EVACUATION TIME ESTIMATES

WITHIN THE PLUME EXPOSURE PATHWAY EMERGENCY PLANNING ZONE FOR THE BYRON NUCLEAR GENERATING STATION

COMMONWEALTH EDISON COMPANY

JUNE 1984

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SECTION 1

INTRODUCTION

This study presents evacuation time estimates for those portions of Illinois within the plume exposure pathway Emergency Planning Zone (EPZ) for the Byron Nuclear Generating Station, hereafter referred to as Byron Station. The Byron Station is located near the Rock River in Rockvale Township, Illinois (Figure 1-1). The Byron Station plume exposure pathway EPZ includes portions of Ogle and Winnebago Counties. Figure 1-1 presents a map of the Byron Station EPZ.

1.1 PURPOSE

This evacuation time estimate study was developed by the Commonwealth Edison Company to support the State of Illinois Plan for Radiological Accidents (IPRA), Byron Volume VI, Revision 0, 2-84, and Commonwealth Edison's Generating Stations Emergency Plan Byron Annex. The primary purpose of this evacuation time estimate study is to assess the relative feasibility of evacuation for the Byron Station Emergency Planning Zone. The study identifies the approximate time frames associated with evacuation based on a detailed consideration of the roadway network and population distribution. It is important to note that this study presents representative time frames for a range of seasonal, diurnal, and weather conditions for the evacuation of various areas around the Byron Station once a decision has been made to evacuate; while the Byron Volume of IPRA is the detailed emergency operations plan for the Byron Station EPZ.

1.2 SUMMARY

The evacuation time estimates presented in this study were developed using the NETVAC2 traffic simulation computer model. Detailed site-specific evacuation road network and vehicle data and public response time distributions were used in NETVAC2 to determine evacuation time estimates. For each of ten primary evacuation zones, evacuation time estimates for the general population within the Byron Station EPZ were developed for eight combinations of conditions: summer and winter seasons; daytime and nighttime; normal and adverse weather. Results of the general population evacuation time estimates for these eighty scenarios, rounded to the nearest minute, are summarized in Table 1-1.

The computer analyses indicate that summer and winter evacuation time estimates are similar. Table 1-1 shows that for normal weather conditions in summer and winter, the general population evacuation time estimates for the full plume exposure pathway EPZ range from 184 to 191 minutes during the day to 96 to 108 minutes at night. In adverse weather, these time estimates range from 216 to 225 minutes for day to approximately 105 to 114 minutes for night scenarios.

Evacuation time estimates for the general population were also prepared for various other evacuation scenarios in the 0-2, 0-5, and 0-10 mile evacuation zones. Summer and winter normal weather 0-2 mile evacuation time estimates range from 184 minutes during the day to 96 minutes at night. Adverse weather condition evacuation time estimates for 0-2 miles for the same time periods are 216 minutes during the day and 105 minutes at night. The 0-5 mile estimates are slightly longer for

some scenarios, primarily due to the larger number of vehicles in the 0-5 mile zones. Normal weather conditions result in a range of 184 to 191 minutes for the day to 96 to 105 minutes at night. The 0-5 mile adverse weather estimates range from 216 to 225 minutes during the day to 105 to 113 minutes at night.

In normal weather conditions, the evacuation times for the 0-10 mile primary evacuation zones during the day are 191 minutes and at night range from 106 to 108 minutes. The adverse weather condition time estimates range from 225 minutes for daytime to 113 to 114 minutes for nighttime.

In addition to an estimate of the time required to evacuate the general population, NUREG 0654, Appendix 4 requires that separate estimates be made of the times required to evacuate special facilities within the EPZ. Accordingly, school districts and nursing homes within the EPZ were analyzed in this study.

Special facility evacuation time estimates range from 35 minutes to 159 minutes for normal weather, and from 37 minutes to 163 minutes for adverse weather scenarios. These estimates are based on winter simulations for the general population, since schools are the most numerous special facilities in the EPZ. Results of the special facility evacuation time estimates are summarized in Annex A.

In addition to developing special facilites evacuation time estimates, several Special Event simulations were also undertaken for special local events such as the Autumn On Parade. The results of these Special Event simulations are discussed in Section 6.

It is important to note that, due to the favorable roadway capacity to population ratio, the evacuation time estimates are relatively insensitive to changes in population. Indeed, if the summer daytime transient population is increased by 50 percent, the additional evacuation time for the full EPZ summer day, normal weather evacuation scenario is 10 minutes.

This evacuation study was prepared in close coordination with the State of Illinois Emergency Services and Disaster Agency (ESDA) personnel responsible for the preparation of the Byron Volume of IPRA. This study was favorably reviewed by Ogle County and State of Illinois ESDA officials. Copies of this study were provided to these ESDA officials.

1.3 SCOPE

This study was prepared pursuant to the recommendations of NUREG-0654/FEMA-REP-1, Rev. 1[1] Appendix 4, Evacuation Time Estimates within the Plume Exposure Pathway Emergency Planning Zone, the current regulatory guidance for preparing evacuation time estimates. Section 2 presents the evacuation study areas and evacuation scenarios. Section 3 discusses the various demographic and vehicle data utilized in this study. Section 4 presents the evacuation time estimate methodology and assumptions for both the general population and the special facilities. Section 5 is a description of the evacuation road network. Section 6 presents the evacuation time estimates. Section 7 presents the conclusions and recommendations of this study.

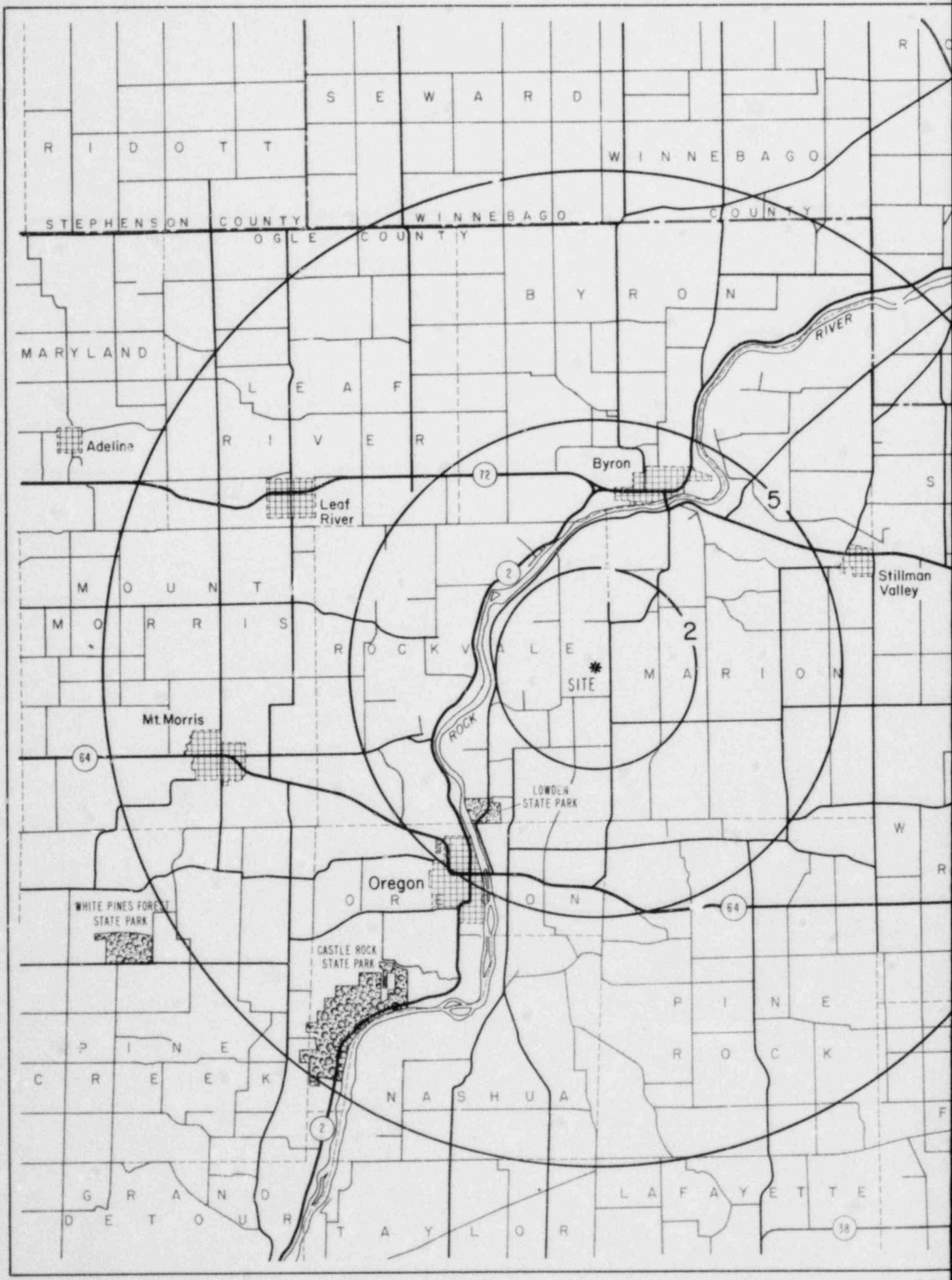
TABLE 1-1

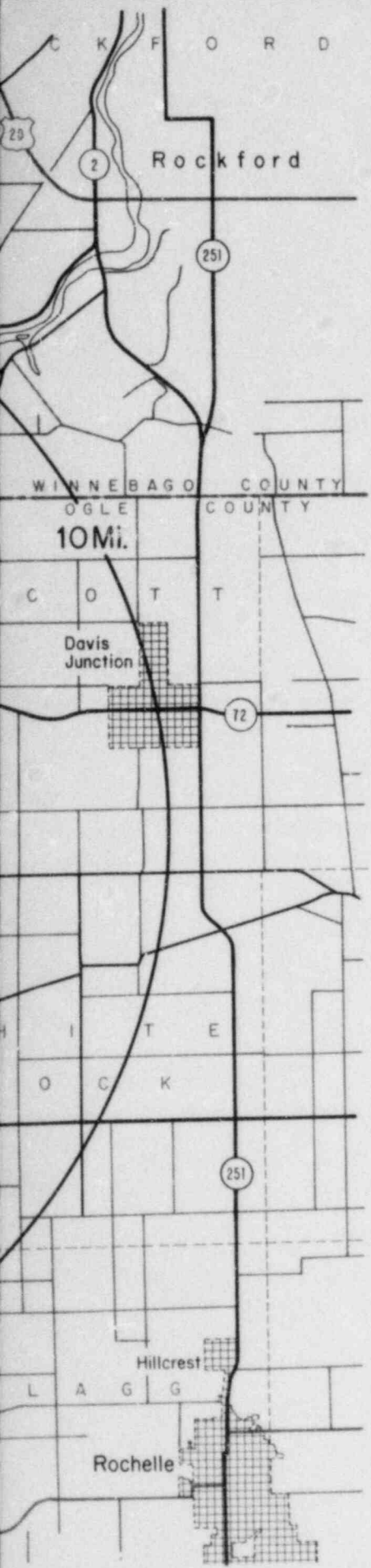
EVACUATION TIME ESTIMATES
GENERAL PUBLIC EVACUATION TIMES (1)

Primary Evacuation Zone (2)	Summer(3) Daytime Normal	Summer(3) Daytime Adverse	Summer(3) Nighttime Normal	Summer(3) Nighttime Adverse	Winter(4) Daytime Normal	Winter(4) Daytime Adverse	Winter(4) Nighttime Normal	Winter(4) Nighttime Adverse
0-2 mile A,B	184	216	96	105	184	216	96	105
0-5 mile A,B,C	188	223	105(6)	113(6)	188	223	105(6)	113(6)
0-5 mile A,B,D	184	216	96	105	184	216	96	105
0-5 mile A,B,E	191	225	105	110	191	224	105	110
0-5 mile A,B,F	184	216	96	105	191	216	96	105
0-10 mile A-F,G	191	225	108(6)	114(6)	191	225	106(6)	113(6)
0-10 mile A-F,H	191	225	107	114	191	225	106	113
0-10 mile A-F,I	191	225	107(7)	114(7)	191	225	106(7)	113(7)
0-10 mile A-F,J	191	225	107	114	191	225	106	113
Full EPZ A-J(5)	191	225	108(8)	114(8)	191	225	106(8)	113(8)

NOTES:

(1) Times have been rounded to nearest minute.
(2) See Figure 2-1 for evacuation study area locations.
(3) As discussed in Section 3.1.
(4) As discussed in Section 3.2.
(5) Full EPZ A-J Scenario is analyzed in accordance with the guidance of Appendix 4 of NUREG-0654/FEMA-REP-1, Rev. 1. This analysis verifies the appropriateness of the selection of the primary evacuation zone boundaries used in the other analyses.
(6) The Quality Metal Finishing Co. in Byron has an estimated shutdown time of 90 minutes. Consequently, the nighttime evacuation time estimate for those employees needed to shut down the facility could increase to 125 and 135 minutes for normal and adverse weather conditions, respectively.
(7) The Acme Resin Co. outside Oregon has an estimated shutdown time of 120 minutes. Consequently, the nighttime evacuation time estimate for those employees needed to shut down the facility could increase to 145 and 155 minutes for normal and adverse weather conditions, respectively.
The Pine Crest Nursing Home in Mt. Morris has a facility mobilization time of 120 minutes. Consequently, the nighttime evacuation time estimate for this facility could increase to 140 and 142 minutes, respectively.
(8) As discussed in notes 6 and 7 above, the Acme Resin Co., Quality Metal Finishing Co. and Pine Crest Nursing Home may have longer evacuation times than estimated for the general public. The nighttime evacuation time estimates for these facilities may increase to 125-145 minutes during normal weather conditions and 135-155 minutes during adverse weather conditions.


SEWARD
RIDOTT
WINNEBAGO
STEPHENSON COUNTY
WINNEBAGO COUNTY
OGLE COUNTY
BYRON
MARYLAND
LEAF
RIVER
Adeline
Byron
72
Leaf River
5
Stillman Valley
2
MOUNT MORRIS
ROCKVALE
SITE
MARION
Mt. Morris
64
ROCK
LOWDEN STATE PARK
Oregon
OREGON
WHITE PINES FOREST STATE PARK
CASTLE ROCK STATE PARK
PINE CREEK
NASHUA
PINE ROCK
GRAND DETOUR
TAYLOR
LAFAYETTE
38



LEGEND

- (2) STATE HIGHWAY
- (20) INTERSTATE HIGHWAY
- INCORPORATED AREA (CITY OR VILLAGE)
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY

SOURCE: Based on revised Illinois general highway maps for Ogle (12/79) and Winnebago (12/80) counties.

0 2 4
SCALE - MILES

FIGURE 1-1
BYRON STATION
PLUME EXPOSURE PATHWAY
EMERGENCY PLANNING ZONE
AND SITE VICINITY

SECTION 2

EMERGENCY PLANNING ZONE AND EVACUATION SCENARIOS

2.1 EVACUATION STUDY AREAS

The area studied for potential evacuation is the plume exposure pathway emergency planning zone (EPZ) for the Byron Station. For the purposes of this study several evacuation study areas were defined within the EPZ.

The study areas for evacuation of the plume EPZ approximate the 0-2 mile, 2-5 mile, and 5-10 mile sector groupings suggested in NUREG-0654, Appendix 4. These evacuation study areas were discussed with and favorably reviewed by ESDA officials of Ogle County and the State of Illinois.

Figure 2-1 identifies the ten evacuation study areas. Table 2-1 identifies the location of these ten study areas and the local communities contained within each study area.

2.2 PRIMARY EVACUATION ZONES

To facilitate preparation of realistic evacuation time estimates, the evacuation study areas were grouped into ten primary evacuation zones. These evacuation zones are designated as follows:

- 0-2 mile, Evacuation Study Areas A and B
- 0-5 mile, Evacuation Study Areas A,B and C
- 0-5 mile, Evacuation Study Areas A,B and D
- 0-5 mile, Evacuation Study Areas A,B and E
- 0-5 mile, Evacuation Study Areas A,B and F
- 0-10 mile, Evacuation Study Areas A through F and G
- 0-10 mile, Evacuation Study Areas A through F and H
- 0-10 mile, Evacuation Study Areas A through F and I
- 0-10 mile, Evacuation Study Areas A through F and J
- Full EPZ, Evacuation Study Areas A through J. (Full EPZ A-J Scenario is analyzed in accordance with the guidance of Appendix 4 of NUREG-0654/FEMA-REP-1, Rev. 1. This analysis verifies the appropriateness of the selection of the primary evacuation zone boundaries used in the other analyses.)

Evacuation time estimates were developed for each of these primary evacuation zones for the conditions discussed in the following sections.

2.3 EVACUATION SCENARIOS

Evacuation scenarios were developed to simulate evacuation conditions determined by the combination of primary evacuation zones with a specified season, time of the day, and weather condition during which an evacuation may be necessary. There are ten primary evacuation zones, two seasons (summer and winter), two time considerations (daytime and nighttime), and two weather conditions (normal and adverse). Therefore, a total of eighty evacuation scenarios were considered in this evacuation time estimate study.

2.3.1 Seasonal and Diurnal Parameters

Section 3 describes demographic data in detail. The following paragraphs summarize this description.

The summer season attracts additional visiting and transient populations to the area of Byron Station, principally as vacationers to the recreational facilities. Therefore, the summer daytime scenarios include the permanent resident, daytime employee, visiting or transient populations, and applicable special facilities populations. The summer nighttime scenarios include the permanent resident, nighttime employee, overnight transient and applicable special facilities populations.

The winter daytime scenarios include the permanent resident, daytime employee, school district, and applicable transient and special facilities populations. The winter nighttime scenarios include the permanent resident, nighttime employee, and applicable transient and special facilities populations.

The above baseline evacuation scenarios are representative of weekday conditions because they occur most frequently. Additional simulations of Special Events were undertaken (see Section 6) which address large weekend events. These Special Events are the Autumn on Parade, which occurs the first weekend in October, and large weekend events at the Byron Dragway and Moto Sports Park.

2.3.2 Weather Parameters

Normal and adverse weather conditions were also considered. For the purposes of this study, adverse weather conditions are assumed to reduce road capacity to 80 percent of normal weather capacity, and include conditions that may impair visibility and/or traction, such as light snow, icing, rain, or fog.

Transportation studies[5] and the opinions of recognized traffic experts[6] indicate that such conditions can reduce road capacity to 76-92 percent of normal weather capacity. Review of the Byron area meteorology has revealed that these weather conditions occur, on an annual basis, about 10 percent of the time.[7] It is important to note that this study does not suggest that evacuations will or should occur under all adverse weather conditions. Under certain extremely adverse weather conditions where evacuation may be infeasible, the alternative protective action of sheltering would be recommended.

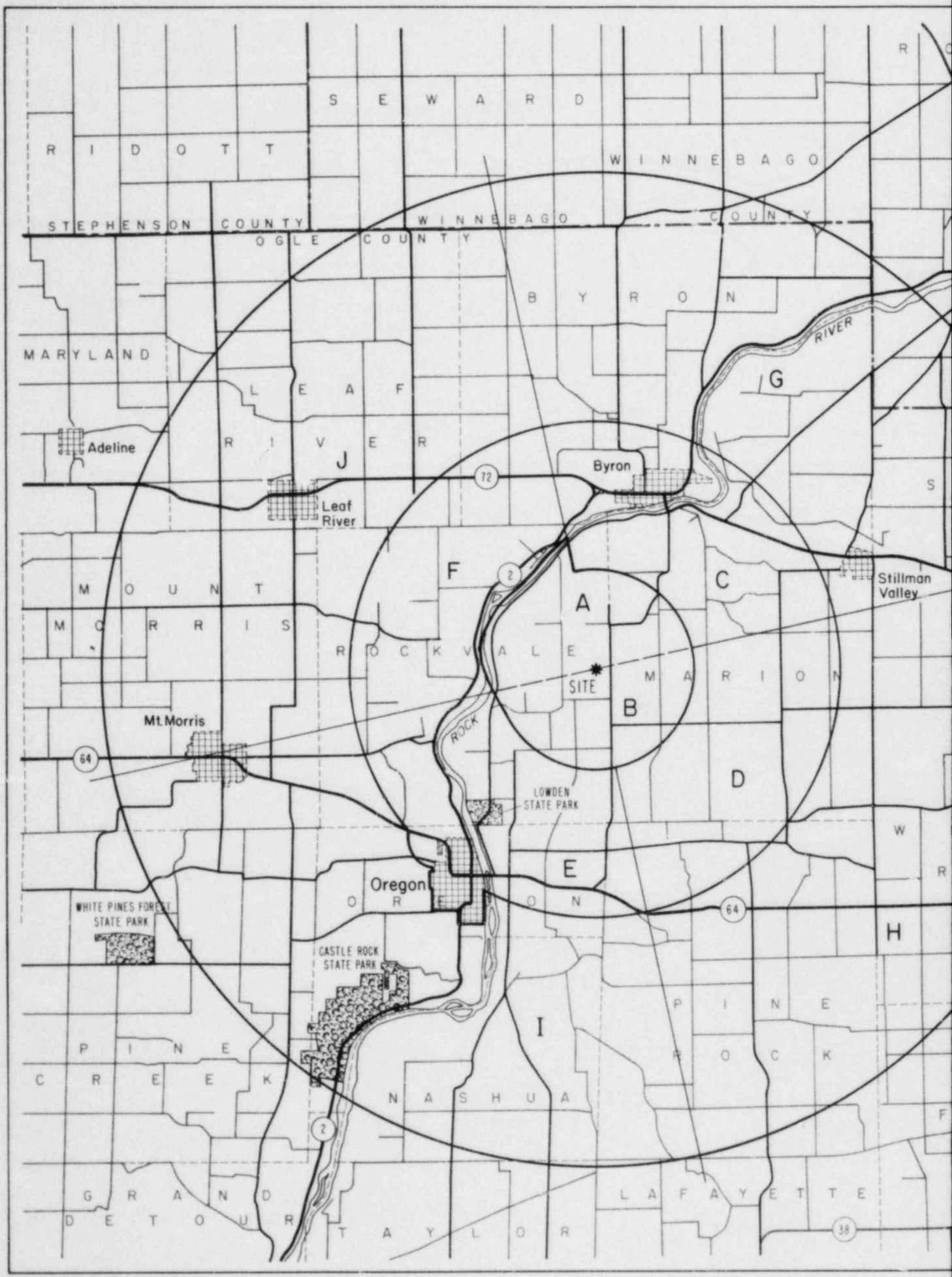
TABLE 2-1

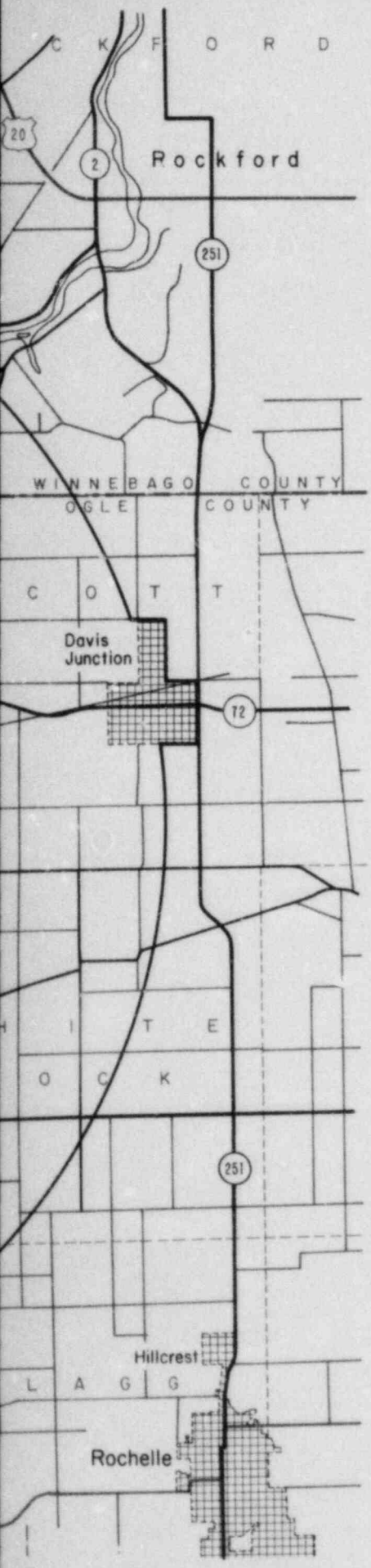
LOCAL COMMUNITIES BY EVACUATION STUDY AREA

Evacuation Area	County	Study Area(1)	Local Communities
0-2 Miles North	Ogle	A	Rockvale Twp., Marion Twp. (Byron Nuclear Generating Station)
0-2 Miles South	Ogle	B	Rockvale Twp., Marion Twp. (Byron Nuclear Generating Station)
2-5 Miles Northeast	Ogle	C	Rockvale Twp., Byron Twp., Marion Twp., Byron
2-5 Miles Southeast	Ogle	D	Marion Twp., Pine Rock Twp.
2-5 Miles Southwest	Ogle	E	Rockvale Twp., Oregon Twp., Pine Rock Twp., Oregon,
2-5 Miles Northwest	Ogle	F	Rockvale Twp., Byron Twp.
5-10 Miles Northeast	Ogle Winnebago	G	Byron Twp., Rockford Twp., Marion Twp., Scott Twp., Winnebago Twp., Seward Twp., Davis Junction, Stillman Valley, Westfield Corners
5-10 Miles Southeast	Ogle	H	Scott Twp., Marion Twp., White Rock Twp., Pine Rock Twp., Holcomb, Davis Junction, Chana, Paynes Point, Flagg Twp.
5-10 Miles Southwest	Ogle	I	Oregon Twp., Nashua Twp., Pine Creek Twp., Mt. Morris Twp., Rockvale Twp., Mt. Morris, Daysville, Honey Creek
5-10 Miles Northwest	Ogle Winnebago	J	Rockvale Twp., Mt. Morris Twp., Leaf River Twp., Byron Twp., Seward Twp., Lightsville, Leaf River, Myrtle, Egan

NOTE:

(1) See Figure 2-1 for Study Area Identification.


