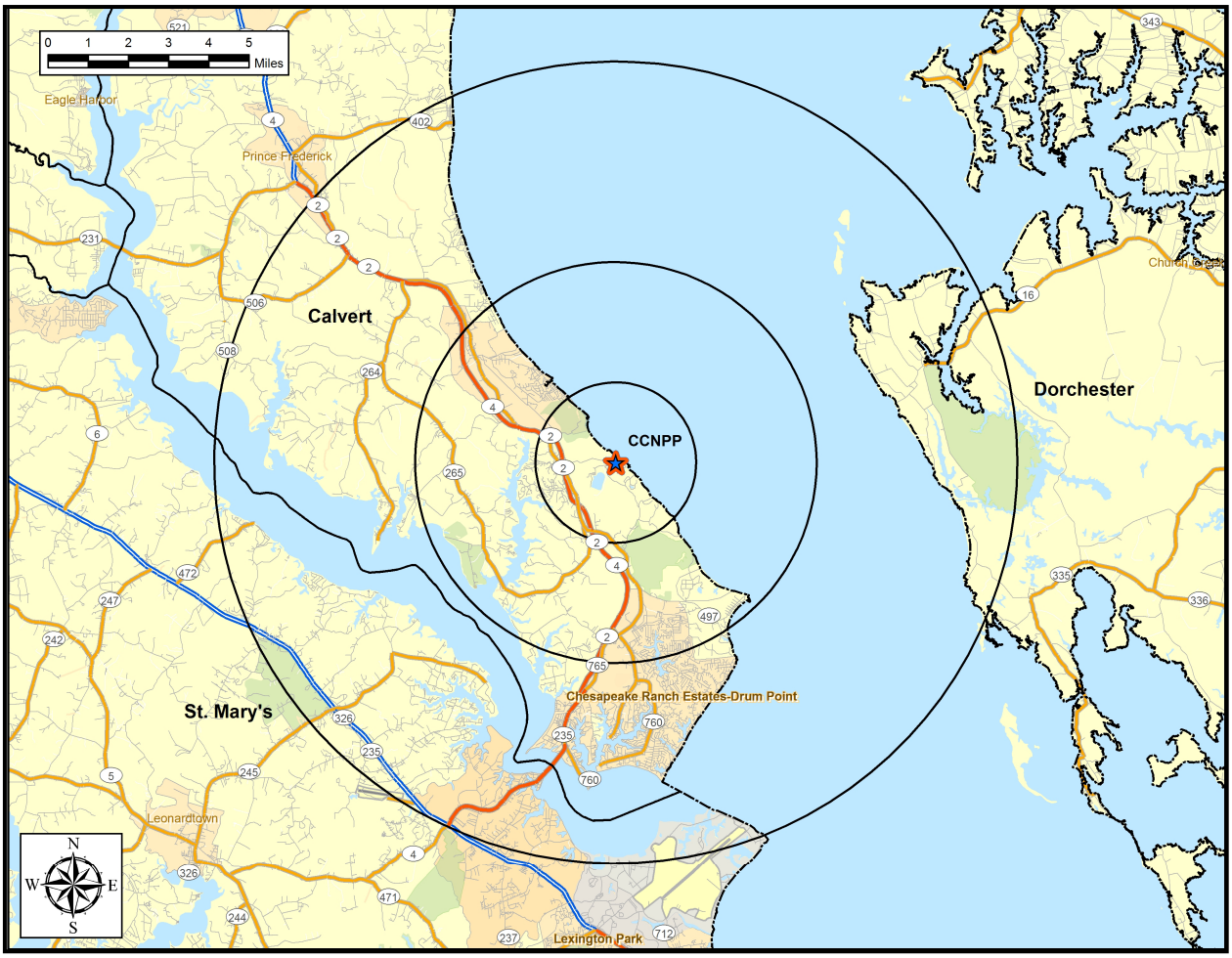
Addendum to
Calvert Cliffs Nuclear Power Plant
Development of Evacuation Time Estimates



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1. INTRODUCTION

This report is an addendum to the ETE Report (KLD TR-421) prepared for the Calvert Cliffs Nuclear Power Plant (CCNPP). This addendum presents the Evacuation Time Estimates (ETE) for the following cases:

1. Evacuation of Zone 6 in St. Mary's County Only,
2. Evacuation of Zone 7 in St. Mary's County Only,
3. Evacuation of Zone 8 in Dorchester County Only, and
4. Evacuation of the Full 10-Mile EPZ when the Thomas Johnson Bridge is closed.

The ETE for cases 1 through 3 are developed for all 12 scenarios considered in the ETE Report (KLD TR-421). The scenarios are listed in Table 1:

Table 1 – List of Scenarios

Scenario	Season	Day of Week	Time of Day	Weather	Special
1	Summer	Midweek	Midday	Good	None
2	Summer	Midweek	Midday	Rain	None
3	Summer	Weekend	Midday	Good	None
4	Summer	Weekend	Midday	Rain	None
5	Summer	Midweek, Weekend	Evening	Good	None
6	Winter	Midweek	Midday	Good	None
7	Winter	Midweek	Midday	Rain	None
8	Winter	Weekend	Midday	Good	None
9	Winter	Weekend	Midday	Rain	None
10	Winter	Midweek, Weekend	Evening	Good	None
11	Summer	Midweek	Midday	Good	New Plant Construction
12	Summer	Weekend	Midday	Good	Airshow at Base

The ETE for Case 4 are calculated as a sensitivity study and compared to the ETE for Scenarios 1 and 6.

2. METHODOLOGY

The number of people (residents, employees and transients) and the corresponding vehicles within Zones 6, 7 and, 8 are presented in Tables 2 and 3.

