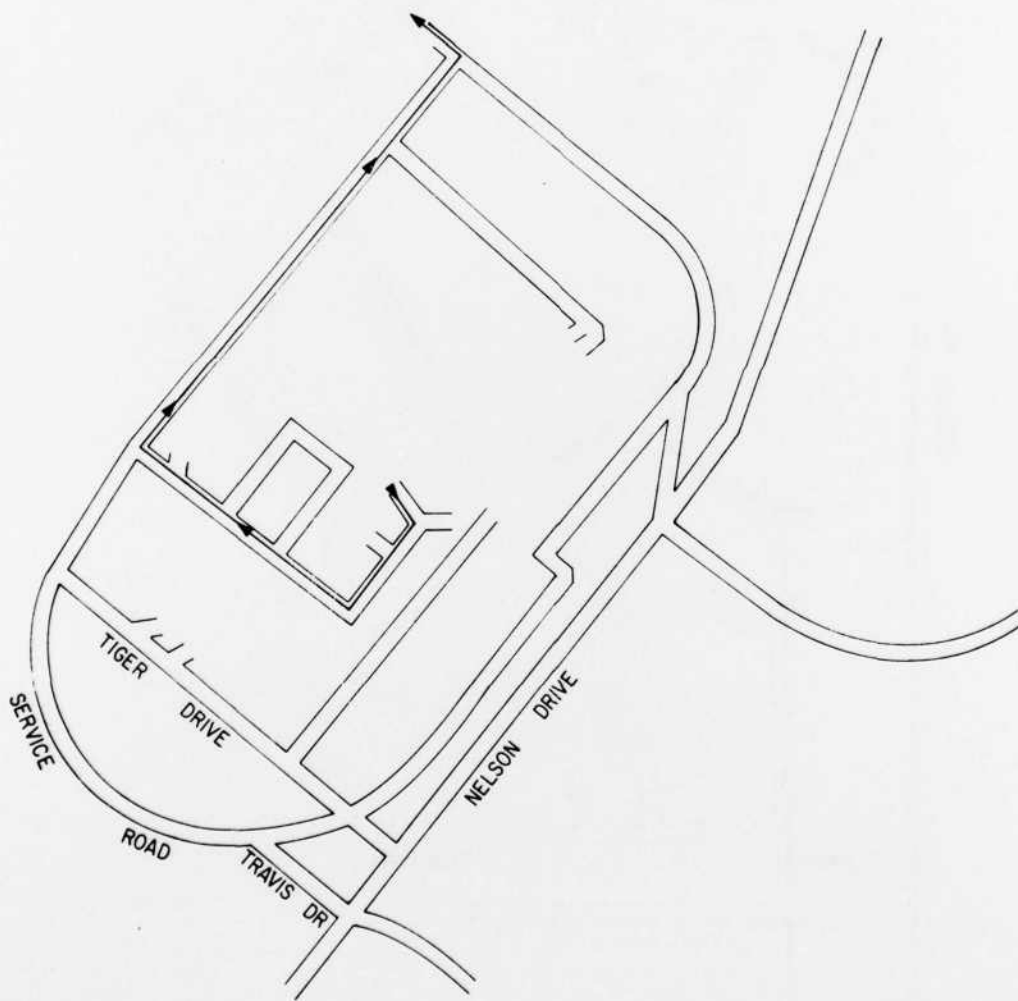


OFFUTT AFB, NEBRASKA

ROUTE 2  
30 CU YD VEHICLE



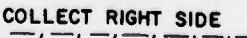
TRAVEL   
 COLLECT BOTH SIDES   
 COLLECT RIGHT SIDE 

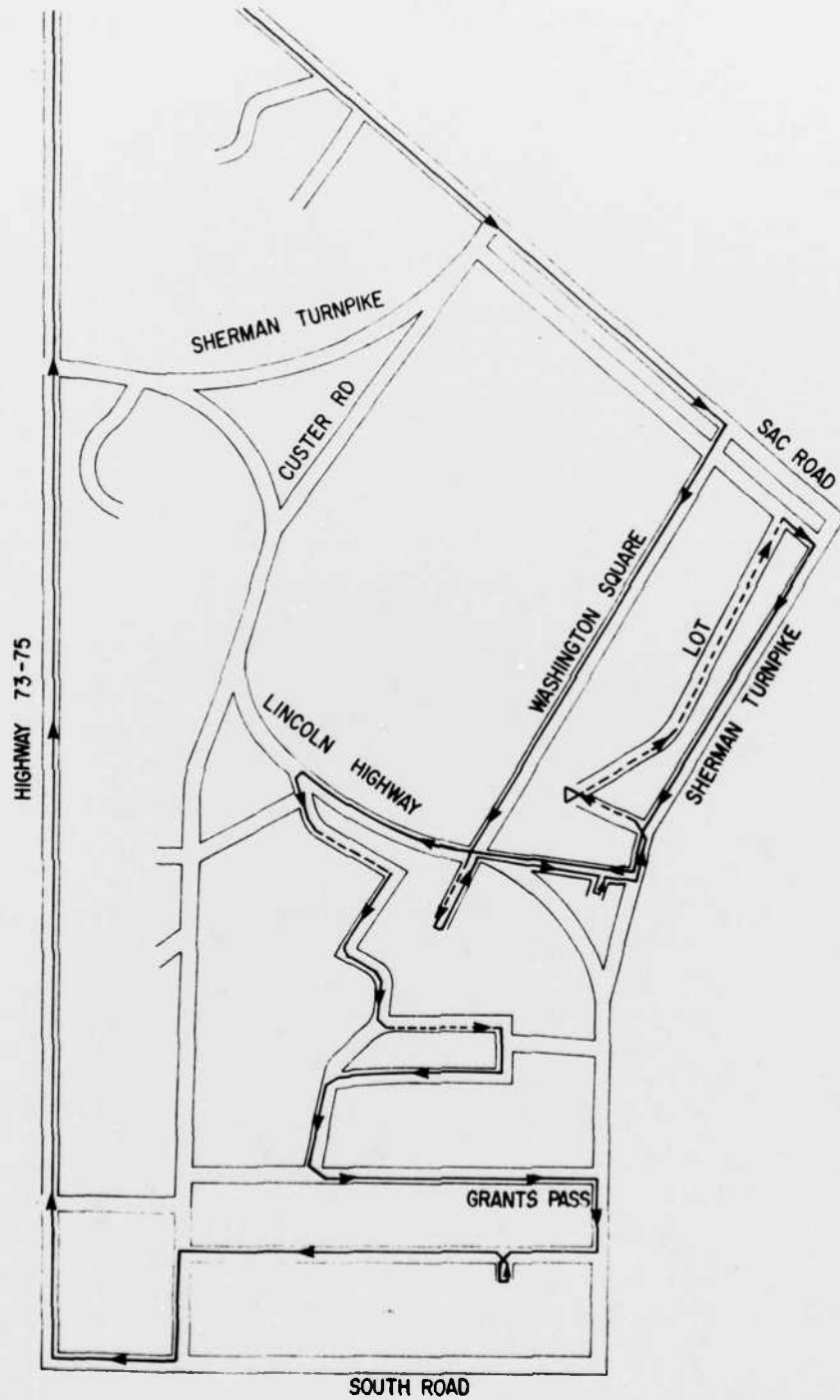




OFFUTT AFB, NEBRASKA

ROUTE 3  
30 CU YD VEHICLE

TRAVEL   
 COLLECT BOTH SIDES   
 COLLECT RIGHT SIDE 



OFFUTT AFB, NEBRASKA

ROUTE 3  
30 CU YD VEHICLE

TRAVEL  
 COLLECT BOTH SIDES  
 COLLECT RIGHT SIDE