SEWARD
RIDOTT
WINNEBAGO
STEPHENSON COUNTY
WINNEBAGO COUNTY
OGLE COUNTY
BYRON
MARYLAND
LEAF
RIVER
Adeline
Leaf River
Byron
ROCK RIVER
G
J
72
F
2
A
C
Stillman Valley
MOUNT MORRIS
ROCKVALE
SITE
MARION
B
Mt. Morris
64
ROCK
LOWDEN STATE PARK
D
Oregon
E
WHITE PINES FOREST STATE PARK
CASTLE ROCK STATE PARK
H
I
PINE CREEK
NASHUA
PINE ROCK
GRAND DETOUR
TAYLOR
LAFAYETTE
38



LEGEND

- (2) STATE HIGHWAY
- (20) INTERSTATE HIGHWAY
- INCORPORATED AREA (CITY OR VILLAGE)
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY

Also Available On Aperture Card

SOURCE: Based on revised Illinois general highway maps for Ogle (12/79) and Winnebago (12/80) counties.

0 2 4
SCALE - MILES

FIGURE 2-1
EVACUATION STUDY AREAS

SECTION 3

DEMOGRAPHIC AND VEHICLE DATA

Demographic information for this study was derived from the official 1980 census data.[9] Additional information was derived from field survey work, and communications with Ogle County and State of Illinois Emergency Services and Disaster Agency (ESDA) officials. Further information was obtained by Illinois ESDA personnel from local property owners and employers. The vehicle data were derived from the demographic data and the average number of persons per household in Ogle County. The study assumes one vehicle per household. The number of registered vehicles in Ogle and Winnebago Counties supports this assumption. Figures 3-1 through 3-10 present specific population and vehicle data by compass sector and distance from the Byron Station for various seasonal and diurnal conditions. As discussed in Section 1.2, the evacuation time estimates are relatively insensitive to changes in population.

This study identifies 21,622 permanent residents within the evacuation study areas. Figures 3-1 and 3-2 present the permanent resident population and vehicle data by compass sector and distance. Tables 3-2 through 3-5 present various transient and special facilities populations. For the purpose of this study, as required by NUREG 0654, Appendix 4, special facilities are those institutions or other population concentrations which are transportation-dependent or may have other special concerns. Transient (non-resident) and special facilities include, as appropriate, schools, major employers, recreation areas, and health care facilities. Schools are shown on Figure 3-11. Figures 3-12

and 3-13 identify the locations of transient populations, including major employers and camps and recreation areas. Major employers are shown on Figure 3-12. Health care facilities, campgrounds, and other similar institutions within the EPZ are shown on Figure 3-13.

The summer daytime period represents the period of greatest population. This study identifies a summer daytime population of 44,493 persons. This figure was derived by adding the number of employees, transients, and applicable special facilities populations to the permanent population. The summer daytime period also has the greatest number of vehicles due to the increase in transients. The study identifies a summer nighttime population of 28,339 including the permanent resident, nighttime employee, overnight transients, and applicable special facilities populations.

This study identifies a winter daytime population of 34,806 which includes the permanent resident, daytime employee, applicable transient and special facilities populations. The winter nighttime population is representative of the permanent resident, nighttime employee, and applicable transient and special facilities populations, and is the period with the lowest number of individuals and vehicles.

Table 3-1 summarizes the population and vehicle data by seasonal period for each of the evacuation study areas. This population data does not include short term events such as the Autumn on Parade and large events at the Byron Dragway and Moto Sports Speedway. These events are discussed in Section 3.4.

NUREG 0654, Appendix 4, recommends that the public transport-dependent population be considered. There are no public transportation systems in the Byron EPZ. Accordingly, this recommendation is not applicable.

3.1 SUMMER SEASON POPULATION DATA

The summer season, as defined by this study, extends from about Memorial Day weekend through Labor Day weekend. There is a significant population influx during this season. The specific population combinations are discussed in the following sections.

3.1.1 Summer Daytime Data

Summer daytime population includes transients (e.g. recreation area visitors, see Table 3-4), and applicable special facilities populations (see Table 3-5), in addition to the permanent resident and employee populations. Figures 3-3 and 3-4 present this data by compass sector for population and vehicles, respectively.

3.1.2 Summer Nighttime Data

The summer nighttime population includes overnight transients (e.g. motels and applicable campgrounds), and applicable special facilities populations (see Table 3-5), in addition to the permanent resident and nighttime employee populations. Figures 3-5 and 3-6 present this data by compass sector for population and vehicles, respectively.

3.2 WINTER SEASON POPULATION DATA

The winter season, as defined by this study, extends from about Labor Day through Memorial Day. This season includes the non-tourist months, when schools are in session. The specific population combinations are discussed in the following sections.

3.2.1 Winter Daytime Data

Winter daytime populations include permanent residents, school enrollments (see Table 3-2), employees (see Table 3-3), applicable camps and recreational facilities (see Table 3-4), and applicable special facilities (see Table 3-5). The winter daytime populations and vehicle data are shown by compass sector on Figures 3-7 and 3-8.

3.2.2 Winter Nighttime Data

Winter nighttime populations include permanent residents, employee night-shift populations, and applicable special facilities (see Table 3-5). The winter nighttime populations and corresponding vehicle data are shown by compass sector on Figures 3-9 and 3-10.

3.3 TRANSIENT AND SPECIAL FACILITIES POPULATION DATA

For the purpose of this study, as required by NUREG 0654, Appendix 4, special facilities are those institutions or other population concentrations which are transportation-dependent or may have other special concerns. Transient and special facilities include, as appropriate, schools, major employers, recreation areas, and health care facilities. Population data for these facilities are shown on Tables 3-2, 3-3, 3-4 and 3-5 respectively.

The locations of schools within the EPZ are identified on Figure 3-11. Figures 3-12 and 3-13 identify the locations of transient populations, including major employers, motels, and camps and recreation areas. Figure 3-12 presents the location of major employers. Nursing homes, motels, campgrounds, the Ogle County jail, and other similar institutions within the EPZ are identified on Figure 3-13.

3.4 SPECIAL EVENTS POPULATIONS

The Special Event populations associated with infrequent short-term activities or special events were identified. Included as Special Events in this study are: the Autumn on Parade, which takes place in the Byron EPZ once a year in October; concurrent peak attendance racing events at the Byron Dragway and the Moto Sports Park which could occur on a weekend during the summer; and a special evacuation sensitivity analysis of transient populations at the recreational areas within the EPZ on a summer holiday to determine the sensitivity of the evacuation time estimates to recreational area populations.

The estimated number of additional people in the EPZ associated with the Autumn on Parade, which takes place on the first weekend in October, is approximately 25,000 people. The peak attendance figures at the Byron Dragway and the Moto Sports Park were estimated to be 15,000 and 10,000, respectively, for concurrent major racing events during the summer. To generate the population data for the special evacuation sensitivity analysis of recreational areas, the transient population data for the camps and recreation areas within the EPZ as identified in Table 3-4, were increased by 50 percent.

The Special Event populations were added to the applicable permanent resident, employee, transient, and special facilities populations. The results of these Special Event analyses are presented in Section 6.3.

TABLE 3-1

DEMOGRAPHIC AND VEHICLE DATA BY EVACUATION STUDY AREA(1)

Evacuation Study Area	Summer(2)				Winter(3)			
	Daytime		Nighttime		Daytime		Nighttime	
	Population(4)	Vehicles(5)	Population(4)	Vehicles(5)	Population(4)	Vehicles(5)	Population(4)	Vehicles(5)
A	6,657	3,032	1,257	430	657	229	657	229
B	3,600	1,759	800	359	3,600	1,759	800	359
C	6,715	2,626	4,914	1,743	4,714	1,575	3,414	1,269
D	392	134	392	134	392	134	392	134
E	8,770	3,139	5,090	1,845	7,626	2,501	4,945	1,801
F	49[illegible]	183	352	121	452	171	352	121
G	4,736	1,601	4,436	1,511	5,523	1,586	4,286	1,503
H	2,230	784	2,205	771	2,180	726	2,030	714
I	8,414	3,275	6,460	2,248	6,807	2,646	5,005	1,858
J	2,433	859	2,433	859	2,855	886	2,433	859

NOTES:

(1) Data derived from the official 1980 census data and field survey work as discussed in Section 3.

(2) Refer to Section 3.1 for description of summer population combinations.

(3) Refer to Section 3.2 for description of winter population combinations.

(4) Data derived from Tables 3-2, 3-3, 3-4, and 3-5 and Figures 3-1, 3-3, 3-5, 3-7, and 3-9.

(5) Data derived from Tables 3-2, 3-3, 3-4, and 3-5 and assumptions in Section 4.1.3. The data are presented on Figures 3-2, 3-4, 3-6, 3-8, and 3-10.

TABLE 3-2

SCHOOLS WITHIN THE EMERGENCY PLANNING ZONE (1)

Facility No.(2)	Direction/ Mile	Study Area	Name of School	No. of Students/Staff(3)
41	WSW/8-9	I	Mt. Morris E.S.	341/30
42	WSW/8-9	I	Mt. Morris Jr. H.S.	187/15
43	WSW/8-9	I	Mt. Morris Sr. H.S.	226/21
44	SW/5-6	E	Oregon Community H.S.	402/41
45	SW/5-6	E	Etnyre Middle School	380/29
46	SW/5-6	E	Jefferson E.S.	445/31
49	SSW/4-5	E	Oregon Bible College	40/15
50	SW/3-4	E	Lorado Taft Field Campus	150/30
51	WNW/7-8	J	Leaf River Community School, K-12	384/38
52	WSW/8-9	I	Ogle County Educational Coop - Mt. Morris	35/32
53	NNE/3-4	C	Byron Middle School	232(4)
54	NNE/3-4	C	Mary Morgan Elementary School, K-5	417(4)
55a	ENE/5-6	G	Highland Grade School & Early Childhood	349/23
55b	ENE/5-6	G	Meridian Jr. H.S.	327/30
55c	ENE/5-6	G	Stillman Valley H.S.	467/41
56	NNE/3-4	C	Byron H.S.	400(4)
57	SW/5-6	E	Oregon County Education Cooperative, Oregon High Annex	75/7
58	SSW/4-5	E	Oregon Community Daycare Center	30/5
66	SW/5-6	I	Village of Progress	91/20

NOTES:
(1) Information is based on data available in January 1984. As discussed in Section 1, the evacuation time estimates are relatively insensitive to changes in population.
(2) See Figure 3-11 for school locations.
(3) This information provided by State of Illinois ESDA personnel responsible for the development of IPRA, Byron Volume VI (See Reference 6).
(4) Numbers represent students plus staff.

TABLE 3-3

MAJOR EMPLOYERS WITHIN THE EMERGENCY PLANNING ZONE(1) (2)

Facility No.(3)	Direction/ Mile	Study Area	Name of Manufacturer	No. of Employees Day	No. of Employees Night
24	NNE/4-5	C	Quality Metal Finishing Co.	125	100
25	NNE/4-5	C	Kysor of Byron	210	15
26	SW/6-7	I	Acme Resin Co.	20	20
27	SSW/5-6	E	Atwood Vacuum Machine Co.	40	40
28	SSW/5-6	E	Cook Manufacturing	30	0
29a	SSW/4-5	E	E.D. Etnyre & Co.	98	0
29b	SSW/5-6	E	E.D. Etnyre & Co.	89	0
30	SW/6-7	I	Unimin Corp. (Formally Martin Marietta Aggregates)	26	12
31	SSW/4-5	E	Progressive Graphics	100	60
32	SSW/6-7	I	Woods Brothers Inc,	365	60
33	WSW/7-8	I	Kable Printing Co.	250	225
34	WSW/7-8	I	Kable News	300	0
38	E/0-1	B	Byron Station	3340	540

Notes

(1) For the purpose of this study, major employers are those with 25 or more total employees. This information is based on data available in January of 1984. As discussed in Section 1, the evacuation time estimates are relatively insensitive to changes in population.

(2) This information was provided by State of Illinois ESDA personnel responsible for the development of IPRA, Byron Volume VI (See Reference 6).

(3) See Figure 3-12 for employer locations.

TABLE 3-4

CAMPS AND RECREATION AREAS WITHIN THE
EMERGENCY PLANNING ZONE(1)

Facility No.(2)	Direction/ Mile	Study Area	Facility Name	Periods of Operation	Transient Population Day	Transient Population Night
1	SW/8-9	I	Lake LaDonna	Summer/Day & Night	2000	1100
3	W/2-3	A	River Road Camping and Marina	Summer/Day & Night	1000	500
4(3)	N/1-2	A	Moto Sports Park	Summer/Day & Night	5000	100
6	SW/8-9	I	White Pines Ranch	Summer/Day & Night Winter/Day & Night	250 150	250 150
7(3)	N/2-3	C	Byron Dragway	Summer/Day & Night	1000	100
8	NNE/4-5	C	Lake Louise	Summer/Day & Night	2000	1400
9	WSW/3-4	E	Stronghold Camp	Summer/Day & Night Winter/Day & Night	200 70	140 70
10	SSW/8-9	I	Castle Rock State Park and Nature Preserve	Summer/Day Winter/Day	350 100	0 0
11	SW/3-4	E	Lowden Memorial State Park	Summer/Day & Night Winter/Day & Night	2600 500	100 25
12	SSW/9-10	I	Camp Lowden Boy Scout Camp	Summer/Day & Night Winter/Day & Night	200 150	200 150
13	NNE/6-7	G	Camp McCormick Girl Scout Camp	Summer/Day & Night Winter/Day & Night	250 100	250 100
14	ESE/6-7	H	Kings Camp	Summer/Day & Night	150	150
15	NNW/2-3	F	Byron Sportsmen's Club	Year-round	100	0
16	SSW/6-7	I	Lutheran Outdoor Ministry	Summer/Day & Night Winter/Day & Night	250 140	250 140
17	SSE/8-9	H	Rochelle Conservation Club	Summer/Day & Night Winter/Day	50 150	25 0
18	WSW/9-10	I	Moosehart Camp Ross	Summer/Day & Night	60	60
19	NW/2-3	F	Mt. Morris Boat Club	Summer/Day	40	0
20	ENE/2-3	C	Weld Memorial Park	Summer/Day	50	0

TABLE 3-4 (Cont)

Facility No.(2)	Direction/ Mile	Study Area	Facility Name	Periods of Operation	Transient Population Day	Transient Population Night
21	SSW/4-5	E	Oregon Golf Club	Summer/Day	100	0
22	NE/9-10	G	Fuller Memorial Forest Preserve	Summer/Day	300	0
23	SW/5-6	E	Oregon Park District	Summer/Day Winter/Day	435 120	0 0
59	SSW/4-5	E	Yellow Bird Senior Citizens Center	Year-round	125	0
70	WSW/6-7	I	Camp Emmaus	Summer/Day & Night Winter/Day & Night	60 25	60 25
71	NNE/9-10	G	Bishop Lane Retreat House	Year-round	100	100

Notes:

(1) This information was provided by State of Illinois ESDA personnel responsible for the development of IPRA, Byron Volume VI (See Reference 6). Information is based on data available as of January 1984. As discussed in Section 1, the evacuation time estimates are relatively insensitive to changes in population.

(2) See Figure 3-13 for facility locations.

(3) Weekends only.

TABLE 3-5

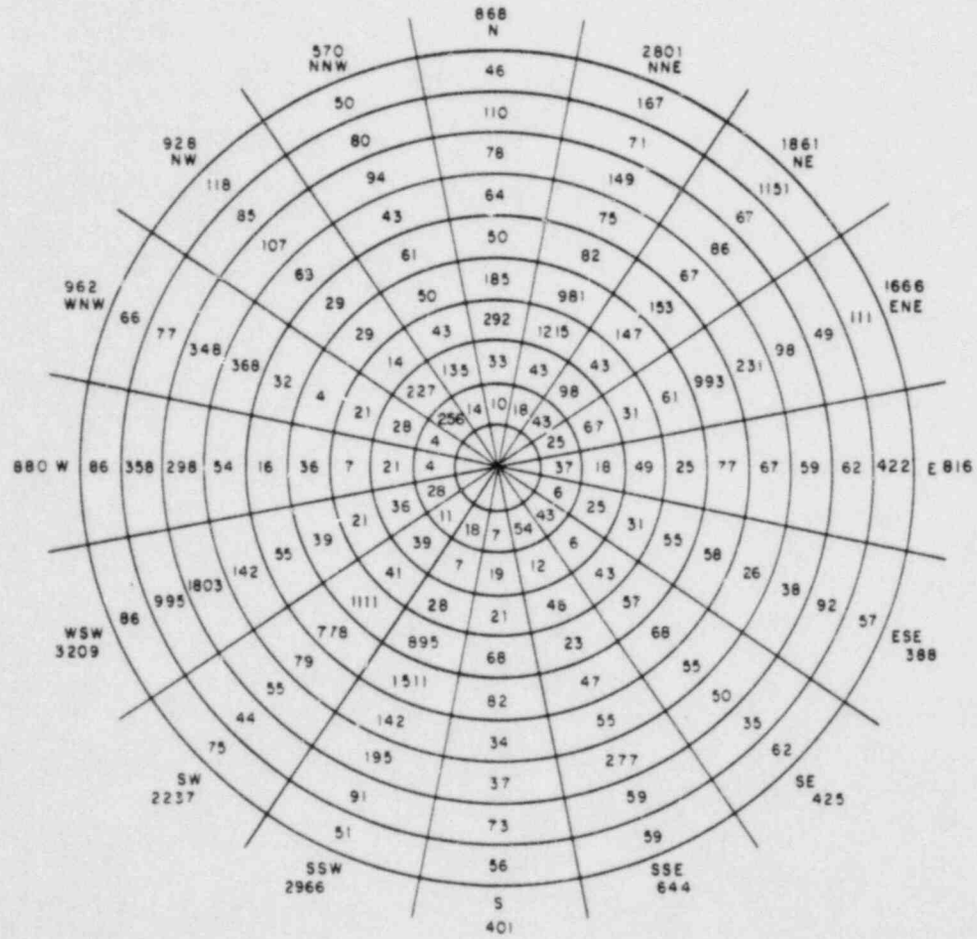
HEALTH CARE FACILITIES, MOTELS AND COUNTY JAIL
WITHIN THE EMERGENCY PLANNING ZONE(1)

Facility No.(2)	Direction/ Mile	Study Area	Facility Name	Resident/Staff Population Day	Night
61	WSW/6-7	I	Mt. Morris Motel	22	22
62	SW/4-5	E	V.I.P. Motel	24	24
63	NNE/3-4	C	The Neighbors Nursing and Care Center	134	103
64	SSW/5-6	E	White Pines Manor	74	65
65	WSW/7-8	I	Pine Crest Manor	192	118
68	SSW/4-5	E	Ogle County Jail	35	35
69	NNE/7-8	G	Black Hawk Trails Motel	12	12

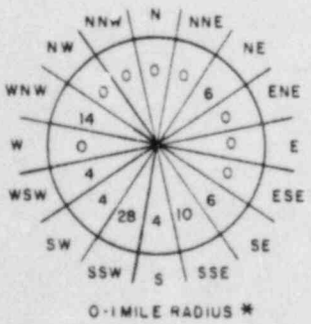
Notes

(1) This information was provided by State of Illinois ESDA personnel responsible for the development of IPRA, Byron Volume VI (See Reference 6). Information is based on data available in January 1984. As discussed in Section 1, the evacuation time estimates are relatively insensitive to changes in population.

(2) See Figure 3-13 for facility locations.



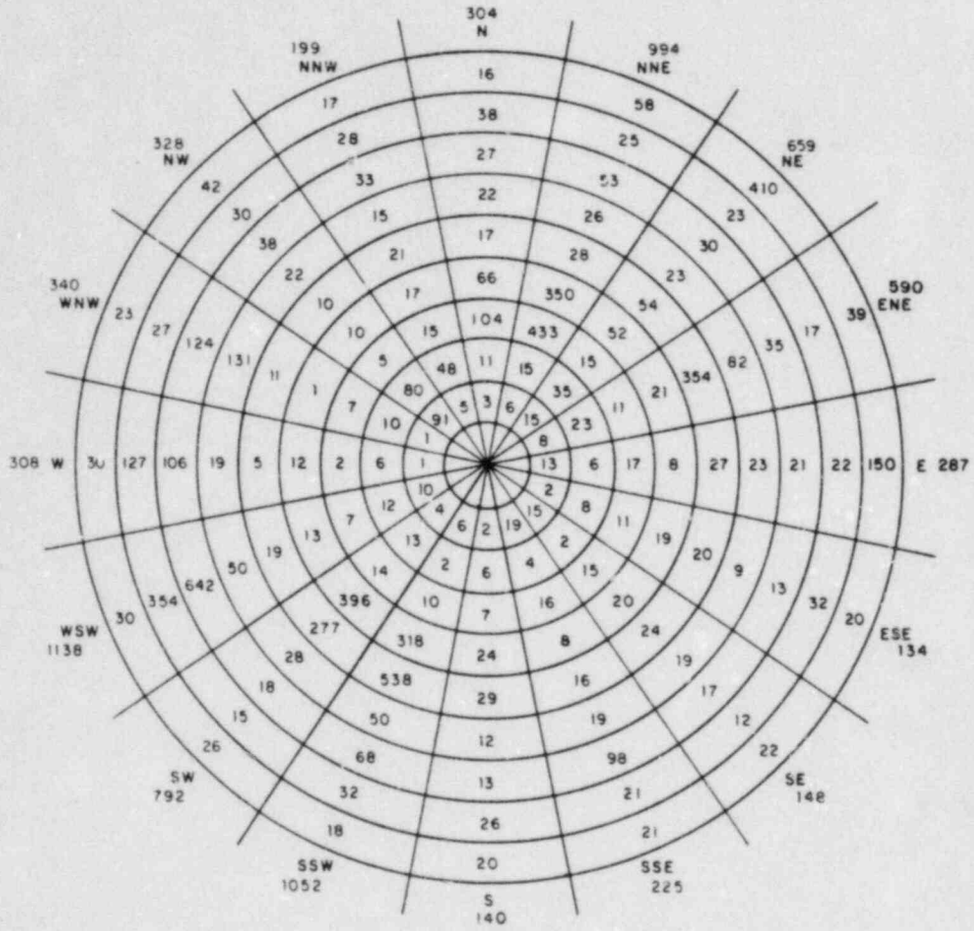
0-2 MI	0-5 MI	0-10MI	2-5 MI	5-10 MI
654	7182	21622	6528	14440



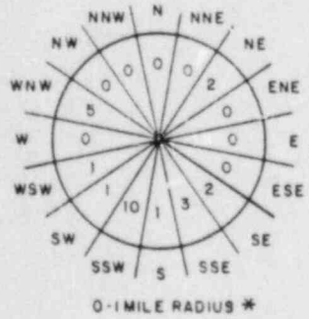
0-1 MILE RADIUS *

* THIS DATA IS INCLUDED WITH THE 1-2 MILE SECTOR POPULATIONS ON SUBSEQUENT POPULATION DISTRIBUTION FIGURES

FIGURE 3-1
PERMANENT POPULATION DISTRIBUTION BY COMPASS SECTOR

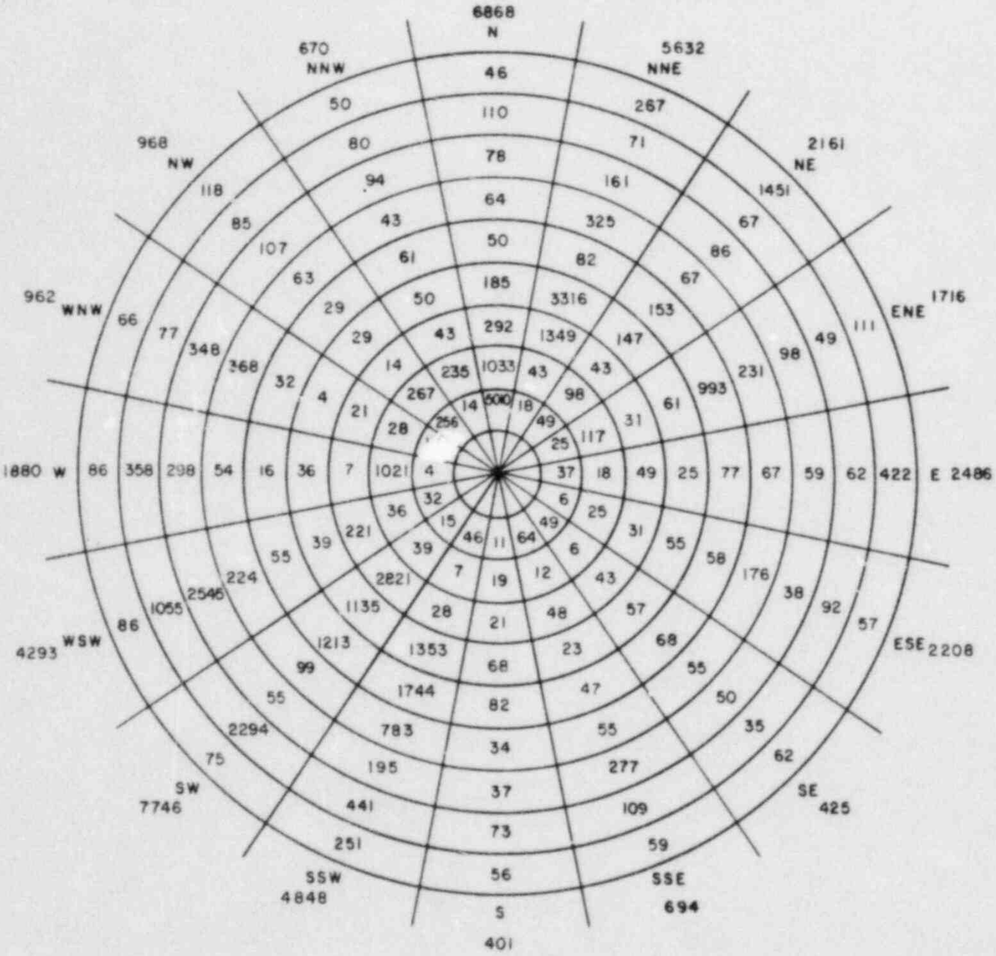


0-2 MI	0-5 MI	0-10 MI	2-5 MI	5-10 MI
226	2531	7638	2305	5107

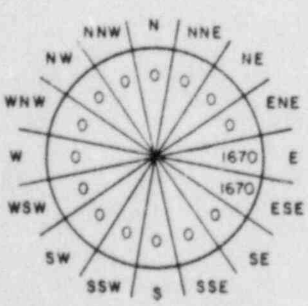


* THIS DATA IS INCLUDED WITH THE 1-2 MILE SECTOR VEHICLES ON SUBSEQUENT VEHICLE DISTRIBUTION FIGURES

FIGURE 3-2
PERMANENT VEHICLE DISTRIBUTION
BY COMPASS SECTOR



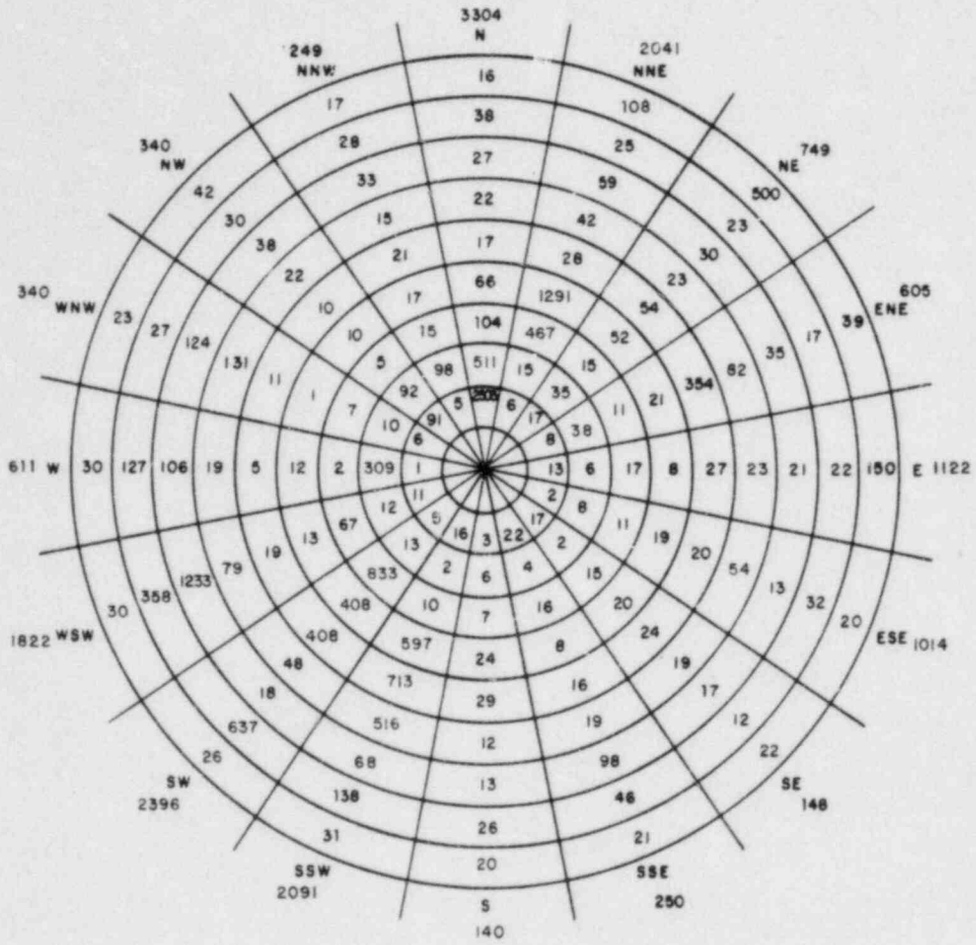
0-2 MI	0-5 MI	0-10MI	2-5 MI	5-10 MI
8994	23643	43958	14649	20315



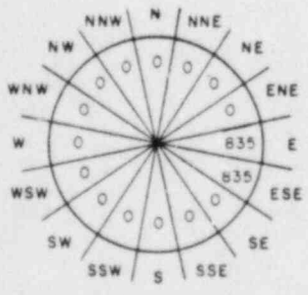
0-1MILE RADIUS

FIGURE 3-3

POPULATION DISTRIBUTION BY COMPASS SECTOR - SUMMER DAY

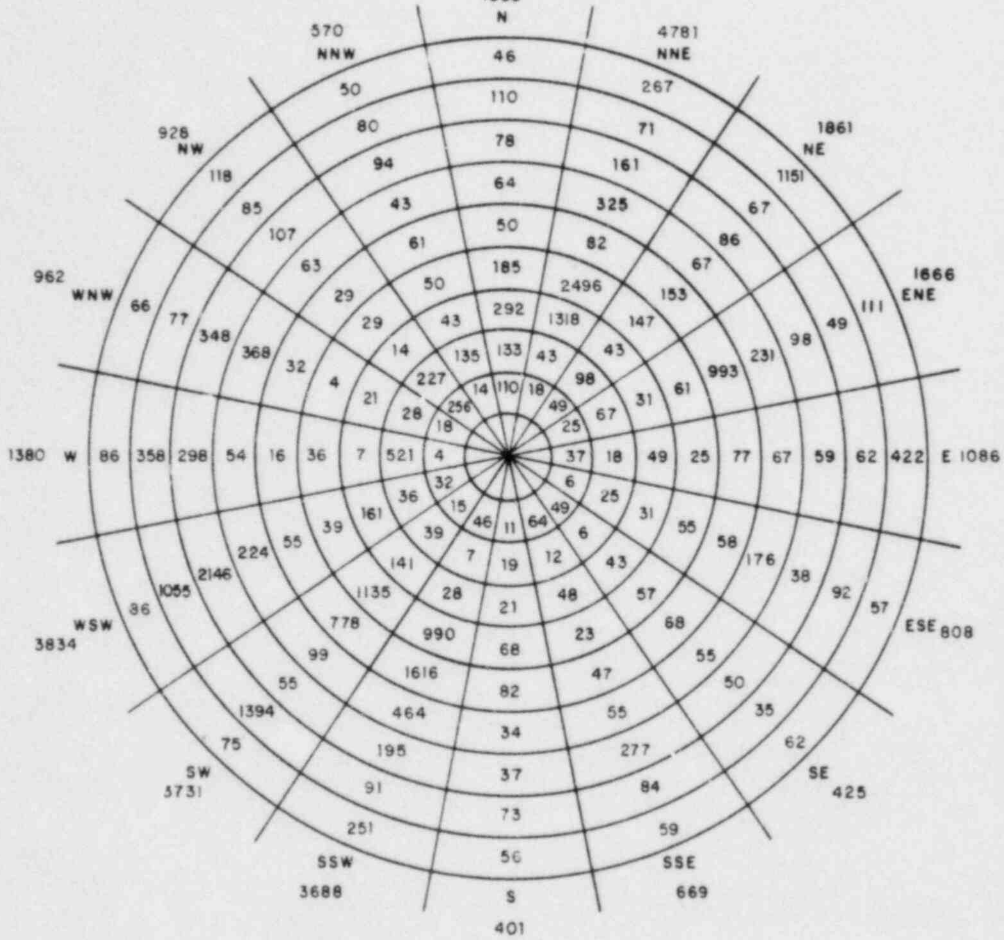


0-2 MI	0-5 MI	0-10 MI	2-5 MI	5-10 MI
4396	9726	17222	5330	7496

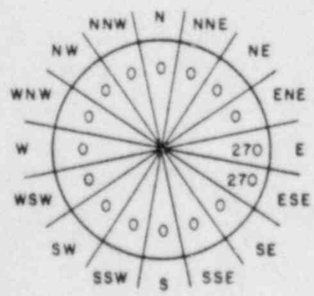


0-1 MILE RADIUS

FIGURE 3-4
VEHICLE DISTRIBUTION BY
COMPASS SECTOR - SUMMER DAY

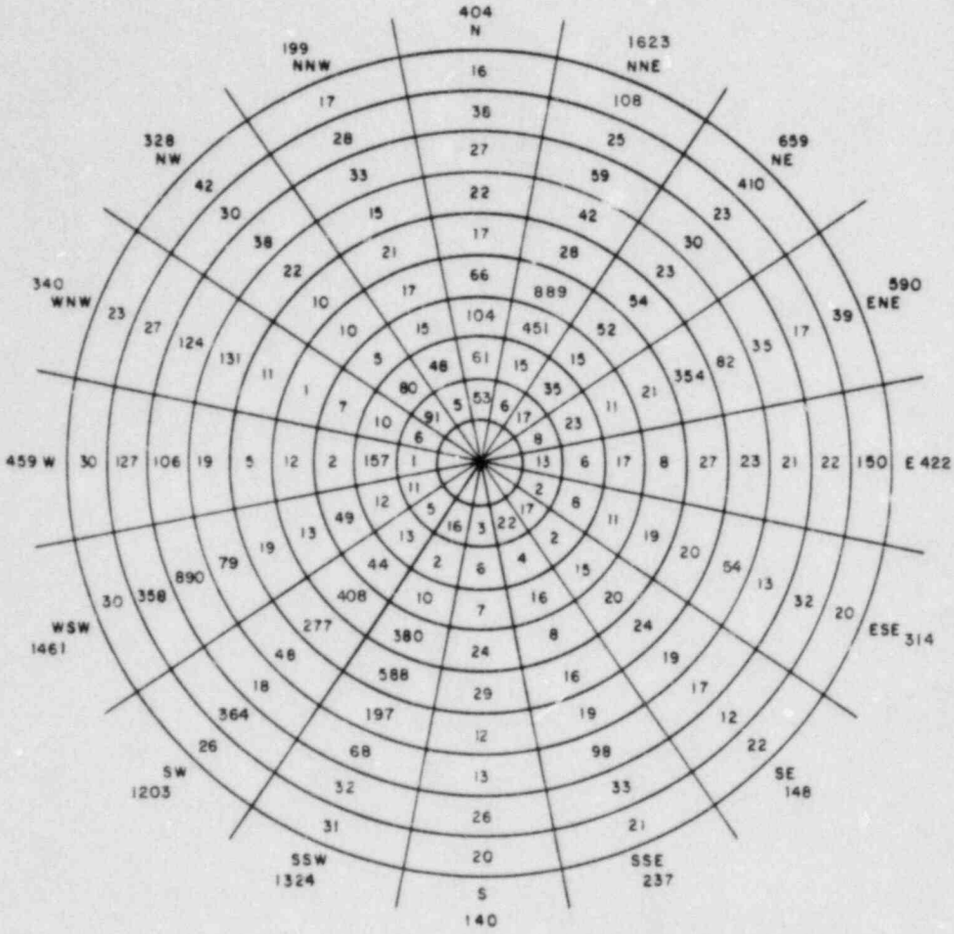


0-2 MI	0-5 MI	0-10 MI	2-5 MI	5-10 MI
1294	10399	27858	9105	17459



0-1 MILE RADIUS

FIGURE 3-5
POPULATION DISTRIBUTION BY
COMPASS SECTOR - SUMMER NIGHT



0-2 MI	0-5 MI	0-10MI	2-5 MI	5-10 MI
546	3755	9851	3209	6096

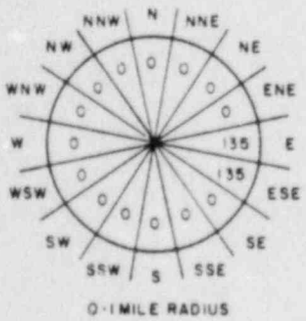
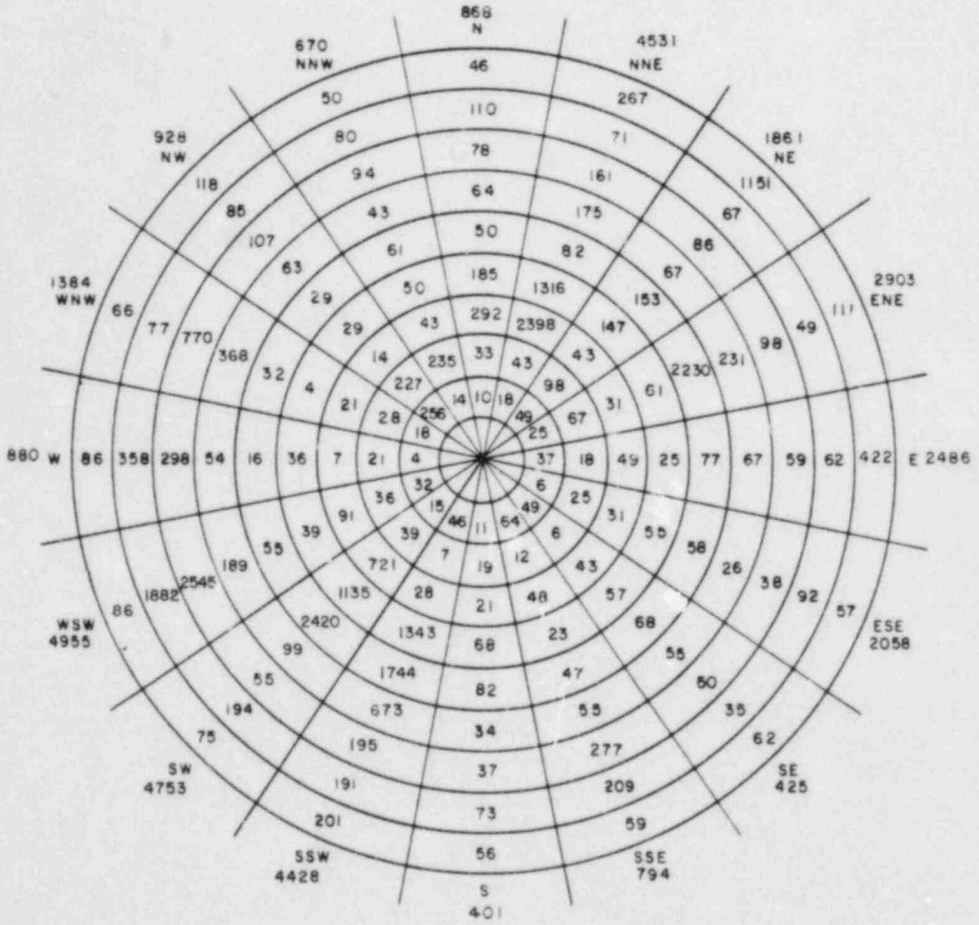
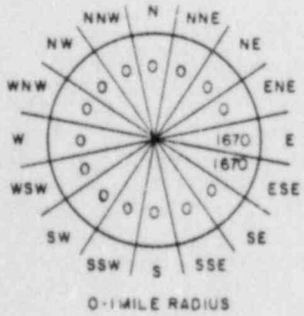


FIGURE 3-6
VEHICLE DISTRIBUTION BY
COMPASS SECTOR-SUMMER NIGHT

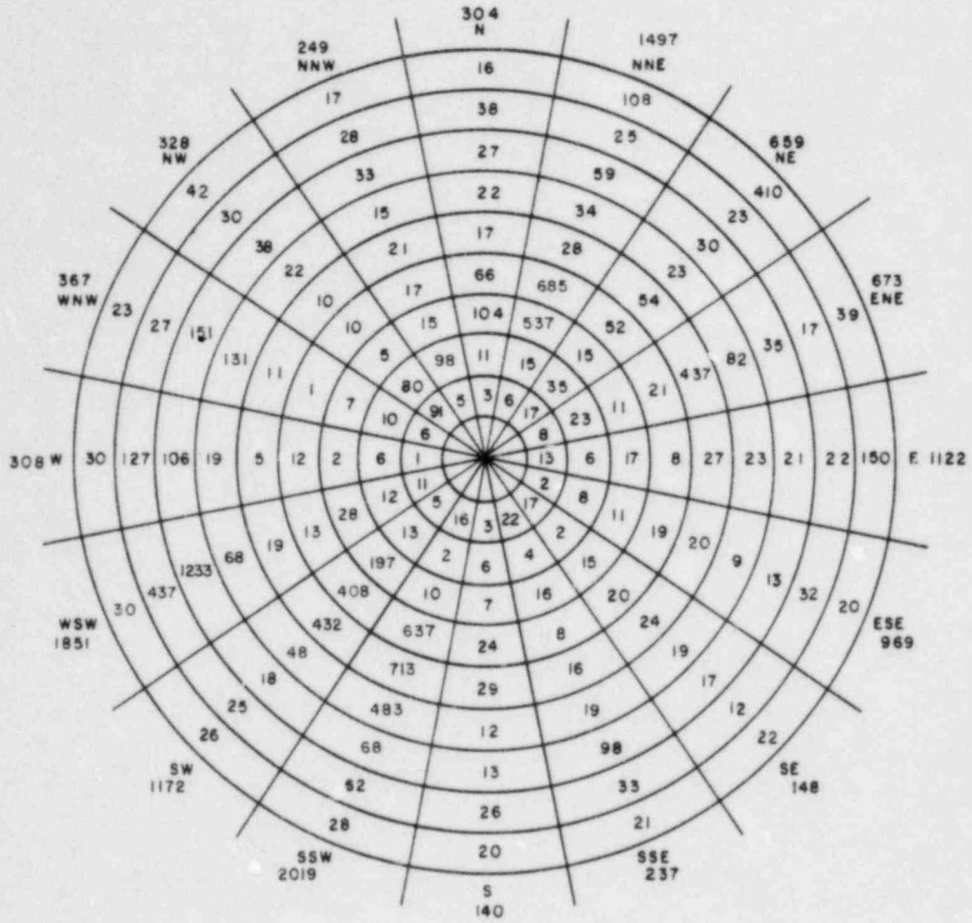


0-2 MI	0-5 MI	0-10 MI	2-5 MI	5-10 MI
3994	13362	34325	9368	20963

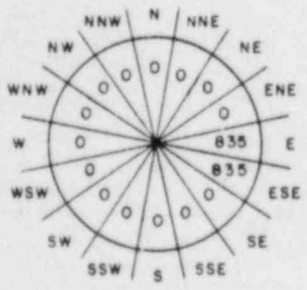


0-1 MILE RADIUS

FIGURE 3-7
POPULATION DISTRIBUTION BY
COMPASS SECTOR-WINTER DAY

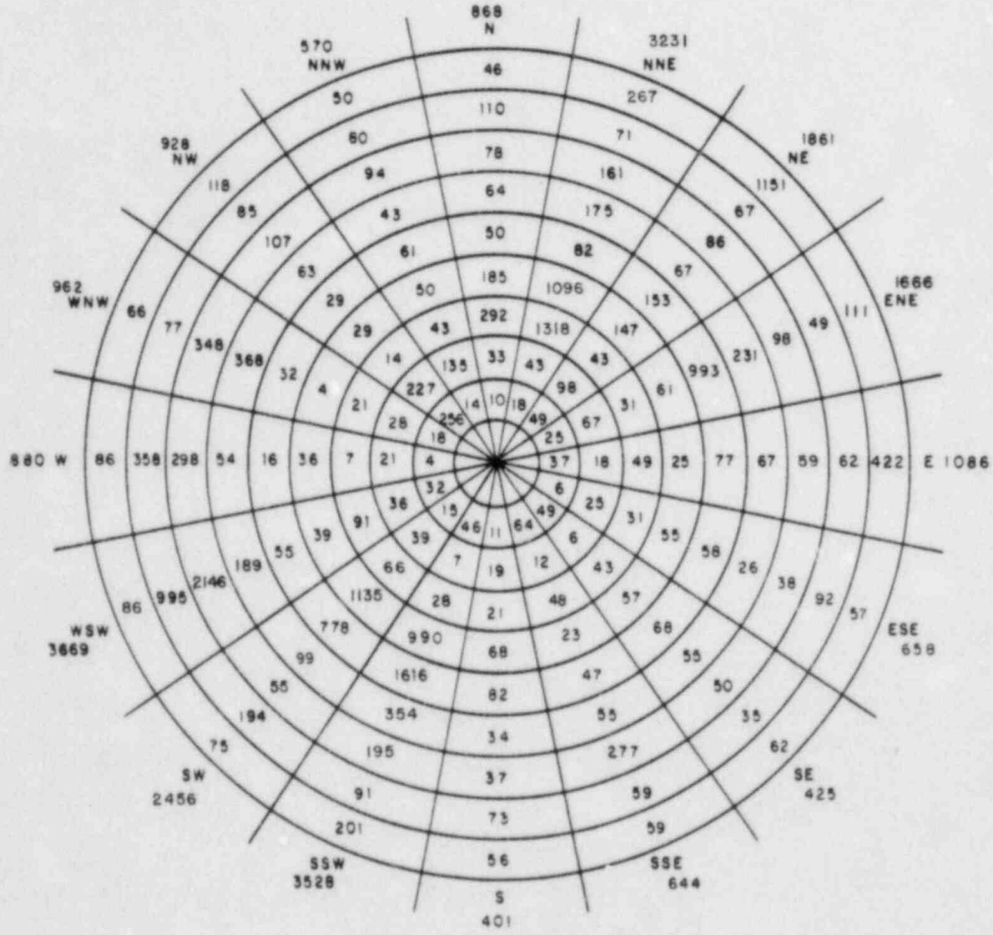


0-2 MI	0-5 MI	0-10MI	2-5 MI	5-10 MI
1896	5225	12043	3329	6818

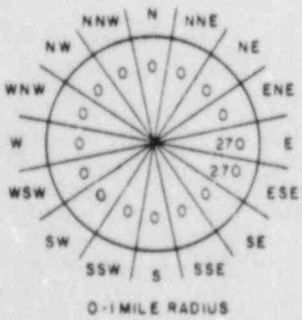


0-1 MILE RADIUS

FIGURE 3-8
VEHICLE DISTRIBUTION BY
COMPASS SECTOR – WINTER DAY

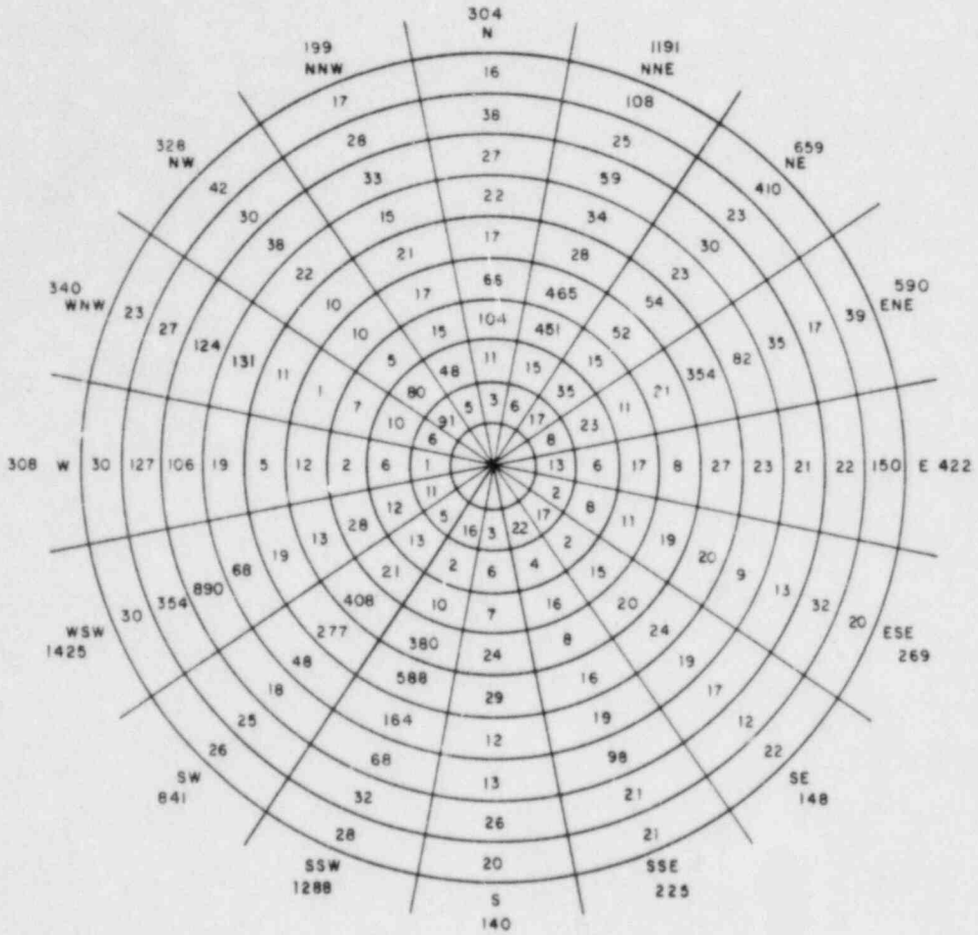


0-2 MI	0-5 MI	0-10 MI	2-5 MI	5-10 MI
1194	8154	23833	6960	15679



0-1 MILE RADIUS

FIGURE 3-9
POPULATION DISTRIBUTION BY
COMPASS SECTOR-WINTER NIGHT



0-2 MI	0-5 MI	0-10 MI	2-5 MI	5-10 MI
496	3036	8677	2540	5641

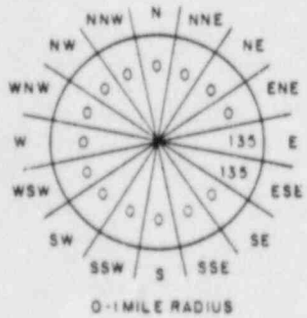
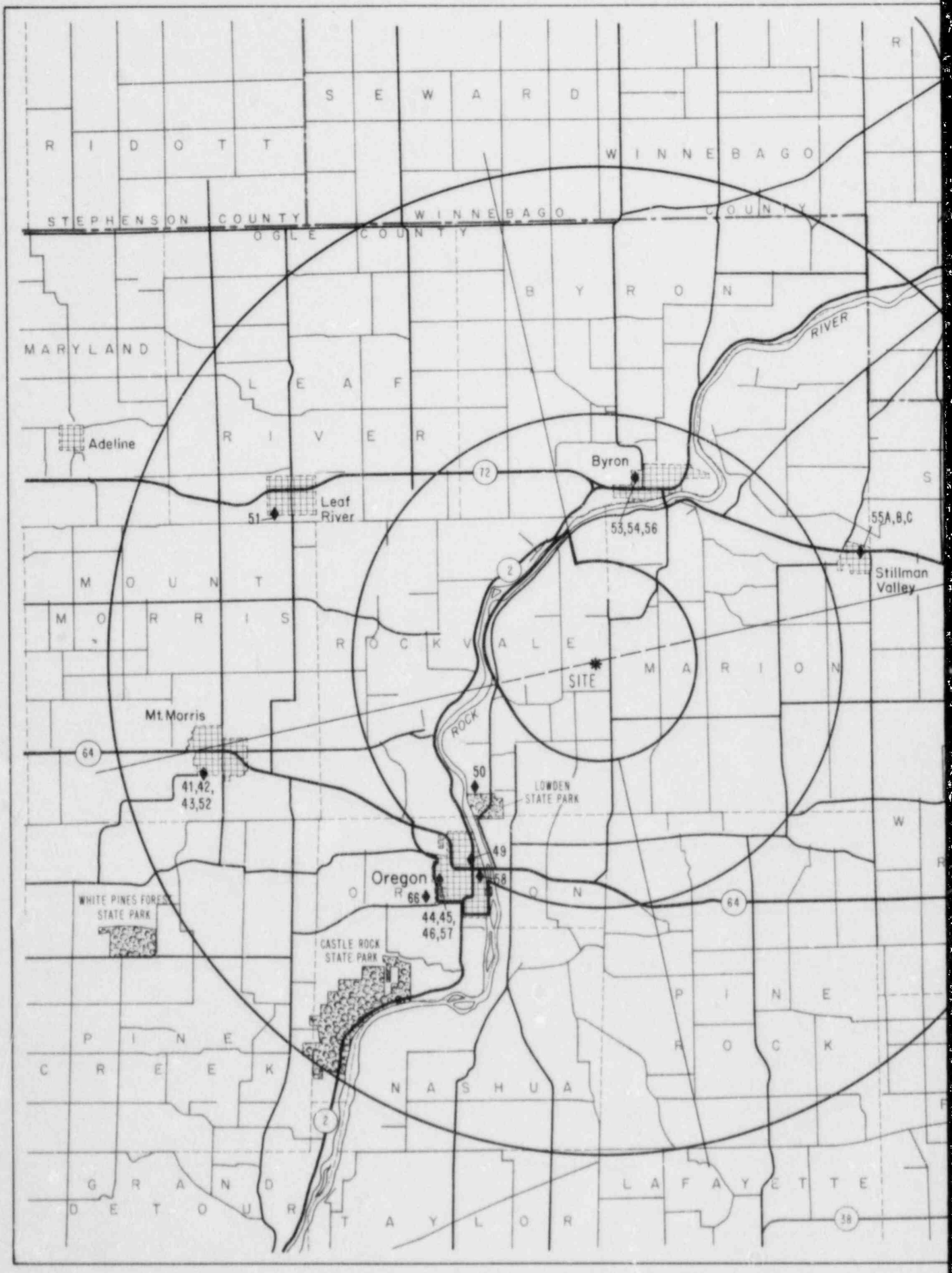
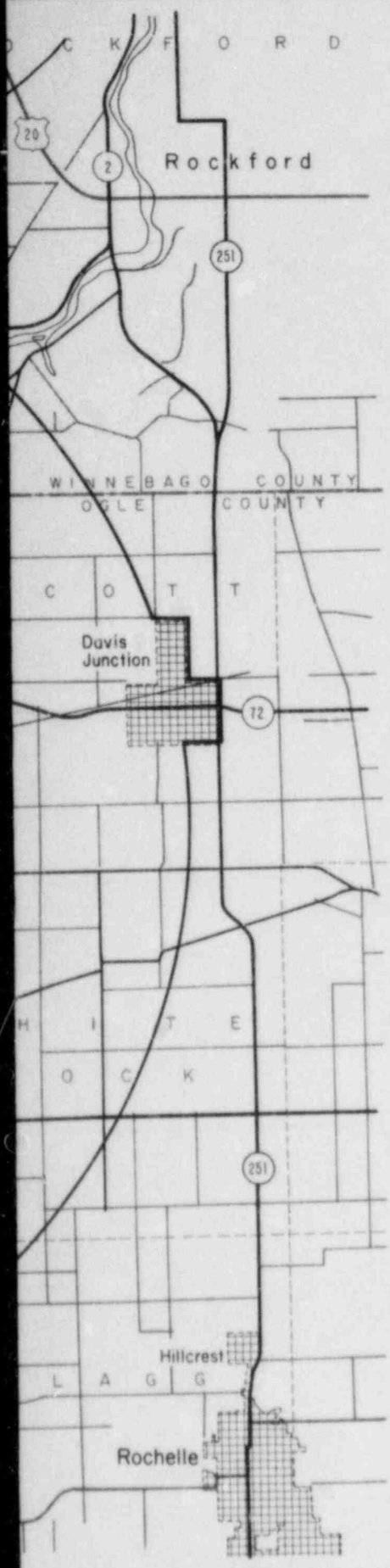


FIGURE 3-10
VEHICLE DISTRIBUTION BY
COMPASS SECTOR-WINTER NIGHT


SEWARD
RIDOTT
WINNEBAGO
STEPHENSON COUNTY
WINNEBAGO COUNTY
OGLE COUNTY
BYRON
MARYLAND
LEAF
RIVER
Adeline
Leaf River
51
Byron
53,54,56
55A,B,C
Stillman Valley
MOUNT MORRIS
ROCKVALE
SITE
MARION
Mt. Morris
41,42,
43,52
50
LOWDEN STATE PARK
49
Oregon
66
58
44,45,
46,57
WHITE PINES FOREST STATE PARK
CASTLE ROCK STATE PARK
PINE CREEK
NASHUA
PINE ROCK
GRAND DETOUR
TAYLOR
LAFAYETTE
72
64
2
38



LEGEND

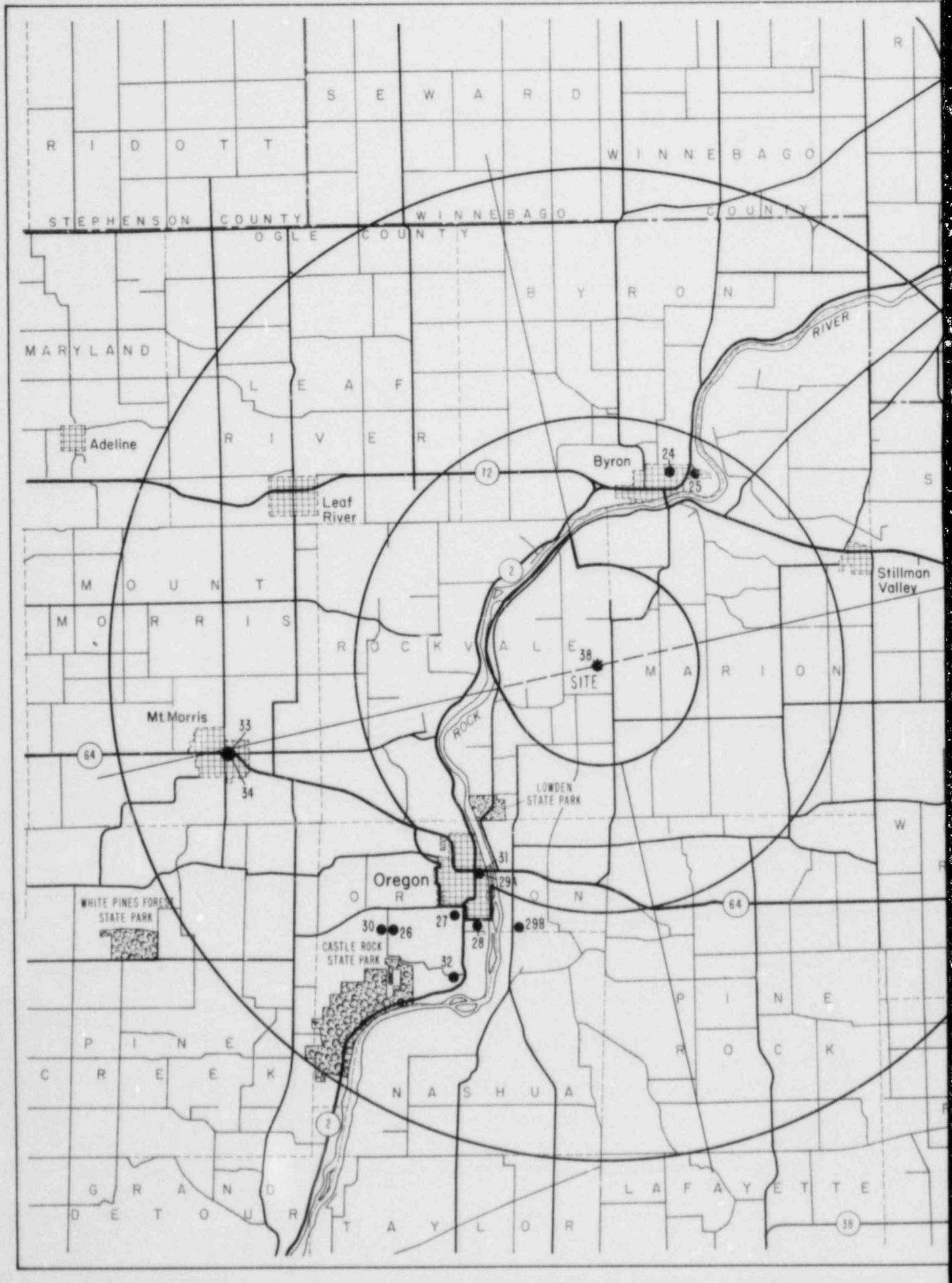
- (2) STATE HIGHWAY
- (20) INTERSTATE HIGHWAY
- INCORPORATED AREA (CITY OR VILLAGE)
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY
- SCHOOLS

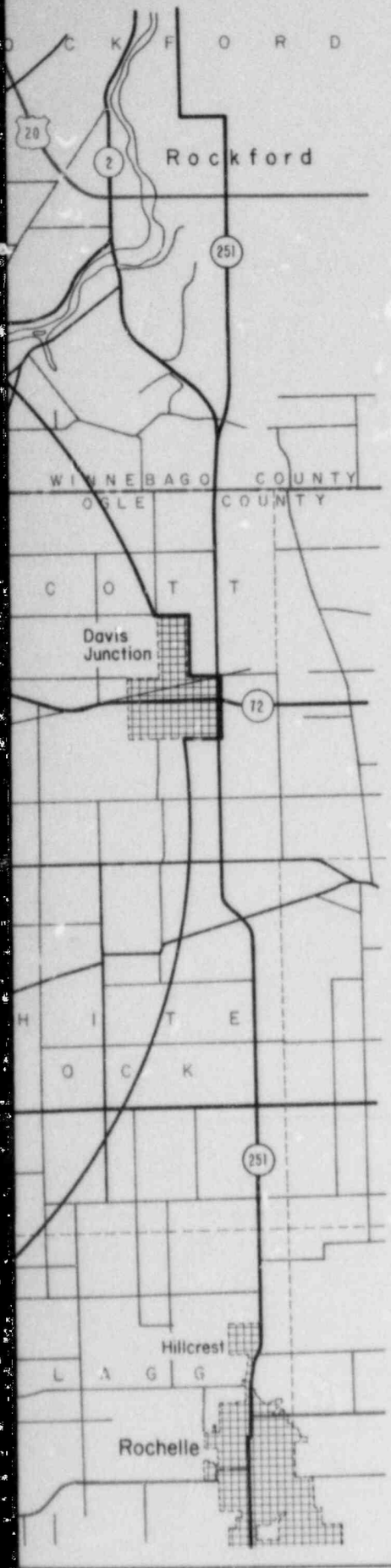
NOTE
NUMBERS REFER TO FACILITIES IDENTIFIED ON TABLE 3-2.

SOURCE: Based on revised Illinois general highway maps for Ogle (12/79) and Winnebago (12/80) counties.

0 2 4
SCALE - MILES

FIGURE 3-11
SPECIAL FACILITIES-SCHOOLS


SEWARD
RIDOTT
WINNEBAGO
STEPHENSON COUNTY
WINNEBAGO COUNTY
OGLE COUNTY
BYRON
MARYLAND
LEAF
RIVER
Adeline
Leaf River
Byron
24
25
72
Stillman Valley
MOUNT MORRIS
ROCKVALE
38
SITE
MARION
Mt.Morris
33
34
64
ROCK
LOWDEN STATE PARK
31
Oregon
29A
WHITE PINES FOREST STATE PARK
30
26
27
28
29B
CASTLE ROCK STATE PARK
32
PINE CREEK
NASHUA
PINE ROCK
GRAND DETOUR
TAYLOR
LAFAYETTE
2
38



LEGEND

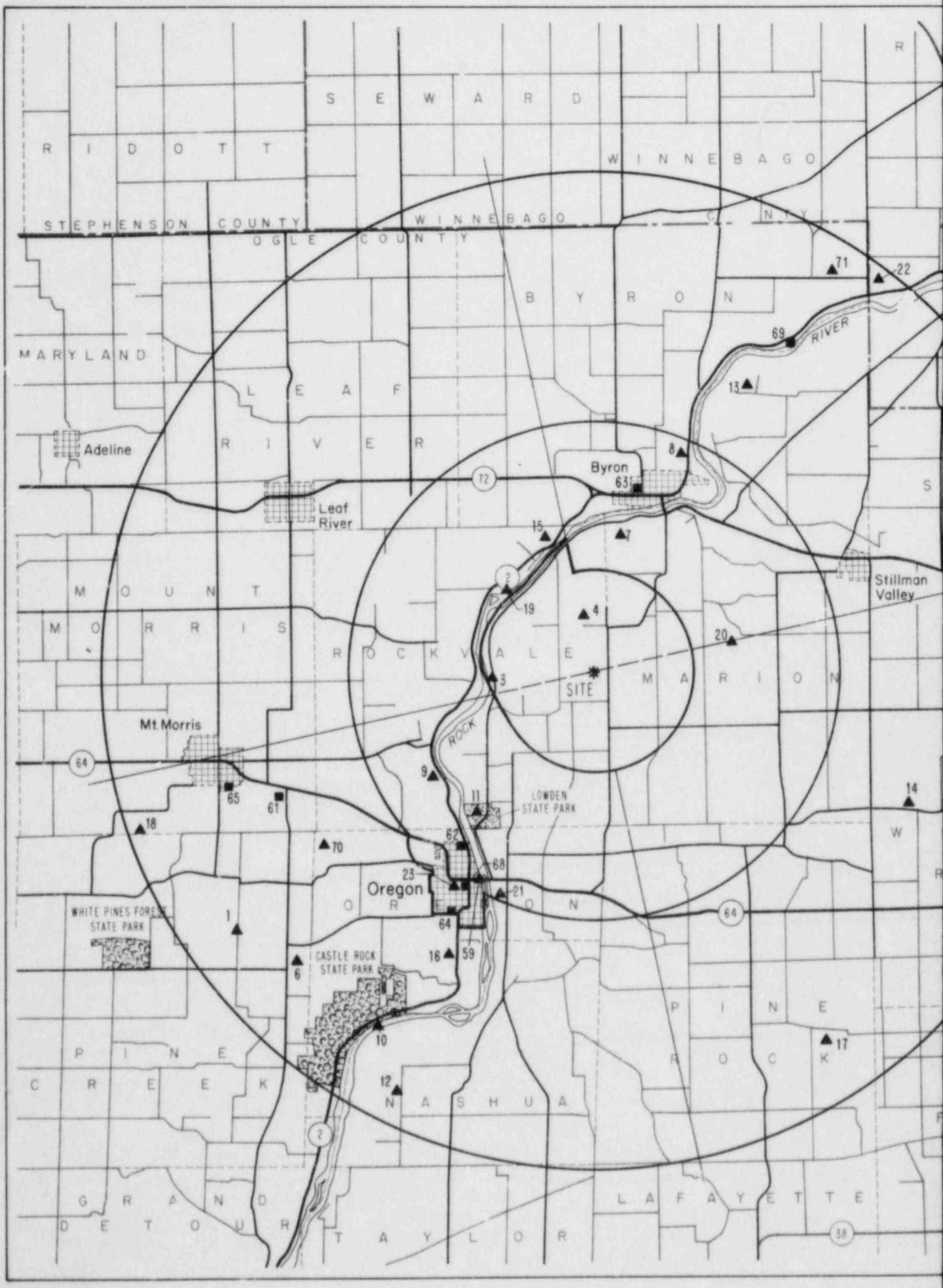
- (2) STATE HIGHWAY
- (20) INTERSTATE HIGHWAY
- INCORPORATED AREA (CITY OR VILLAGE)
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY
- EMPLOYERS

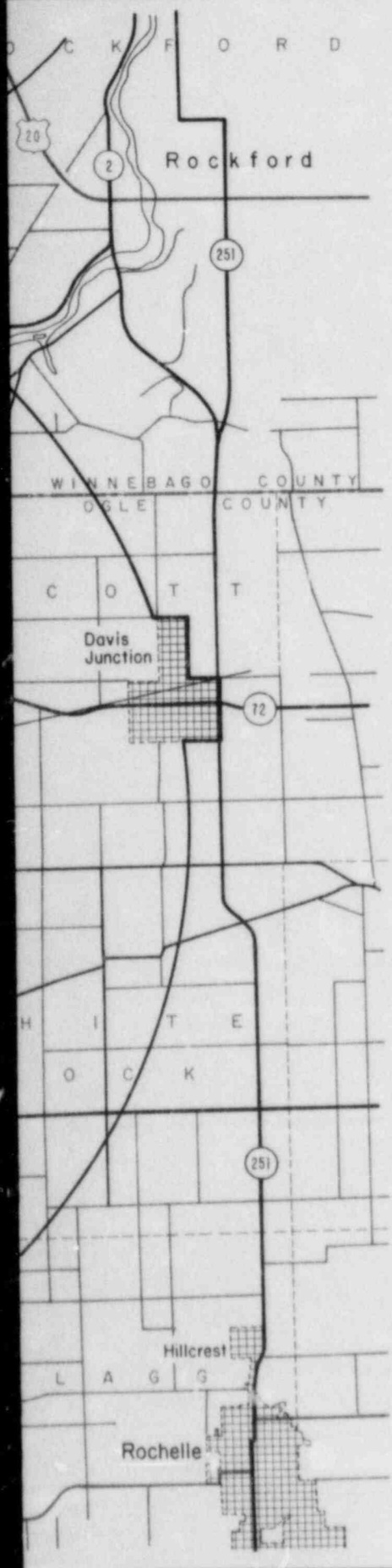
NOTE
NUMBERS REFER TO FACILITIES IDENTIFIED ON TABLE 3-3.

SOURCE: Based on revised Illinois general highway maps for Ogle (12/79) and Winnebago (12/80) counties.

0 2 4
SCALE - MILES

FIGURE 3-12
TRANSIENT POPULATION-MAJOR EMPLOYERS


STEPHENSON COUNTY
WINNEBAGO COUNTY
OGLE COUNTY
SEWARD
WINNEBAGO
RIDOTT
BYRON
MARYLAND
LEAF RIVER
Adeline
Leaf River
Byron
Stillman Valley
MOUNT MORRIS
ROCKVALE
MARION
SITE
Mt. Morris
ROCK RIVER
LOWDEN STATE PARK
Oregon
WHITE PINES FOREST STATE PARK
CASTLE ROCK STATE PARK
PINE CREEK
NASHUA
PINE ROCK
GRAND DETOUR
TAYLOR
LAFAYETTE
72
64
2
38



LEGEND

- (2) STATE HIGHWAY
- (20) INTERSTATE HIGHWAY
- INCORPORATED AREA (CITY OR VILLAGE)
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY
- ▲ CAMPS AND RECREATION AREAS
- ■ SPECIAL FACILITIES (HEALTH CARE, MOTELS, AND COUNTY JAIL)

NOTE
NUMBERS REFER TO FACILITIES IDENTIFIED ON TABLES 3-4 AND 3-5.

SOURCE: Based on revised Illinois general highway maps for Ogle (12/79) and Winnebago (12/80) counties.

0 2 4
SCALE - MILES

FIGURE 3-13
TRANSIENT POPULATION-CAMPS, RECREATION AREAS AND SPECIAL FACILITIES

SECTION 4

EVACUATION TIME ESTIMATE METHODOLOGY AND ASSUMPTIONS

This section presents the methodology and assumptions used to develop the evacuation time estimates for the general population. Additionally, the methodology and assumptions used for a separate assessment for selected special facilities as required by NUREG 0654, Appendix 4, are presented.

4.1 GENERAL POPULATION EVACUATION TIME ESTIMATES

The general population, for the purposes of developing evacuation time estimates, is comprised of the permanent population, transients, and special facilities population appropriate for each of the particular evacuation scenarios. The general population evacuation time estimates are presented in Section 6.1.

The general population evacuation time estimates were calculated using the NETVAC2 computerized traffic simulation model,[2] which was developed to simulate the traffic flow over a transportation network during an evacuation. As input for the evacuation time estimates, this model utilizes site specific road network and vehicle data, as well as public notification and mobilization times.

4.1.1 Evacuation Time Estimates Methodology

The NETVAC2 model was developed primarily for calculating the evacuation times for areas around nuclear power facilities. This model simulates the flow of traffic from entry nodes, where the vehicles enter the road network, to the exit nodes, located outside the EPZ boundary, where the

vehicles leave the network. The model uses the Highway Capacity Manual[3] equations and revisions contained in the Interim Material on Highway Capacity[4] to calculate the capacity of the road network. In addition, vehicle speeds on the road network are computed using the inverse linear relationship between speed and density presented in the Highway Capacity Manual. The NETVAC2 model has been extensively used for other evacuation studies similar to the Byron Study, and the results in those other studies have been favorably reviewed by the appropriate local, State and Federal authorities.

The NETVAC2 model allows a detailed evacuation roadway network to be analyzed by utilizing an area specific data base, which includes link (road segment) length, lane width, number of lanes, node (intersection, point of entry, or point of exit) approach width, shoulder width, traffic controls, signal timing, turning lanes, and direction of turns. This data is used to determine road network capacity and direction of traffic flow. The evacuation road network is discussed in Section 5.

Additional input data is used by the model to derive vehicle loading rates for each primary evacuation zone. Vehicles are entered at specific points (nodes) on the network and their loading rates varied with time. Therefore, the vehicle loading rate is tailored to match actual population centers and time distributions of the public's response to notification. This notification response was approximated by a probability distribution of the public's reaction time during an evacuation and is discussed in detail in Section 4.1.2.

NETVAC2 also uses dynamic route choice, which means that vehicle turning movements at individual intersections are changed with traffic conditions to reduce the number of vehicles that have turned onto a congested roadway. Appendix A discusses the NETVAC2 Model in greater detail.

4.1.2 Public Response Times and Network Loading Rates

The range and variation of public reaction to evacuation notification was described by a probability distribution of response times. This response time distribution was derived by combining the response time distributions for several components of the public response to the evacuation notification process. These components are as follows:

- Receive Warning, the time period between the activation of the prompt public notification system and the receipt by the public of the message to evacuate;
- Leave Work, the time period required for employees to leave work and travel to their vehicles;
- Travel from Work to Home, the time period required to drive from work to home; and
- Prepare Home for Evacuation, the time period required to gather essential belongings and prepare home for evacuation.

Total mobilization times were determined by combining these components for each evacuation scenario. The range and average public response times for each of these components are shown in Table 4-1. These

response times were favorably reviewed by Ogle County and State of Illinois ESDA officials.

A normal distribution was assumed for the time span of these individual components. This distribution represents the situation in which most persons respond in the average time for a given event, while fewer individuals respond earlier and later than the average time. Therefore, the cumulative probability distribution of each of these components is an "S" shaped curve. The curves have been derived by using standard mathematical techniques based on NUREG-0654/FEMA-REP-1, Appendix 4[1] recommendations. Figure 4-1 presents the distribution curves used for this study. Nighttime curves were derived by combining two components: Receive Warning and Prepare Home for Evacuation. Daytime curves were derived by combining four components: Receive Warning, Leave Work, Travel Home, and Prepare Home for Evacuation. The cumulative distribution of these different components, when combined, has an "S" shaped curve similar to the curves for the individual components, and represents the spectrum of public response times.

These public response time curves were used to determine the rate and time for vehicle loading. These curves provide information on the percentage of people leaving their homes within specific periods of time. Vehicles were loaded onto the evacuation roadway network using the percentage and times outlined in the public response time curves.

It should be noted that during the course of developing these public response times, this study assessed the employment center shut down times for the major employers in the EPZ as listed in Table 3-3. Eleven

of the thirteen major employers have shut down times of 60 minutes or less. The remaining two major employers (Quality Metal Finishing Co. in Byron and Acme Resin Co. outside of Oregon) have shut down times of from 90 to 120 minutes, although in both cases only a small percentage of the work force would be needed for this entire time period with the majority of the employees being dismissed in less than 60 minutes.

Since the response times of the major employers are well within the cumulative public response time for most evacuation scenarios, no modification of the public response curves because of the employment center shut down times is necessary or appropriate. However, because two of the major employers have shut down times of from 90 to 120 minutes, which approximates the general public evacuation time estimates for some scenarios and could therefore result in slightly longer evacuation times for those employees needed to shut down these facilities, appropriate notations were made to Tables 1-1, 6-1, and 6-2.

4.1.3 Assumptions Used in Developing the Evacuation Time Estimates

- The prompt public notification system, which utilizes sirens, will be used. (Based on this system, the time to notify essentially 100 percent of the full plume exposure pathway EPZ population has been estimated to be 15 minutes.)

- Evacuation network routes will be passable.

- Persons within the plume exposure pathway EPZ, when instructed to evacuate, will leave.

- People in the outer primary evacuation zones will not evacuate when an inner primary evacuation zone is the only zone recommended to be evacuated.

- Adequate transportation will be available for summer camps.

- Evacuation of health care facilities, recreation areas, and other special facilities will occur simultaneously with the general population evacuation.

- Traffic rules and controls will be obeyed; only the proper travel lane will be used (not shoulders or opposite flow lanes); and traffic lights will be functioning normally or traffic control officers will be stationed at the location of nonfunctioning traffic lights.

- No major traffic will be on the road network prior to the start of an evacuation.

- Appropriate traffic and access control points will be manned.

- Roadway capacities will be reduced to 80 percent of normal weather capacity during adverse weather. [5,6,7] Adverse weather conditions are those that may impair visibility and/or traction such as light snow, icing, rain, or fog.

- Private vehicles will be the primary mode of evacuation.

- Only one vehicle per household will be used in an evacuation. (There are 2.8 persons per household, based on an average of people per household in Ogle County.[9])

- One vehicle per two visitors at clubs will be used in an evacuation.

- Boats will moor and the occupants will then evacuate by car with one vehicle allotted per boat.

- One vehicle per campsite at recreational campgrounds will be used for evacuation. (This assumes 3.3 people per vehicle as this is the Illinois State average number of people per family.[10])

- One vehicle per employee at major employers will be used in an evacuation.

People without vehicles will receive rides from either neighbors or designated public service vehicles in accordance with the Standard Operating Procedures contained in IPRA - Byron Volume VI. (Since there are no public transportation systems in the Byron EPZ, residents without vehicles would have developed some transportation options for general daily use and movements. Additionally, Standard

Operating Procedure 6-SOP-8 of IPRA-Byron, Vol. VI[8] has a number of mechanisms for providing transportation assistance to individuals and/or groups during an emergency. IPRA-Byron Vol. VI also has in place 6-SOP-12 by which a Mobility Impaired Transportation List for the Byron EPZ has been developed and is maintained by Ogle County emergency planning officials so as to be available during an emergency.)

4.2 SELECTED SPECIAL FACILITIES EVACUATION TIME ESTIMATE METHODOLOGY AND ASSUMPTIONS

In addition to deriving an estimate of the time required to evacuate the general population, NUREG 0654, Appendix 4 requires that separate estimates be made of the times required to evacuate special facilities within the EPZ. Special facilities selected to be analyzed in Annex A to this study include school districts and nursing homes in the Byron EPZ. The separate evacuation time estimates for these selected special facilities are presented in Section 6.2.

Selected special facility evacuation time estimates include mobilization time for obtaining transportation, time for loading persons into vehicles, and the travel time out of the EPZ. Appropriate mobilization and loading times for the selected special facilities evaluated in this study were obtained by State of Illinois ESDA personnel through interviews with facility officials.

Travel time out of the plume exposure pathway EPZ was determined using the average vehicle speed calculated by the NETVAC2 model along the appropriate evacuation route. Data for these calculations were taken from the general population evacuation simulation for the full EPZ winter daytime scenario for both normal and adverse weather conditions. The winter simulation was utilized for the selected special facilities evacuation time estimates since the winter period is concurrent with the school year. The mobilization time estimates for each selected special facility were combined with the travel time out of the plume exposure pathway EPZ to calculate the total selected special facility evacuation

time. The Byron Station EPZ school district and nursing home evacuation time estimates and feasibility analyses are presented in Annex A.

4.3 SPECIAL EVENT EVACUATION TIME ESTIMATE METHODOLOGY AND ASSUMPTIONS

The evacuation time estimates for the special event analyses as defined in Section 3.4 were calculated using the NETVAC2 computerized traffic simulation model[2] discussed in Section 4.1. Only two additional assumptions were used for these special event evacuation analyses. Specifically, the primary evacuation routes were modified to represent a more realistic flow of traffic from the Byron Dragway and the Moto Sports Park as follows: 1) vehicles from Byron Dragway would travel both north and south along River Road; and 2) vehicles from the Moto Sports Park would likewise travel both north and south along German Church Road. Additionally, it was also assumed that a traffic control point would be in place at the intersection of River and German Church Roads to facilitate the maximum flow of vehicles at that point on the evacuation roadway network.

TABLE 4-1

PUBLIC RESPONSE TIME ESTIMATES(1)

Public Response Component	Average Time for Component (minutes)(3)	Range of Component Times (minutes)(2)
Receive Warning(4)	15	0-30
Leave Work(5)	15	0-30
Travel Home(5)		
Normal Weather	30	0-60
Adverse Weather(6)	45	0-90
Prepare Home for Evacuation	30	0-60

NOTES:

(1) Favorably reviewed by Ogle County and State of Illinois ESDA Officials.

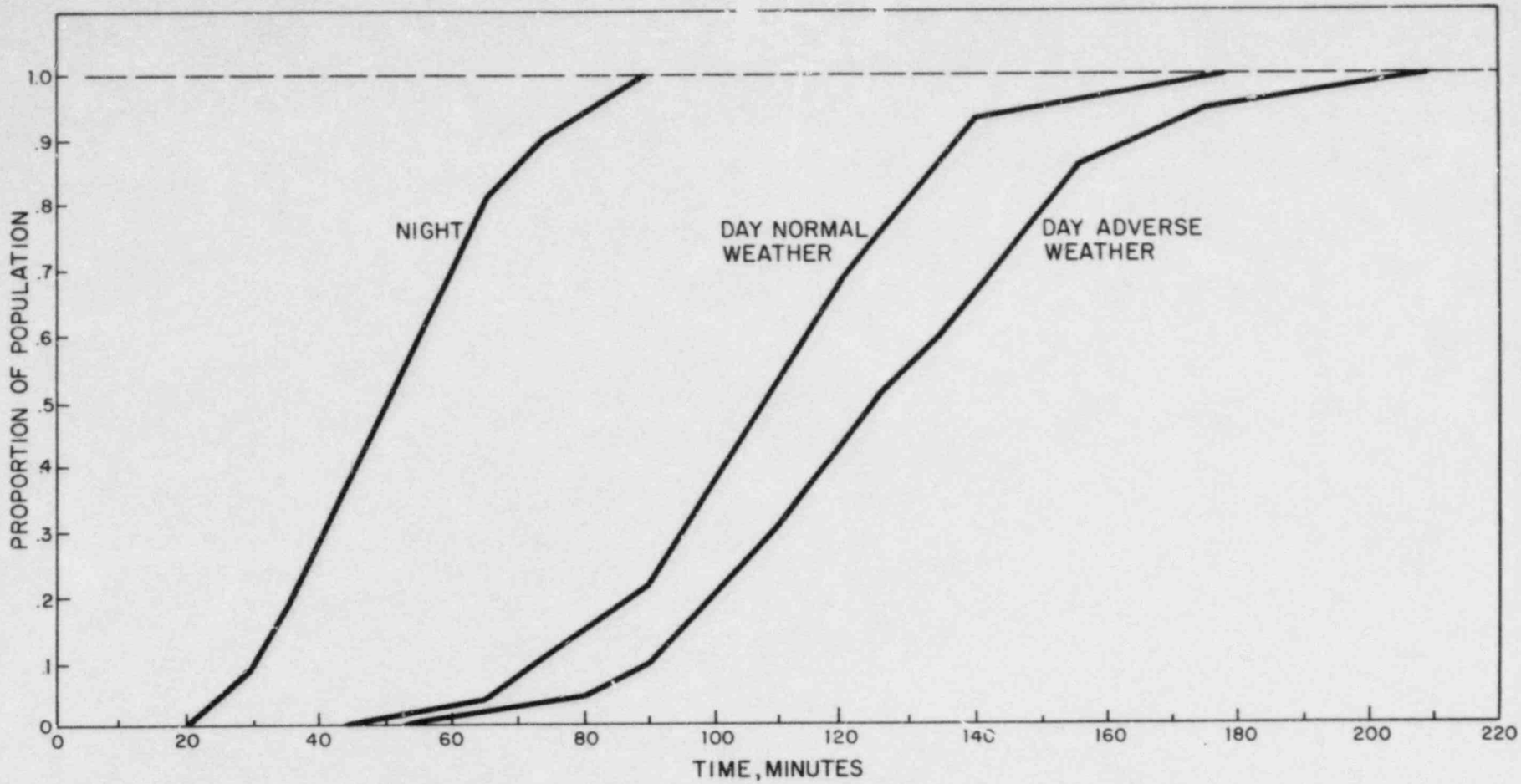
(2) This range implies that some people will initiate the identified event within the lower range of the component times while others will initiate the event within the upper range of the component times.

(3) See Figure 4-1 for public response distribution curves.

(4) An average time of 15 minutes was utilized with a 0 to 30 minute time distribution.

(5) Daytime evacuation scenarios only.

(6) Based on a reduced adverse weather road capacity factor of 0.8.



NOTE:
SEE TABLE 4-1 FOR AVERAGE TIME FOR EVENTS

FIGURE 4-1
PUBLIC RESPONSE TIME ESTIMATES

SECTION 5

EVACUATION ROAD NETWORK DESCRIPTION

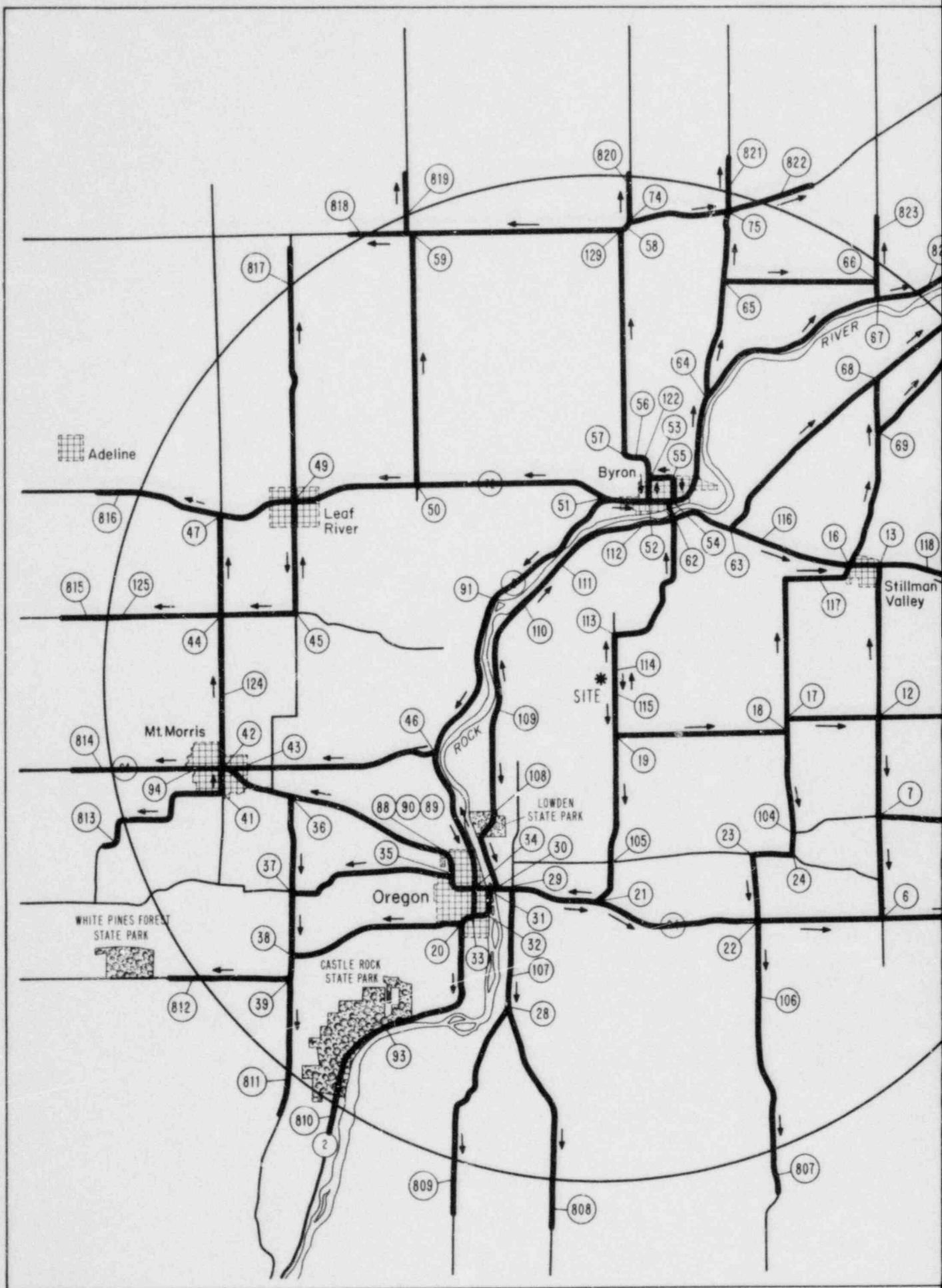
5.1 ROAD NETWORK DEFINITION

The series of roads designated for evacuating the plume exposure pathway EPZ is called the evacuation road network. The network includes major arterials and collector roads. The major intersections are assigned numbers as nodes in the network. The road segments between these nodes are called links.

Figure 5-1 illustrates the series of links and nodes that represent the evacuation road network for the Byron Station EPZ. Appendix B presents the location of each node by identifying the names of the roads that intersect at that node. The evacuation road network exit nodes, located outside the Byron Station EPZ, are numbered in the 800's. This evacuation road network was derived from official Illinois Department of Transportation maps and was field verified by road data collection. The evacuation network has been favorably reviewed by Ogle County and State of Illinois ESDA officials.

5.2 ROAD CAPACITIES AND CLASSIFICATIONS

The NETVAC2 model used field data, such as road widths and travel speeds, to calculate the capacity of each of the links and nodes in the evacuation network. The specific capacities and classifications of each road and intersection in the evacuation network are presented in Appendix C. The majority of the roads in this study are classified as rural undivided highways. There are also a few rural divided highways.


Adeline
Leaf River
Byron
Mt. Morris
Oregon
SITE
Stillman Valley
LOWDEN STATE PARK
WHITE PINES FOREST STATE PARK
CASTLE ROCK STATE PARK
ROCK RIVER
820
821
822
819
818
74
823
75
59
129
58
817
66
65
RIVER
87
64
68
56
122
53
57
55
69
49
816
47
50
51
116
112
52
54
62
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16
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118
815
125
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111
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110
113
44
45
114
124
115
46
109
18
17
12
814
42
43
19
94
108
7
88
90
89
813
41
36
104
105
34
30
23
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37
29
21
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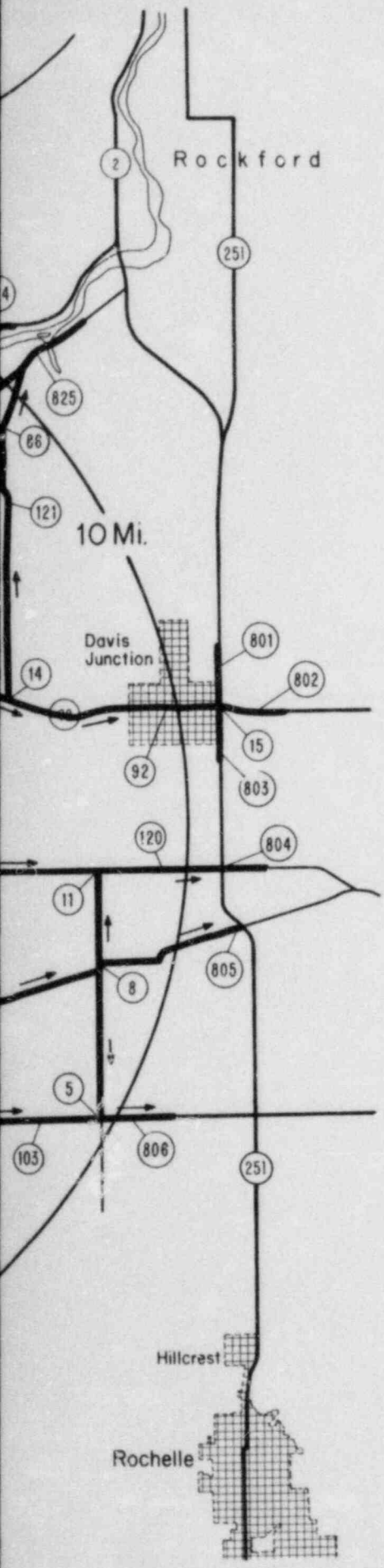
93
811
810
2
809
807
808



LEGEND

- (2) STATE HIGHWAY
- INCORPORATED AREA (CITY OR VILLAGE)
- EVACUATION ROUTE
- TRAFFIC FLOW
- (50) ENTRY AND EXIT NODES

SOURCE: Based on revised Illinois general highway maps for Ogle (12/79) and Winnebago (12/80) counties.

0 2 4

SCALE - MILES

FIGURE 5-1
BYRON NUCLEAR GENERATING STATION
EVACUATION ROAD NETWORK

SECTION 6

EVACUATION TIME ESTIMATES

6.1 GENERAL PUBLIC EVACUATION TIMES

Evacuation time estimates for the general public, including mobilization and travel times, were calculated using the NETVAC2 model for the various combinations of the ten evacuation study areas that are discussed in Section 2. Each of the ten primary evacuation zones was analyzed for four population combinations associated with summer and winter, day and night times, and normal and adverse weather conditions. Thus, a total of eighty evacuation scenarios was considered in this evacuation time estimate study. Tables 6-1 and 6-2 present the evacuation time estimates for these NETVAC2 calculations for each primary evacuation zone.

The NETVAC 2 model results show that the summer and winter evacuation time estimates for all primary evacuation zones do not differ significantly. Under normal weather conditions, evacuation of the full EPZ takes 191 minutes for the daytime scenario and 106 to 108 minutes for the nighttime scenario. For adverse weather conditions the evacuation time estimates are 225 minutes during the day, and 113 to 114 minutes at night for the full EPZ scenario.

During normal weather conditions, the evacuation times for the 0-10 mile evacuation zones are 191 minutes during the daytime and range from 106 to 108 minutes for the nighttime condition. The adverse weather time estimates are 225 minutes during the daytime and range from 113 to 114 minutes at night.

The evacuation time estimates for the four 0-5 mile evacuation zones in normal weather for the daytime range from 184 minutes to 191 minutes, and for the nighttime evacuation range from 96 to 105 minutes. The adverse weather condition evacuation time estimates for the four 0-5 mile evacuation zones during the day range from 216 minutes to 225 minutes, and at night range from 105 to 113 minutes. The evacuation time estimates for the 0-2 mile evacuation zone are only a few minutes less than those for the 0-5 mile zones.

For the eighty baseline evacuation scenarios, the NETVAC2 model results indicate that there would be no queuing (backup) on the evacuation road network during summer or winter, daytime or nighttime evacuations in either normal or adverse weather conditions. Consequently, the total times estimated for evacuation are only slighty longer than the total public response times.

6.2 SELECTED SPECIAL FACILITIES EVACUATION TIMES

Evacuation time estimates and feasibility analyses for selected special facilities in the Byron Station EPZ are presented in Annex A.

6.3 SPECIAL EVENTS EVACUATION TIMES

Special Event evacuation times were analyzed for: Autumn on Parade, which takes place in the Byron EPZ once a year in October; concurrent peak attendance racing events at the Byron Dragway and the Moto Sports Park which could occur on a weekend during the summer; and a special evacuation senstivity analysis of transient populations at the recreational areas within the EPZ on a summer holiday to determine the sensitivity of the evacuation time estimate to recreational area populations, as discussed in Section 3.4.

The results of the Special Event evacuation simulation for Autumn on Parade produced an estimated evacuation time of 191 minutes, which is identical to the evacuation time for the full EPZ winter day, normal weather general population scenario. These results demonstrate the adequacy of the Byron vicinity's roadway network capacity.

The special event peak attendance evacuation simulation for 15,000 visitors at Byron Dragway and 10,000 visitors at Moto Sports Park results in a total evacuation time of 241 minutes, which is 50 minutes greater than the full EPZ summer day, normal weather general population scenario. As discussed in Section 4.3, this analysis assumed a traffic control point at the intersection of River and German Church Roads.

The results of the special evacuation sensitivity analysis of transient populations at the recreational areas within the EPZ produced an evacuation time of 201 minutes, which is only 10 minutes longer than the estimated evacuation time for the full EPZ summer day, normal weather general population scenario.

It is important to note that, due to the favorable roadway capacity to population ratio, the evacuation time estimates are relatively insensitive to changes in population.

6.4 EVACUATION CONFIRMATION TIMES

Evacuation confirmation time, as defined by NUREG 0654, is the time required for emergency service vehicles to traverse the roads within the primary evacuation zones, and to confirm that all persons desiring to evacuate have done so. The evacuation confirmation times have been estimated by assuming that emergency service vehicles will drive the evacuated areas, road by road, at 6 miles per hour. This speed allows for the effective use of public address systems. This speed is about twice the walking speed of an adult.[11] Based upon discussions with State of Illinois ESDA personnel, at least 15 vehicles were deemed to be available for confirmation of evacuation. Accordingly, that number of vehicles was assumed for this study. The time estimates for evacuation confirmation are presented in Table 6-3.

TABLE 6-1

SUMMARY OF EVACUATION TIME ESTIMATES

SUMMER

Primary Evacuation Zone (1)	Population (2)		Vehicles		General Public Evacuation Times (minutes)(3)			
					Daytime		Nighttime	
	Daytime	Nighttime	Daytime	Nighttime	Normal	Adverse	Normal	Adverse
0-2 mile A,B	10,257	2,057	4,791	789	184	216	96	105
0-5 mile A,B,C	16,972	6,971	7,417	2,532	188	223	105(5)	113(5)
0-5 mile A,B,D	10,649	2,449	4,925	923	184	216	96	105
0-5 mile A,B,E	19,027	7,147	7,930	2,634	191	225	105	110
0-5 mile A,B,F	10,749	2,409	4,974	910	184	216	96	105
0-10 mile A-F,G	31,362	17,241	12,474	6,143	191	225	108(5)	114(5)
0-10 mile A-F,H	28,856	15,010	11,657	5,403	191	225	107	114
0-10 mile A-F,I	35,040	19,265	14,148	6,880	191	225	107(6)	114(6)
0-10 mile A-F,J	29,059	15,238	11,732	5,491	191	225	107	114
Full EPZ A-J (4)	44,439	28,339	17,392	10,021	191	225	108(7)	114(7)

NOTES:

(1) See Figure 2-1 for evacuation study area locations.

(2) Population is composed of permanent population and applicable transient and special facilities populations as discussed in Section 3.1.

(3) All times have been rounded to nearest minute.

(4) See footnote (5) on Table 1-1.

(5) The Quality Metal Finishing Co. in Byron has an estimated shutdown time of 90 minutes. Consequently, the nighttime evacuation time estimate for those employees needed to shut down the facility could increase to 125 and 135 minutes for normal and adverse weather conditions, respectively.

(6) The Acme Resin Co. outside Oregon has an estimated shutdown time of 120 minutes. Consequently, the nighttime evacuation time estimate for those employees needed to shut down the facility could increase to 145 and 155 minutes for normal and adverse weather conditions, respectively.
The Pine Crest Nursing Home in Mt. Morris has a facility mobilization time of 120 minutes. Consequently, the nighttime evacuation time estimate for this facility could increase to 140 and 142 minutes, respectively.

(7) As discussed in notes 5 and 6 above, the Acme Resin Co., Quality Metal Finishing Co. and Pine Crest Nursing Home may have longer evacuation times than estimated for the general public. The nighttime evacuation time estimates for these facilities may increase to 125-145 minutes during normal weather conditions and 135-155 minutes during adverse weather conditions.

TABLE 6-2

SUMMARY OF EVACUATION TIME ESTIMATES

WINTER

Primary Evacuation Zone (1)	Population (2)		Vehicles		General Public Evacuation Times (minutes)(3)			
					Daytime		Nighttime	
	Daytime	Nighttime	Daytime	Nighttime	Normal	Adverse	Normal	Adverse
0-2 mile A,B	4,257	1,457	1,988	588	184	216	96	105
0-5 mile A,B,C	8,971	4,871	3,563	1,857	188	223	105(5)	113(5)
0-5 mile A,B,D	4,649	1,849	2,122	722	184	216	96	105
0-5 mile A,B,E	11,883	6,402	4,489	2,389	191	224	105	110
0-5 mile A,B,F	4,709	1,809	2,159	709	191	216	96	105
0-10 mile A-F,G	22,964	14,846	7,955	5,416	191	225	106(5)	113(5)
0-10 mile A-F,H	19,621	12,590	7,095	4,627	191	225	106	113
0-10 mile A-F,I	24,248	15,565	9,015	5,771	191	225	106(6)	113(6)
0-10 mile A-F,J	20,296	12,993	7,255	4,772	191	225	106	113
Full EPZ A-J(4)	34,806	24,314	12,213	8,847	191	225	106(7)	113(7)

NOTES:

(1) See Figure 2-1 for evacuation study area locations.
(2) Population is composed of permanent population and applicable transient and special facilities populations as discussed in Section 3.2.
(3) All times have been rounded to nearest minute.
(4) See footnote (5) on Table 1-1.
(5) The Quality Metal Finishing Co. in Byron has an estimated shutdown time of 90 minutes. Consequently, the nighttime evacuation time estimate for those employees needed to shut down the facility could increase to 125 and 135 minutes for normal and adverse weather conditions, respectively.
(6) The Acme Resin Co. outside Oregon has an estimated shutdown time of 120 minutes. Consequently, the nighttime evacuation time estimate for those employees needed to shut down the facility could increase to 145 and 155 minutes for normal and adverse weather conditions, respectively.
The Pine Crest Nursing Home in Mt. Morris has a facility mobilization time of 120 minutes. Consequently, the nighttime evacuation time estimate for this facility could increase to 140 and 142 minutes, respectively.
(7) As discussed in notes 5 and 6 above, the Acme Resin Co., Quality Metal Finishing Co. and Pine Crest Nursing Home may have longer evacuation times than estimated for the general public. The nighttime evacuation time estimates for these facilities may increase to 125-145 minutes during normal weather conditions and 135-155 minutes during adverse weather conditions.

TABLE 6-3

EVACUATION CONFIRMATION TIMES BY
PRIMARY EVACUATION ZONE(1)

Primary Evacuation Zone (2)	Evacuation Confirmation Time (3)
0-2 mile A, B	17
0-5 mile A, B, C	38
0-5 mile A, B, D	30
0-5 mile A, B, E	38
0-5 mile A, B, F	35
0-10 mile A-F, G	157
0-10 mile A-F, H	161
0-10 mile A-F, I	152
0-10 mile A-F, J	152
Full EPZ A-J(4)	349

NOTES:

(1) Evacuation confirmation times are required by NUREG-0654, Appendix 4.

(2) See Figure 2-1 for evacuation study area locations which comprise the primary evacuation zones.

(3) Evacuation confirmation times are rounded to the nearest minute.

(4) See footnote (5) on Table 1-1.

SECTION 7

CONCLUSIONS AND RECOMMENDATIONS

Based upon this evacuation time estimate study, the entire population within the plume exposure pathway EPZ for Byron Station (including the general public and special facilities) could be evacuated in 3 to 4 hours. Except as noted in the following paragraph, the longest daytime evacuation time estimate for the EPZ in normal weather is 191 minutes; the longest daytime adverse weather evacuation time estimate for the EPZ is 225 minutes. The longest nighttime evacuation time estimate for the EPZ in normal weather is 108 minutes; the longest nighttime adverse weather evacuation time estimate for the EPZ is 114 minutes. The nighttime evacuation time estimates for Pine Crest Nursing Home, the Acme Resin Co. and the Quality Metal Finishing Co. could increase to between 125 and 145 minutes during normal weather conditions and to between 135 and 155 minutes under adverse weather conditions.

For the eighty baseline evacuation scenarios, the NETVAC2 model results indicate that there would be no queuing (backup) on the evacuation road network during summer or winter, daytime or nighttime evacuations in either normal or adverse weather conditions. For the Special Event evacuation scenarios, the NETVAC2 model results indicate that there would be only one location in which queuing in the evacuation road network could affect the evacuation time estimates. Specifically, the Special Event evacuation simulation of concurrent large weekend events at the Byron Dragway and Moto Sports Park indicates queuing along German Church Road south of the town of Byron including the intersection of

Route 72, River Road, and German Church Road. Accordingly, CECo is recommending to Ogle County emergency planning officials that they consider giving this intersection priority traffic control during an emergency should peak activities at the Byron Dragway and the Moto Sports Park occur simultaneously. This will result in an estimated evacuation time of 241 minutes for this scenario.

The conclusions and recommendations of this study have been provided to Ogle County and State of Illinois Emergency Services and Disaster Agency officials.

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APPENDIX A

NETVAC2 DESCRIPTION

APPENDIX A

NETVAC2 DESCRIPTION

This Appendix describes the general structure of the NETVAC2 Model and three of its major features: the dynamic route selection, the priority treatment of flow at unsignalized intersections, and the capacity calculation.

General Structure

NETVAC2 is organized in four basic units (procedures): the main program, the data procedure, the preprocessor, and the simulator. This section briefly explains the functions of each of these units. The main program controls the entire execution. It starts by calling on the data procedure, which reads in the data and execution instructions, then calls in the preprocessor, which performs some preliminary capacity calculations. Next, the main program controls the simulation itself and the reporting of the network conditions at specified intervals including the plotting. This program also controls the rest of the reports and the length of the simulation by terminating the program once the network is empty (or after a specified time).

The data procedure reads in the network, the parameters and the options to be used in the run. This subroutine uses a special list processing technique to store the network; the link list is stored with both forward and backward pointers. In other words, all the links pointing into and out of any given node can be easily identified at any moment

during the simulation. This list processing technique is one of the keys to the model's computational efficiency.

On request, the data procedure performs a set of checks on the network to ensure connectivity and validity. It also performs a set of checks on the input data to identify coding errors. It is expected that these checks would be performed only once for each site studied. If errors are found, the routine keeps scanning the network until it has been completely checked and the run is then terminated. The data procedure also produces a set of warnings if unlikely (but possible) situations are encountered.

The processor procedure converts the physical description of each link into measures of capacity, speed and density. For each specified type of link, the preprocessor computes two types of capacity:

- section capacity - which is the capacity along the link regardless of downstream intersection restrictions; and
- approach capacity - which is the capacity of the link to handle vehicles approaching the downstream intersection.

Section capacities are associated with highway sections whereas the traffic flow through intersections is controlled by the approach capacity. NETVAC2 computes both capacities since they serve different purposes. The section capacity serves as an upper bound on the flow that can move along a link, restricting the number of vehicles that will

reach the intersection during a simulation interval and the number of vehicles that can be loaded onto a link from the intersection. The approach capacity, on the other hand, limits the number of cars that can actually move through the intersection. Vehicles that reach the intersection but cannot move through it are assigned to a queue.

The NETVAC2 simulator includes two separate procedures, the link pass and the node pass. The link pass handles the flow on the links while the node pass handles the transfer of flow from link to link.

Dynamic Route Selection

NETVAC2 does not use a pre-specified set of turning movements at each intersection; instead, the turning movements are determined at each simulation interval as a function of the changing traffic conditions and direction of the links. Drivers approaching an intersection are assumed to make a choice of outbound (away from the intersection) links based on how fast this outbound link can get them to safety. This, in turn, is a function of the direction of the outbound links (away from the nuclear plant or hazard area) and the traffic conditions on the outbound links.

The route selection procedure used in NETVAC2 reflects the two above-mentioned choice criteria through a user-supplied "preference factor" which is specified for each link and the speeds on each of the outbound links. To facilitate the explanation of the route choice mechanism, let PF_j denote the preference factor for the j-th outbound link at some intersection. In other words, the relative 'a priori'

preference of link j is $PF_{jk}xPF_k$ where the sum goes over all the links emanating out of the node under consideration (including j). The choice probability, or the share of drivers choosing an outbound link j out of a given intersection at (simulated) time t, $P_j(t)$, is determined as a function of the preference factors and the speeds on all the outbound links are:

$$P_j(t) = \frac{PF_j \times U_j(t)}{\Sigma_k PF_k \times U_k(t)}$$

where $U_j(t)$ is the speed on link j at time t. Note that driver behavior during an evacuation is assumed to be myopic in that only information regarding the immediate outbound links at each intersection is assumed to influence route choice decisions. Also note that the $P_j(t)$s are computed for each incoming link separately due to turning prohibitions from some links into some other links (a reference to the incoming link was omitted from the notation of the choice probability for clarity of exposition).

The Priority Treatment

Even under evacuation conditions, it can be expected that traffic from certain links approaching an unsignalized intersection would have the right of way over incoming traffic from lower priority approaches. Since it is not clear that such priority would correspond to the existing intersection controls, the input to NETVAC2 includes a

user-specified link priority parameter. This is a binary parameter indicating primary or secondary priority of a link.

The volume of vehicles being processed (at every intersection and at each simulation interval) and transferred from inbound to outbound links is subject to several constraints which determine the effective capacity of the intersection. During the simulation, traffic coming in from all primary priority links is assigned to the intersection first, subject only to the intersection capacity constraints. Lower priority traffic, on the other hand, is restricted by both the capacity of the intersection and the effect of the higher priority traffic.

The capacity of the secondary priority approaches is a function of the gap acceptance behavior of the minor approach drivers and the headway distribution in the primary approaches' flow. To model the capacity of secondary priority approaches, a capacity allocation problem procedure is utilized. The secondary priority approaches emit traffic only under one of the following conditions: first, if there is residual intersection capacity from the primary priority traffic, flow can be emitted into the intersection from the secondary priority road subject to the residual capacity constraint. Second, if the residual capacity is zero, NETVAC2 provides some small capacity for the lower priority approaches to allow for "sneak-in" effects.

Note that the priority treatment applies only to unsignalized intersections and that both types of approaches (primary and secondary

priority) are treated identically in the model in all respects except for the added constraint on the flow from secondary priority approaches.

Capacity Calculations

The capacity of a transportation facility is the maximum flow that can go through the facility. NETVAC2 determines capacity in two stages: first, the preprocessor assigns a section capacity and an approach capacity to each link in the network. Second, approach capacities are updated throughout the simulation depending on the conditions at certain points in the simulation.

The capacity calculations are based on the Highway Research Board's Highway Capacity Manual (HCM). Following this reference, the section capacity is calculated in the preprocessor for links with and without physical separation between opposing directions while the approach capacity is calculated as a function of the physical conditions (width, parking, turning pockets, etc.), environmental conditions (area type, peak hour and load factors), traffic characteristics (traffic mix and percentage of turning movements), and approach type. Derivations of these calculations are outlined in the users manual for the model.

As mentioned before, the approach capacities calculated in the preprocessor are not the actual bounds on the flow. NETVAC2 adjusts the approach capacity continuously in order to reflect the changing vehicular movements resulting from the dynamic route selection. The

capacity of the i^{-th} approach coming into an intersection at simulation interval t, $C_i(t)$ is given by:

$$C_i(t) = C_i \times AL(t) \times AR(t)$$

where C_i is the standard capacity of link i calculated by the preprocessor and AL(t) and AR(t) are the correction factors for left and right turning movements, respectively. These correction factors are a function of the percent of turning traffic, the approach width, and parking allowance, as suggested by the HCM. These factors do not apply when the turning traffic is using special turning lanes or turning pockets.

APPENDIX B

EVACUATION NETWORK NODE IDENTIFICATION

APPENDIX B

EVACUATION NETWORK NODE IDENTIFICATION

Node	Location
5	Rte. 64 & Church Rd.
6*	Rte. 64 & Meridian Rd.
7*	Lindenwood Rd. & Meridian Rd.
8*	Church Rd. & Lindenwood Rd.
11*	Holcomb Rd. & Church Rd.
12*	Holcomb Rd. & Meridian Rd.
13*	Rte. 72 & Meridian Rd.
14	Rte. 72 & Rothwell Rd.
15	Rte. 72 (Chicago St.) & Rte. 51
16	Rte. 72 & Stillman Rd.
17*	Stillman Rd. & Holcomb Rd. (east of Stillman Rd.)
18*	Stillman Rd. & Holcomb Rd. (west of Stillman Rd.)
19*	Holcomb Rd. & German Church Rd.
20*	Hill St., Seventh St. & Pine St.
21*	Rte. 64 & German Church Rd.
22*	Rte. 64 & Chana Rd.
23*	Chana Rd. & Brick Rd.
24*	Brick Rd. & Stillman Rd.
28*	Daysville Rd., Honey Creek Rd. & Lowden Rd.
29*	Rte. 64 & Daysville Rd.
30	Rte. 64 & River Rd.
31	Rte. 64 (Washington St.) & Third St.
32*	Third St. & Gale St.

Node	Location
33*	Gale St. & Rte. 2 (Fourth St.)
34	Rte. 2 (Fourth St.) & Rte. 64 (Washington St.)
35*	Rte. 64 & Monroe St.
36*	Rte. 64 & Ridge Rd.
37*	Ridge Rd. & Oregon Trail
38*	Pines Rd. & Ridge Rd. (east of Ridge Rd.)
39*	Pines Rd. & Ridge Rd. (west of Ridge Rd.)
41*	Brayton Rd. & S. McKendrie Ave.
42	N. McKendrie Ave. & Rte. 64 (E. Hitt St.)
43*	Rte. 64 (E. Hitt St.) & Ogle Ave.
44*	Mt. Morris Rd. & West Grove Rd.
45*	West Grove Rd. & Leaf River Rd.
46*	Rte. 2 & Mud Creek Rd.
47*	Rte. 72 & Mt. Morris Rd.
49*	Rte. 72 & Main St.
50*	Rte. 72 & Pecatonica Rd.
51*	Rte. 2 & Rte. 72
52*	Rte. 2 (Main St.) & Tower Rd.
53*	Second St. & Tower Rd.
54	Union St. & Rte. 2 (Main St.)
55*	Second St. & Union St.
56*	Tower Rd. & Mill Rd. (east of Tower Rd.)
57*	Tower Rd. & Mill Rd.

Node	Location
58*	Montague Rd. & Tower Rd.
59*	Pecatonica Rd. & Montague Rd.
62*	Rte. 72, German Church Rd. & River Rd.
63*	Rte. 72 & Kishwaukee Rd.
64*	Rte. 2 & Kennedy Hill Rd.
65*	Kennedy Hill Rd. & McGregor Rd.
66*	McGregor Rd. & Meridian Rd.
67*	Rte. 2 & Meridian Rd.
68*	Meridian Rd. & Kishwaukee Rd.
69*	Stillman Valley Rd. & Meridian Rd.
74	Montague Rd. & Osborne Rd.
75*	Westfield Rd., Kennedy Hill Rd. & Montague Rd.
86*	Stillman Valley Rd. & Rothwell Rd.
88	Rte. 64, 1 block north of Monroe St.
89	Rte. 2 (Fourth St.) & Ford St.
90*	Jackson St., between Rte. 2 & Rte. 64
91*	Rte. 2 & Camling Rd.
92*	Rte. 72 & Junction Rd.
93*	Rte. 2 & Castle Rd.
94*	Rte. 64 (W. Hitt St.) & S. Reynolds Ave.
103*	Rte. 64 & White Rock Rd.
104	Lindenwood Rd. & Stillman Valley Rd.
105*	Brick Rd. & German Church Rd.

Node	Location
106*	Honey Creek Rd. & Chana Rd.
107*	Daysville Rd. (Daysville North City Limits)
108*	River Rd. & Park Rd.
109*	River Rd. & Spring Creek Rd.
110*	River Rd. & Devil's Lane
111*	River Rd. & Razorville Rd.
112*	River Rd. & Byron Dragway Entrance
113*	Ash Rd. & German Church Rd.
114*	German Church Rd. & N. Site Access Rd.
115*	German Church Rd. & S. Site Access Rd.
116*	Rte. 72 & Bradley St.
117*	Stillman Rd. & Valley Dr.
118*	Rte. 72 & Armour Rd.
120*	Holcomb Rd. & Junction Rd.
121	Rothwell Rd. & Edson Rd.
122	Tower Rd. & Byron High School Entrance
124*	Mt. Morris Rd. & Midtown Rd.
125	West Grove Rd. & Adeline Rd.
129*	Kendall Rd. & Montague Rd.
801**	Rte. 51, north of Utility Rd.
802**	Rte. 72, west of Blackwood Rd.
803**	Rte. 51 & Big Mound Rd.
804**	Rte. 51 & Holcomb Rd.

Node	Location
805**	Rte. 51 & Lindenwood Rd.
806**	Rte. 64 & First St.
807**	Chana Rd. & Flagg Rd.
808**	Flagg Rd. & Daysville Rd.
809**	Hay Rd. & Lowden Rd.
810**	Rte. 2, north of Nashua Township line
811**	Ridge Rd. & Henry Rd.
812**	Pines Rd. & Columbian Rd.
813**	Canada Rd. & Lowell Park
814**	Rte. 64, east of Maple Grove Rd.
815**	West Grove Rd., east of Cedar Rd.
816**	Rte. 72, east of Adeline Rd.
817**	Egan Rd. & Leaf River Rd.
818**	Spielman Rd. & Montague Rd.
819**	Pecatonica Rd., south of Murphy Rd.
820**	Osborne Rd., south of Edwardsville Rd.
821**	Westfield Rd., south of Edwardsville Rd.
822**	Severson Rd. & Montague Rd.
823**	Meridian Rd., south of Tipple Rd.
824**	Rte. 2 & Prairie Rd.
825**	Kishwaukee Rd. & Stillman Valley Rd.

* Utilized as a vehicle entry node.

** Utilized as a vehicle exit node located outside the EPZ.

APPENDIX C

NETVAC2 COMPUTER OUTPUT

APPENDIX C

KEY TO NETVAC2 COMPUTER PRINTOUT

LINK = Link identification number

FRM = Upstream node number (A-node) for associated link

TO = Downstream node number (B-node) for associated link

LEN = Link length in feet (A-node to B-node)

AW = Approach width in feet

LW = Link lane width in feet

SW = Lateral clearance or shoulder width in feet = Distance from edge of travel-way to obstructions along link midblock

L = Number of lanes in direction of travel

PR = Priority of movement along link, in reference to movement along intersecting links. Dominant or major link approaches are classified as Priority 1. Secondary (i.e., those link approaches controlled by stop signs, yield signs, etc.) approaches are generally classified as Priority 2.

LT = Lane type, classified as follows:

1 - One-way, no parking
2 - One-way, parking on one side
3 - One-way, parking on both sides
4 - Two way, no parking
5 - Two-way, with parking
6 - Rural divided highway, no parking
7 - Rural undivided highway, no parking
8 - Freeways and expressways

AT = Area type, classified as follows:

1 - Central business district
2 - Fringe
3 - Outer business district
4 - Residential

PK = T - Parking along link permitted
F - Parking along link prohibited

SPD = Free-flow or average speed over link in miles per hour

JAM = Jam Density or relative measure of link's carrying capacity in vehicles per mile

PRF = User preference or movement along each outbound link in terms of percentage. Preferences are initially assigned based upon free-flow conditions. Actual route assignments are calculated by the program, considering the assigned preferences as well as speed, density and capacity relationships.

FCAP = Link capacity per lane

STR SPLT CAP
= Identifies node destination of straight movement from downstream node, and associated percent green signal time (split) and intersection capacity.

RGT SPLT CAP
= Identifies node destination of right-turn movement from downstream node, and associated percent green signal time and special turning lane capacity, if applicable.

LFT SPLT CAP
= Identifies node destination of left-turn movement from downstream node, and associated percent green signal time and special turning lane capacity, if applicable.

DIAG SPLT CAP
= Identifies node destination of diagonal movement from downstream node, and associated percent green signal time and capacity.

NETWORK LISTING

LINK	FRM	TO	LEN	AM	LM	SM	L	PR	LT	AT	PK	SPD	JAM	PRF	FCAP	STR	SPLT	CAP	RGT	SPLT	CAP	LFT	SPLT	CAP	DIAG	SPLT	CAP
1	5	806	2690.	12.	11.	6.	1	1	7	4	F	44.	147.	1.00	1600.	0	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
2	6	103	10032.	11.	11.	6.	1	1	7	4	F	44.	147.	1.00	1600.	5	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
3	7	8	16500.	10.	9.	6.	1	1	7	4	F	40.	123.	0.90	1232.	805	0.0	1120.	5	0.0	0.	11	0.0	0.	0	0.0	0.
4		6	10560.	9.	9.	6.	1	1	7	4	F	36.	137.	0.10	1232.	0	0.0	1030.	0	0.0	0.	103	0.0	0.	0	0.0	0.
5	8	5	12672.	9.	9.	2.	1	2	7	4	F	40.	117.	0.05	1168.	0	0.0	1030.	0	0.0	0.	806	0.0	0.	0	0.0	0.
6		805	13200.	9.	9.	4.	1	1	7	4	F	32.	150.	0.90	1200.	0	0.0	1030.	0	0.0	0.	0	0.0	0.	0	0.0	0.
7		11	8448.	9.	10.	6.	1	1	7	4	F	32.	178.	0.05	1424.	0	0.0	1030.	120	0.0	0.	0	0.0	0.	0	0.0	0.
8	11	120	5280.	9.	10.	6.	1	1	7	4	F	32.	178.	1.00	1424.	804	0.0	1030.	0	0.0	0.	0	0.0	0.	0	0.0	0.
9	12	7	10560.	9.	9.	4.	1	1	7	4	F	36.	133.	0.05	1200.	6	0.0	1030.	0	0.0	0.	8	0.0	0.	0	0.0	0.
10		11	15840.	9.	10.	2.	1	1	7	4	F	36.	151.	0.90	1360.	120	0.0	1030.	0	0.0	0.	0	0.0	0.	0	0.0	0.
11		13	15840.	9.	9.	4.	1	1	7	4	F	36.	133.	0.05	1200.	0	0.0	1030.	118	0.0	0.	0	0.0	0.	0	0.0	0.
12	13	118	5280.	12.	12.	4.	1	1	7	4	F	24.	293.	1.00	1600.	14	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
13	14	121	16896.	9.	9.	6.	1	1	7	4	F	32.	154.	0.05	1232.	86	0.0	1030.	0	0.0	0.	0	0.0	0.	0	0.0	0.
143		92	13200.	12.	12.	1.	1	1	7	4	F	44.	156.	0.95	1600.	15	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
14	15	801	5000.	12.	12.	6.	1	1	8	4	F	44.	145.	0.40	1600.	0	0.0	1600.	0	0.0	0.	0	0.0	0.	0	0.0	0.
15		802	5000.	10.	10.	6.	1	1	7	4	F	40.	142.	0.20	1424.	0	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
16		803	5000.	12.	12.	6.	1	1	8	4	F	44.	145.	0.40	1600.	0	0.0	1600.	0	0.0	0.	0	0.0	0.	0	0.0	0.
17	16	13	3168.	12.	12.	6.	1	1	7	4	F	24.	299.	0.75	1600.	118	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
18		69	14256.	9.	11.	2.	1	1	7	4	F	36.	172.	0.25	1552.	86	0.0	1030.	0	0.0	0.	68	0.0	0.	0	0.0	0.
19	17	12	10032.	10.	10.	2.	1	1	7	4	F	36.	151.	0.75	1360.	11	0.0	1120.	7	0.0	0.	0	0.0	0.	0	0.0	0.
20		117	19008.	11.	11.	6.	1	1	7	4	F	44.	147.	0.25	1600.	18	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
21	18	17	1056.	10.	10.	6.	1	1	7	4	F	40.	142.	0.75	1424.	117	0.0	1120.	12	0.0	0.	0	0.0	0.	0	0.0	0.
132		104	11560.	11.	11.	6.	1	1	7	4	F	40.	162.	0.25	1600.	24	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
22	19	18	18216.	10.	9.	4.	1	1	7	4	F	40.	120.	0.25	1200.	0	0.0	1120.	104	0.0	0.	17	0.0	0.	0	0.0	0.
23		105	13464.	12.	10.	6.	1	1	7	4	F	32.	178.	0.75	1424.	21	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
24	20	38	18480.	10.	10.	6.	1	1	7	4	F	32.	178.	0.10	1424.	0	0.0	1120.	0	0.0	0.	39	0.0	0.	0	0.0	0.
145		93	15840.	14.	12.	6.	1	1	7	4	F	32.	224.	0.90	1600.	810	0.0	1478.	0	0.0	0.	0	0.0	0.	0	0.0	0.
25	21	29	9240.	11.	12.	6.	1	1	7	4	F	44.	163.	0.20	1600.	30	0.0	1210.	0	0.0	0.	107	0.0	0.	0	0.0	0.
26		22	17424.	11.	12.	6.	1	1	7	4	F	44.	163.	0.80	1600.	6	0.0	1210.	106	0.0	0.	0	0.0	0.	0	0.0	0.
27	22	6	13464.	11.	11.	2.	1	1	7	4	F	44.	141.	0.90	1552.	103	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
28		106	7920.	10.	10.	6.	1	1	7	4	F	44.	129.	0.10	1424.	807	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
29	23	22	7128.	11.	11.	2.	1	1	7	4	F	36.	172.	1.00	1552.	106	0.0	1210.	0	0.0	0.	6	0.0	0.	0	0.0	0.
30	24	23	4224.	9.	9.	6.	1	1	7	4	F	32.	154.	1.00	1232.	0	0.0	1030.	0	0.0	0.	22	0.0	0.	0	0.0	0.
31	28	808	22176.	11.	11.	6.	1	1	7	4	F	44.	147.	0.50	1600.	0	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
32		809	19270.	10.	10.	4.	1	1	7	4	F	24.	232.	0.50	1392.	0	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
33	29	30	1584.	15.	11.	6.	1	1	7	4	F	36.	180.	0.45	1600.	31	0.0	1568.	0	0.0	0.	0	0.0	0.	0	0.0	0.
34		21	8976.	11.	12.	6.	1	1	7	4	F	44.	163.	0.45	1600.	22	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
35		107	8976.	11.	12.	1.	1	1	7	4	F	40.	171.	0.10	1600.	28	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
36	30	29	1584.	10.	11.	6.	1	1	7	4	F	36.	180.	0.05	1600.	21	0.0	1120.	107	0.0	0.	0	0.0	0.	0	0.0	0.
37		31	1320.	13.	13.	1.	2	1	4	3	F	36.	178.	0.95	1600.	34	0.57	543.	0	0.0	0.	32	0.57	960.	0	0.0	0.
38	31	32	2640.	16.	12.	3.	1	1	5	3	T	24.	259.	0.05	1552.	0	0.0	940.	33	0.0	0.	0	0.0	0.	0	0.0	0.
39		34	1056.	11.	12.	2.	2	1	4	3	F	24.	256.	0.95	1536.	35	0.44	448.	0	0.0	0.	33	0.44	960.	0	0.0	0.
40	32	31	2640.	22.	12.	3.	1	1	5	3	T	24.	259.	0.05	1552.	0	0.0	1330.	0	0.0	0.	34	0.43	960.	0	0.0	0.
41		33	1320.	17.	12.	3.	1	1	4	3	F	20.	310.	0.95	1552.	0	0.0	1465.	34	0.0	0.	20	0.0	0.	0	0.0	0.
42	33	34	2640.	12.	12.	5.	1	1	4	3	F	32.	198.	0.05	1504.	0	0.0	990.	0	0.0	0.	35	0.56	960.	0	0.0	0.
43		20	1530.	13.	13.	6.	1	1	7	4	F	32.	246.	0.95	1600.	93	0.0	1389.	38	0.0	0.	0	0.0	0.	0	0.0	0.
44	34	33	2640.	16.	12.	5.	1	1	4	3	F	32.	198.	0.10	1504.	20	0.0	1370.	0	0.0	0.	0	0.0	0.	0	0.0	0.
45		35	2640.	11.	12.	6.	1	1	7	4	F	32.	224.	0.90	1600.	88	0.0	1210.	0	0.0	0.	37	0.0	0.	0	0.0	0.
46	35	37	17160.	10.	12.	6.	1	1	7	4	F	40.	179.	0.10	1600.	0	0.0	1120.	0	0.0	0.	38	0.0	0.	0	0.0	0.
138		69	2640.	12.	12.	6.	1	1	7	4	F	44.	163.	0.90	1600.	36	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.

LINK	FRN	TO	LEN	AN	LN	SN	L	PR	LT	AT	PK	SPD	JAM	PRF	FCAP	STR	SPLT	CAP	RGT	SPLT	CAP	LFT	SPLT	CAP	DIAG	SPLT	CAP
47	36	37	10032.	10.	9.	6.	1	1	7	4	F	36.	137.	0.05	1232.	38	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
48		43	7920.	12.	12.	6.	1	1	7	4	F	32.	224.	0.95	1600.	42	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
49	37	38	6600.	10.	11.	6.	1	1	7	4	F	36.	180.	1.00	1600.	39	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
50	38	39	2640.	10.	10.	1.	1	1	7	4	F	40.	134.	1.00	1344.	811	0.0	1120.	812	0.0	0.	0	0.0	0.	0	0.0	0.
51	39	812	10560.	12.	10.	4.	1	1	7	4	F	40.	139.	0.50	1392.	0	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
52		811	10560.	10.	10.	6.	1	1	7	4	F	40.	142.	0.50	1424.	0	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
53	41	813	15840.	11.	11.	1.	1	1	7	4	F	32.	192.	0.25	1536.	0	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
54		42	1840.	16.	12.	6.	1	2	7	4	F	24.	299.	0.75	1600.	124	0.0	1600.	0	0.0	0.	94	0.0	0.	0	0.0	0.
55	42	124	7920.	11.	12.	6.	1	1	7	4	F	36.	199.	0.05	1600.	44	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
147		94	1840.	15.	13.	6.	1	1	7	4	F	36.	219.	0.95	1600.	814	0.0	1568.	0	0.0	0.	0	0.0	0.	0	0.0	0.
56	43	42	1056.	15.	12.	6.	1	1	7	4	F	24.	299.	1.00	1600.	94	0.0	1568.	124	0.0	0.	0	0.0	0.	0	0.0	0.
57	44	47	10560.	12.	12.	5.	1	1	7	4	F	40.	178.	0.50	1600.	0	0.0	1299.	0	0.0	0.	816	0.0	0.	0	0.0	0.
58		125	10560.	10.	10.	6.	1	1	7	4	F	40.	142.	0.50	1424.	815	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
59	45	44	7656.	12.	10.	6.	1	1	7	4	F	40.	142.	0.50	1424.	125	0.0	1299.	47	0.0	0.	0	0.0	0.	0	0.0	0.
60		49	11880.	12.	10.	6.	1	1	7	4	F	40.	142.	0.50	1424.	817	0.0	1299.	0	0.0	0.	47	0.0	0.	0	0.0	0.
61	46	43	21648.	14.	11.	6.	1	1	7	4	F	44.	147.	0.75	1600.	42	0.0	1478.	0	0.0	0.	0	0.0	0.	0	0.0	0.
136		89	10560.	15.	12.	2.	1	1	4	3	F	44.	140.	0.25	1536.	34	0.0	1275.	0	0.0	0.	0	0.0	0.	0	0.0	0.
62	47	816	10560.	12.	12.	6.	1	1	7	4	F	44.	163.	1.00	1600.	0	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
63	49	47	8448.	12.	11.	6.	1	1	7	4	F	32.	202.	0.90	1600.	816	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
64		817	22968.	12.	11.	6.	1	1	7	4	F	32.	202.	0.05	1600.	0	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
65		45	11880.	10.	10.	6.	1	1	7	4	F	40.	142.	0.05	1424.	0	0.0	1120.	44	0.0	0.	0	0.0	0.	0	0.0	0.
66	50	59	26400.	11.	12.	6.	1	1	7	4	F	44.	163.	0.05	1600.	819	0.0	1210.	0	0.0	0.	818	0.0	0.	0	0.0	0.
67		49	13200.	12.	12.	6.	1	1	7	4	F	36.	199.	0.95	1600.	47	0.0	1299.	817	0.0	0.	45	0.0	0.	0	0.0	0.
68	51	50	21120.	12.	12.	6.	1	1	7	4	F	44.	163.	0.75	1600.	49	0.0	1299.	59	0.0	0.	0	0.0	0.	0	0.0	0.
134		91	15680.	13.	11.	2.	1	1	7	4	F	44.	141.	0.25	1552.	46	0.0	1389.	0	0.0	0.	0	0.0	0.	0	0.0	0.
69	52	51	4224.	11.	11.	6.	1	1	7	4	F	44.	147.	0.20	1600.	50	0.0	1210.	0	0.0	0.	91	0.0	0.	0	0.0	0.
70		53	1848.	11.	11.	6.	1	1	4	3	F	24.	253.	0.20	1520.	122	0.0	895.	0	0.0	0.	0	0.0	0.	0	0.0	0.
71		54	2112.	21.	12.	0.	1	1	5	3	T	28.	215.	0.60	1504.	64	0.0	1265.	62	0.0	0.	0	0.0	0.	0	0.0	0.
72	53	52	1848.	11.	11.	6.	1	1	4	3	F	24.	253.	0.50	1520.	0	0.0	895.	51	0.0	0.	54	0.0	0.	0	0.0	0.
73		122	1320.	11.	11.	6.	1	1	4	3	F	16.	380.	0.50	1520.	56	0.0	895.	0	0.0	0.	0	0.0	0.	0	0.0	0.
74	54	62	1584.	10.	9.	2.	1	1	7	4	F	24.	195.	0.10	1168.	0	0.0	1120.	0	0.0	0.	63	0.0	0.	0	0.0	0.
75		64	13200.	12.	12.	6.	1	1	7	4	F	40.	179.	0.45	1600.	67	0.0	1299.	0	0.0	0.	65	0.0	0.	0	0.0	0.
76		52	2112.	21.	12.	0.	1	1	5	3	T	28.	215.	0.45	1504.	51	0.0	1265.	53	0.0	0.	0	0.0	0.	0	0.0	0.
77	55	53	2112.	17.	12.	0.	1	1	5	3	T	20.	301.	0.50	1504.	0	0.0	1003.	122	0.0	0.	52	0.0	0.	0	0.0	0.
78		54	1584.	21.	12.	0.	1	1	5	3	T	24.	251.	0.50	1504.	62	0.0	1265.	52	0.0	0.	64	0.0	0.	0	0.0	0.
79	56	122	1320.	11.	10.	6.	1	1	4	3	F	16.	356.	0.50	1424.	53	0.0	895.	0	0.0	0.	0	0.0	0.	0	0.0	0.
80		57	2640.	15.	10.	6.	1	1	4	3	F	40.	142.	0.50	1424.	0	0.0	1275.	53	0.0	0.	0	0.0	0.	0	0.0	0.
81	57	56	2640.	10.	10.	6.	1	1	4	3	F	40.	142.	0.25	1424.	0	0.0	800.	122	0.0	0.	0	0.0	0.	0	0.0	0.
82		58	23760.	11.	11.	6.	1	1	4	3	F	40.	152.	0.75	1520.	0	0.0	895.	74	0.0	0.	0	0.0	0.	0	0.0	0.
83	58	129	1848.	11.	10.	6.	1	1	7	4	F	36.	158.	0.40	1424.	59	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
84		74	1188.	11.	10.	6.	1	1	7	4	F	36.	158.	0.60	1424.	75	0.0	1210.	0	0.0	0.	820	0.0	0.	0	0.0	0.
85	59	818	5280.	10.	10.	6.	1	1	7	4	F	40.	142.	0.50	1424.	0	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
86		819	2904.	10.	10.	6.	1	1	7	4	F	40.	142.	0.50	1424.	0	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
87	62	63	6072.	12.	12.	4.	1	1	7	4	F	40.	176.	0.50	1600.	116	0.0	1299.	0	0.0	0.	68	0.0	0.	0	0.0	0.
88		54	1584.	21.	11.	2.	1	1	5	3	T	24.	243.	0.50	1456.	0	0.0	1265.	64	0.0	0.	52	0.0	0.	0	0.0	0.
89	63	116	3168.	12.	12.	6.	1	1	7	4	F	36.	199.	0.75	1600.	16	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
90		68	22704.	11.	10.	3.	1	1	7	4	F	36.	153.	0.25	1376.	825	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
91	64	65	12672.	10.	10.	6.	1	1	7	4	F	44.	129.	0.10	1424.	75	0.0	1120.	66	0.0	0.	0	0.0	0.	0	0.0	0.
92		67	22176.	11.	12.	6.	1	1	7	4	F	44.	163.	0.90	1600.	824	0.0	1210.	0	0.0	0.	66	0.0	0.	0	0.0	0.
93	65	66	16368.	10.	10.	6.	1	1	7	4	F	44.	129.	0.10	1424.	0	0.0	1120.	0	0.0	0.	823	0.0	0.	0	0.0	0.
94		75	7392.	11.	10.	6.	1	1	7	4	F	44.	129.	0.90	1424.	821	0.0	1210.	822	0.0	0.	0	0.0	0.	0	0.0	0.
95	66	823	5808.	11.	11.	6.	1	1	7	4	F	44.	147.	1.00	1600.	0	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
96	67	66	1848.	11.	11.	6.	1	1	7	4	F	44.	147.	0.10	1600.	823	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
97		824	4752.	11.	11.	6.	1	1	7	4	F	44.	147.	0.90	1600.	0	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
98	69	825	11880.	11.	12.	6.	1	1	7	4	F	44.	163.	1.00	1600.	0	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
99	69	68	5280.	12.	10.	6.	1	1	7	4	F	44.	129.	0.50	1424.	0	0.0	1299.	825	0.0	0.	0	0.0	0.	0	0.0	0.

LINK	FRM	TO	LEN	AM	LM	SW	L	PR	LT	AT	PK SPD	JAM	PRF	FCAP	STR	SPLT	CAP	RGT	SPLT	CAP	LFT	SPLT	CAP	DIAG	SPLT	CAP
100		86	10032.	9.	9.	6.	1	1	7	4	F 36.	137.	0.50	1232.	825	0.0	1030.	0	0.0	0.	0	0.0	0.	0	0.0	0.
101	74	820	4480.	9.	10.	6.	1	1	7	4	F 44.	129.	0.50	1424.	0	0.0	1030.	0	0.0	0.	0	0.0	0.	0	0.0	0.
102		75	10560.	11.	11.	6.	1	1	7	4	F 44.	147.	0.50	1600.	822	0.0	1210.	0	0.0	0.	821	0.0	0.	0	0.0	0.
103	75	821	2640.	11.	10.	6.	1	1	7	4	F 44.	129.	0.50	1424.	0	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
104		822	4224.	11.	11.	6.	1	1	7	4	F 44.	147.	0.50	1600.	0	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
105	86	825	6336.	9.	9.	6.	1	1	7	4	F 32.	154.	1.00	1232.	0	0.0	1030.	0	0.0	0.	0	0.0	0.	0	0.0	0.
139	88	36	17424.	12.	12.	6.	1	1	7	4	F 44.	163.	1.00	1600.	43	0.0	1299.	0	0.0	0.	37	0.0	0.	0	0.0	0.
137	89	34	4220.	15.	12.	2.	1	1	4	3	F 44.	140.	0.50	1536.	33	0.56	1275.	35	0.0	0.	0	0.0	0.	0	0.0	0.
142		46	10560.	13.	12.	2.	1	1	7	4	F 44.	157.	0.50	1600.	0	0.0	1389.	0	0.0	0.	43	0.0	0.	0	0.0	0.
140	90	88	2000.	12.	12.	6.	1	1	7	4	F 32.	224.	0.50	1600.	0	0.0	1299.	0	0.0	0.	0	0.0	0.	36	0.0	1299.
141		89	2000.	12.	12.	6.	1	1	7	4	F 32.	224.	0.50	1600.	0	0.0	1299.	34	0.0	0.	46	0.0	0.	0	0.0	0.
133	91	46	16000.	13.	11.	2.	1	1	7	4	F 44.	141.	0.50	1552.	89	0.0	1389.	43	0.0	0.	0	0.0	0.	0	0.0	0.
135		51	15680.	11.	11.	2.	1	1	7	4	F 44.	141.	0.50	1552.	0	0.0	1210.	0	0.0	0.	50	0.0	0.	0	0.0	0.
144	92	15	5280.	12.	12.	1.	1	1	7	4	F 44.	156.	1.00	1600.	802	0.0	1299.	803	0.0	1500.	801	0.0	1500.	0	0.0	0.
146	93	810	10560.	14.	12.	6.	1	1	7	4	F 32.	224.	1.00	1600.	0	0.0	1478.	0	0.0	0.	0	0.0	0.	0	0.0	0.
148	94	814	10560.	15.	13.	6.	1	1	7	4	F 36.	219.	1.00	1600.	0	0.0	1568.	0	0.0	0.	0	0.0	0.	0	0.0	0.
106	103	5	5280.	12.	12.	6.	1	1	7	4	F 44.	163.	1.00	1600.	806	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
107	104	24	2112.	10.	11.	6.	1	1	7	4	F 36.	180.	1.00	1600.	0	0.0	1120.	23	0.0	0.	0	0.0	0.	0	0.0	0.
108	105	21	5280.	12.	12.	5.	1	1	7	4	F 32.	222.	1.00	1600.	0	0.0	1299.	29	0.0	0.	22	0.0	0.	0	0.0	0.
109	106	807	20064.	10.	10.	2.	1	1	7	4	F 40.	136.	1.00	1360.	0	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
110	107	28	3432.	10.	12.	1.	1	1	7	4	F 40.	171.	1.00	1600.	808	0.0	1120.	809	0.0	0.	0	0.0	0.	0	0.0	0.
111	108	30	10560.	12.	11.	6.	1	2	7	4	F 36.	180.	1.00	1600.	0	0.0	1299.	31	0.0	0.	29	0.0	0.	0	0.0	0.
112	109	108	9504.	10.	11.	6.	1	1	7	4	F 44.	147.	0.50	1600.	30	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
113		110	13200.	11.	11.	2.	1	1	7	4	F 44.	141.	0.50	1552.	111	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
114	110	111	6864.	11.	11.	5.	1	1	7	4	F 44.	145.	1.00	1600.	112	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
115	111	112	8976.	11.	11.	6.	1	1	7	4	F 44.	147.	1.00	1600.	62	0.0	1210.	0	0.0	0.	0	0.0	0.	0	0.0	0.
116	112	62	4224.	11.	10.	4.	1	1	7	4	F 24.	232.	1.00	1392.	63	0.0	1210.	0	0.0	0.	54	0.0	0.	0	0.0	0.
117	113	62	16896.	12.	12.	6.	1	1	7	4	F 36.	199.	1.00	1600.	54	0.0	1299.	63	0.0	0.	0	0.0	0.	0	0.0	0.
118	114	113	3960.	12.	12.	3.	1	1	7	4	F 36.	194.	0.50	1600.	62	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
119		115	1320.	12.	12.	6.	1	1	7	4	F 32.	224.	0.50	1600.	19	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
120	115	114	1320.	12.	12.	6.	1	1	7	4	F 32.	224.	0.50	1600.	113	0.0	1299.	0	0.0	0.	0	0.0	0.	0	0.0	0.
121		19	4277.	12.	10.	6.	1	1	7	4	F 32.	178.	0.50	1424.	105	0.0	1299.	0	0.0	0.	18	0.0	0.	0	0.0	0.
122	116	16	10560.	12.	12.	4.	1	1	7	4	F 24.	293.	1.00	1600.	13	0.0	1299.	0	0.0	0.	69	0.0	0.	0	0.0	0.
123	117	16	3696.	11.	11.	6.	1	2	7	4	F 24.	269.	1.00	1600.	69	0.0	1210.	13	0.0	0.	0	0.0	0.	0	0.0	0.
124	118	14	2640.	12.	12.	6.	1	1	7	4	F 36.	199.	1.00	1600.	92	0.0	1299.	0	0.0	0.	121	0.0	0.	0	0.0	0.
125	120	804	5280.	9.	11.	6.	1	1	7	4	F 36.	180.	1.00	1600.	0	0.0	1030.	0	0.0	0.	0	0.0	0.	0	0.0	0.
126	121	86	5280.	9.	9.	6.	1	1	7	4	F 36.	137.	1.00	1232.	0	0.0	1030.	825	0.0	0.	0	0.0	0.	0	0.0	0.
127	122	56	1320.	10.	10.	6.	1	1	4	3	F 16.	356.	0.50	1424.	0	0.0	800.	0	0.0	0.	57	0.0	0.	0	0.0	0.
128		53	1320.	11.	11.	6.	1	1	4	3	F 16.	380.	0.50	1520.	52	0.0	895.	0	0.0	0.	0	0.0	0.	0	0.0	0.
129	124	44	7920.	10.	12.	6.	1	1	7	4	F 40.	179.	1.00	1600.	47	0.0	1120.	0	0.0	0.	125	0.0	0.	0	0.0	0.
130	125	815	2640.	10.	10.	6.	1	1	7	4	F 40.	142.	1.00	1424.	0	0.0	1120.	0	0.0	0.	0	0.0	0.	0	0.0	0.
131	129	59	20592.	12.	12.	6.	1	1	7	4	F 24.	299.	1.00	1600.	818	0.0	1299.	819	0.0	0.	0	0.0	0.	0	0.0	0.

ANNEX A

EVACUATION FEASIBILITY ANALYSIS FOR SCHOOL DISTRICTS AND NURSING HOMES WITHIN THE BYRON STATION EPZ

COMMONWEALTH EDISON COMPANY
JUNE 1984

ANNEX A

A.1 INTRODUCTION

These additional analyses reflect and are a result of emergency planning efforts which occurred subsequent to the issuance of the December 1982 Evacuation Time Estimates Study for the Byron Nuclear Generating Station. This annex presents an updated analysis of the feasibility and associated time estimates for evacuating appropriate selected special facilites within the Byron Station Emergency Planning Zone (EPZ).

It is important to note that this study presents representative time frames for a range of seasonal, diurnal, and weather conditions for the evacuation of various areas around the Byron Station once a decision has been made to evacuate; while the Byron Volume of IPRA is the detailed emergency operations plan for the Byron Station EPZ.

A.2 SUMMARY

These special facility evacuation feasibility analyses are based upon the facility-specific Standard Operating Procedures developed in conjunction with and in support of the Illinois Plan for Radiological Accidents (IPRA), Byron Volume VI. The applicable special facility population and associated vehicle demand data were incorporated in the NETVAC2 evacuation simulations for the full EPZ scenario for winter. Using individual facility-specific mobilization times and the results of the NETVAC2 simulations, evacuation times for the selected special facilities were calculated.

A.3 SCOPE

The special facilites in the Byron Station EPZ for which a detailed evacuation feasibility analysis was considered were the three EPZ nursing homes, the five EPZ school districts (including the Ogle County Educational Cooperative), the Ogle County Jail, the Oregon Bible College, and the Lorado Taft Field Campus of Northern Illinois University.

If the occupants of the Ogle County Jail (maximum occupancy of 50, average occupancy of 35) are evacuated, they would be transported in law enforcement vehicles brought into the area from outside of Ogle County, under the specific instructions of the Ogle County Sheriff's Department as discussed in the Ogle County Sheltering Guide. The Sheriff will notify other Sheriff's Departments in the surrounding counties who will dispatch their own vehicles to the jail in Oregon. These vehicles will then transport the inmates to holding facilities in the surrounding counties. The Ogle County Sheriff estimates the evacuation of inmates could be completed in two hours or less, which is within the time estimates for evacuation of the general public.

As of January 1984, the Oregon Bible College had an enrollment of 40 students and a staff of 15. Persons at the Oregon Bible College generally have direct access to transportation at the campus. This would allow the evacuation of the Oregon Bible College to be carried out in conjunction with and in the same time frame as the evacuation of the general population.

The Lorado Taft Field Campus of Northern Illinois University has a highly variable student population which ranges from 20 to 150 students at any given time over the course of the year. In addition, the transportation requirements of the student population are also highly variable. Because of these considerations and the fact that any transportation assistance would likely be provided in the same manner and in the same general time frame as assistance given to the school districts for which detailed assessments were performed, such an assessment was not deemed necessary or useful for this facility.

A.4 DEMOGRAPHIC, TRANSPORTATION AND MOBILIZATION DATA

Each of the Byron Station EPZ special facilities analyzed in this Annex was contacted by State of Illinois Emergency Services and Disaster Agency (ESDA) planning personnel in January 1984 to confirm their user populations, transportation needs and resources, and mobilization times prior to undertaking these evacuation feasibility analyses. Tables A-1, A-2, and A-3 present the facility-specific population and vehicle data gathered for each of the Byron EPZ five school districts and three nursing homes for various diurnal conditions. The five school districts have an identified total population of 4856 students, faculty and staff. (For the purposes of this Annex, the population of the Ogle County Educational Cooperative was included in the analysis of the Oregon and Mt Morris School districts, as 82 and 67 respectively.) The three nursing homes presently have total populations (patients and staff) of 286 at night and 400 during the day. Tables A-2 and A-4 present the estimated transportation mobilization times and facility population mobilization times as well as total evacuation times for the special facilities.

School district mobilization times varied greatly due primarily to the locations of school buses and drivers at the time of notification. As shown in Table A-2, the shorter mobilization times, 15 to 70 minutes, are generally due to school buses and drivers being at or near the school districts. The longer mobilization times, 25 to 136 minutes, are generally due to the time required to bring additional school buses into the EPZ from the outlying school districts. The nursing homes' mobilization times are generally longer than the EPZ school district

mobilization times because of the time needed to assemble the nursing home staff and prepare the residents for travel.

A.5 SPECIAL FACILITY EVACUATION TIMES

The total estimated evacuation times for both the school districts and nursing homes are as shown in Tables A-2 and A-4. With the exception of a nighttime evacuation of Pine Crest Manor Nursing Home, the times are within those estimated for the general population.

Two evacuation times for the school districts were calculated to reflect the mobilization times of different transportation resource options. In the longest school district evacuation scenario, it was determined that the last school district would be evacuated under normal weather conditions in 159 minutes, that is, 32 minutes sooner than the general population. Under adverse weather conditions, the longest school district evacuation is expected to be completed in 163 minutes, that is, 62 minutes before the general population.

For the nursing homes, it is estimated that the longest daytime evacuation will take 80 to 81 minutes, or 111 to 144 minutes less than the general population under both normal and adverse weather conditions respectively. The nighttime nursing home evacuation time estimates are slightly less than the general population normal and adverse weather evacuation times of 106 and 113 minutes with the exception of Pine Crest Manor. Pine Crest Manor has nighttime evacuation times of 140 and 142 minutes, or 34 and 29 minutes longer than the general population at night under both normal and adverse conditions respectively. It should be noted that if the Pine Crest Manor staff has been mobilized, then the facility can be evacuated within the same time frame as the general public.

TABLE A-1

BYRON EPZ SCHOOLS

School District	District Schools	Number of Faculty and Staff	Number of School Students	Total School Population (12/83)	Total District Population (12/83)
Byron Community Unit School District #226	Mary Morgan Elementary	(--------417---------)		417	
	Byron Middle School	(--------232---------)		232	
	Byron High School	(--------400---------)		400	1,049
Leaf River Community Unit School District #270	Leaf River Community	38	384	422	422
Oregon Community Unit School District #220	Oregon Community High	41	402	443	
	Etnyre Middle School	29	380	409	
	Jefferson Elementary	31	445	476	
	Ogle County Educational Coop, Oregon High Annex*	7	75	82	1,410
Mt. Morris Community Unit School District #261	Mt. Morris Elementary	30	341	371	
	Mt. Morris Junior High	15	187	202	
	Mt. Morris Senior High	21	226	247	
	Ogle County Educational Coop, Mt. Morris*	32	35	67	887
Meridian Community Unit School District #223	Highland Grade School & Early Childhood	23	349	372	
	Meridian Junior High	30	327	357	
	Stillman Valley High	41	467	508	1,237
Total					5,005

* Included for the purposes of this analysis.

TABLE A-2

BYRON EPZ SCHOOL DISTRICT EVACUATION TIMES

School District	School District Population (12/83) (Faculty, Staff and Students)	Mobilization Time for Faculty, Staff and Students (minutes)	District Buses			
			Total No. of Buses Required for Evacuation(1)	Number of Buses Available	Mobilization for Bus Drivers (minutes)	Mobilization Time for Buses (minutes)
Byron Community Unit School District #226	1,049	5	18	12 (3 during vacation months)	10	5
Leaf River Community Unit School District #270	422	10	7	7	10	5
Oregon Community Unit School District #220	1,410	10	24	11	30	5
Mt. Morris Community Unit School District #261	820(3)	15	14	8	15	15
Meridian Community Unit School District #223	1,237	15	21	18	60	10

NOTES:

(1) Assumed average bus capacity of 60.
(3) See note (3) on page 3 of 3.

TABLE A-2 (Cont)

School District	No. of Additional Buses Required	Additional Buses: Option Location 1/ Option Location 2(2)	Additional Buses: Mobilization Time for Bus Drivers (minutes)	Additional Buses: Mobilization Time for Buses (minutes)	Additional Buses: Travel Time to School (minutes)	Additional Buses: Total Mobilization Time (minutes)
Byron Community Unit School District #226	6	Stillman Valley Rochelle	60 60-90	10 5-10	6 35-36	136
Leaf River Community Unit School District #270	0	Forrestville Mt. Morris	60 15	5 15	12 7	-
Oregon Community Unit School District #220	13	Polo/Eswood Rochelle/Kings	60 60-90	5 5-10	25 30-33	133
Mt. Morris Community Unit School District #261	6	Leaf River Polo	10 60	5 5	7 17	82
Meridian Community Unit School District #223	3	Kings Eswood	5 5	5 5	8 15	25

NOTE:

(2) Additional school district transportation assistance is available as discussed in IPRA Vol. VI.

TABLE A-2 (Cont)

School District	Notification Time (minutes)	Total Mobilization Time (minutes)	Travel Time from EPZ (minutes) Winter Day		Total Evacuation Time (minutes)		General Population Evacuation Times (minutes)	
			Normal	Adverse	Normal	Adverse	Normal	Adverse
Byron Community Unit School District #226	15	15-136	8	12	38-159	42-163	191	225
Leaf River Community Unit School District #270	15	15	5	7	35	37	191	225
Oregon Community Unit School District #220	15	35-133	9	13	59-157	63-161	191	225
Mt. Morris Community Unit School District #261	15	30-82	5	6	50-102(3)(4)	51-103(3)(4)	191	225
Meridian Community Unit School District #223	15	70-25	8	12	93-48	97-52	191	225

NOTES:

(3) The 67 person population of the Ogle County Educational Coop. (OCEC) in Mt. Morris would primarily use vehicles from KAL Bus Lines in an evacuation instead of school district buses and therefore this population has not been included in the Mt. Morris School District population.

(4) These evacuation time frames are applicable to and representative of the evacuation time estimates for the Ogle County Educational Coop. (OCEC) in Mt. Morris. The OCEC evacuation time estimates (80 to 101 minutes) include a facility mobilization time of 45 to 60 minutes and a concurrent transportation mobilization time of 45 to 60 minutes. Therefore the OCEC evacuation time estimates are similar to the evacuation time estimates for the Mt. Morris School District.

TABLE A-3

BYRON EPZ NURSING HOMES

Nursing Home	Number of Staff		Number of Residents		Total Population		Total No. of Vehicles Required for Evacuation	
	Day	Night	Day	Night	Day	Night	Day	Night
Pine Crest Manor Nursing Home	80	6	112	112	192	118	42	23
White Pines Nursing Home	12	3	62	62	74	65	16	10
Neighbors Nursing Home	35	4	99	99	134	103	34	18

TABLE A-4

BYRON EPZ NURSING HOME EVACUATION TIMES

Nursing Home	Total Population (1/84) Day	Total Population (1/84) Night	Notification Time from ESDA (minutes)	Facility Mobilization Time (minutes) Day	Facility Mobilization Time (minutes) Night	Total Mobilization Time Day (minutes)	Total Mobilization Time Night (minutes)	Travel Time from EPZ Day (minutes) Normal	Travel Time from EPZ Day (minutes) Adverse	Travel Time from EPZ Night (minutes) Normal	Travel Time from EPZ Night (minutes) Adverse	Total Evacuation Time Day (minutes) Normal	Total Evacuation Time Day (minutes) Adverse	Total Evacuation Time Night (minutes) Normal	Total Evacuation Time Night (minutes) Adverse
Pine Crest Manor Nursing Home	192	118	15	60	120	75	135	5	6	5	7	80	81	140	142
White Pines Nursing Home	74	65	15	45	75	60	90	9	13	9	13	69	73	99	103
Neighbors Nursing Home	134	103	15	45	80	60	95	9	13	9	13	69	73	104	108
Total															

Nursing Home	General Population Evacuation Time Normal	General Population Evacuation Time Adverse	Normal	Adverse
Pine Crest Manor Nursing Home	191	225	106	113
White Pines Nursing Home	191	225	106	113
Neighbors Nursing Home	191	225	106	113
Total				