Table 2. Population by Zone				
Zone	**Permanent Residents**	**Transients**	**Employees who reside outside the EPZ**	**Total**
6	5,074	16	56	5,146
7	9,284	1,144	255	10,683
8	311	200	No employment	511

Table 3. Summary of Vehicles by Zone				
Zone	**Permanent Residents**	**Transients**	**Employees who reside outside the EPZ**	**Total**
6	2,648	8	54	2,710
7	4,852	572	250	5,674
8	164	67	No employment	231

Voluntary and shadow evacuations (as defined in Section 2 and Figure 2-1 of TR-421) are not considered for Cases 1-3. The evacuation roadway network and the associated highway capacity as defined in TR-421 are used to develop the ETE for these zones.

The existing roadway network and demand (Section 3 of TR-421) are used for Case 4 (TJ Bridge Closure). People evacuating from Zone 3 are not permitted to travel southbound along MD 2/4 as the TJ Bridge is closed for this case. Voluntary and shadow evacuations are considered for this case.

3. RESULTS

An evacuation region consists of a Zone or grouping of zones issued an advisory to evacuate. There are 14 regions considered in TR-421. Figures 1, 2 and 3 show the 10 Mile EPZ for CCNPP with the Zones 6, 7 and 8 highlighted and identified as Regions 15 through 17, respectively. Tables 4A through 4D present the ETE for the evacuation of Zones 6, 7 and 8, individually. Guidance is provided in Section 7 of the TR-421 for the use of Tables 4A through 4D. The ETE for the 100th percentile of population is 4:00 for all scenarios, which is equal to the mobilization time.

These results indicate that public education programs may hasten mobilization time, thereby reducing ETE.

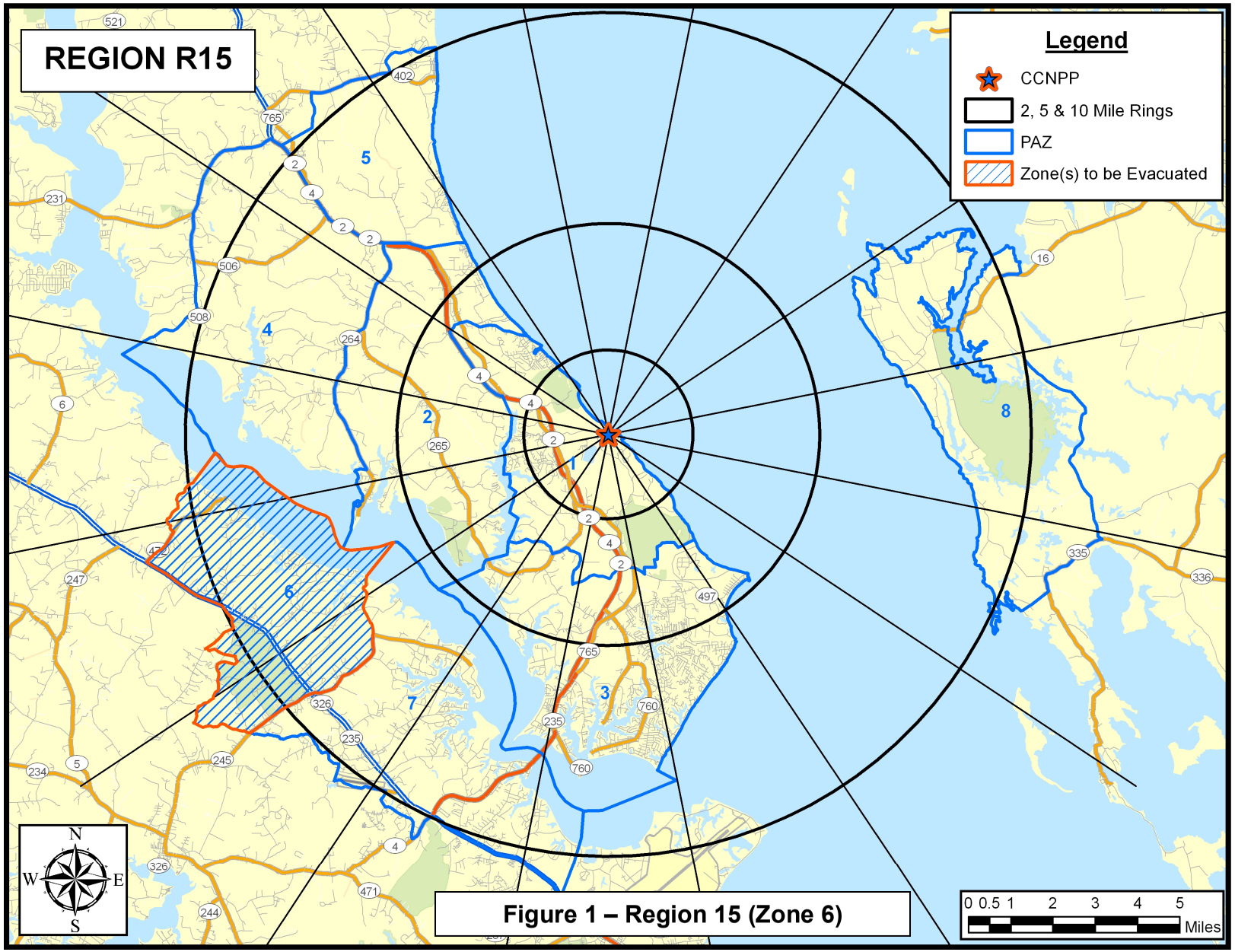


Figure 1 – Region 15 (Zone 6)

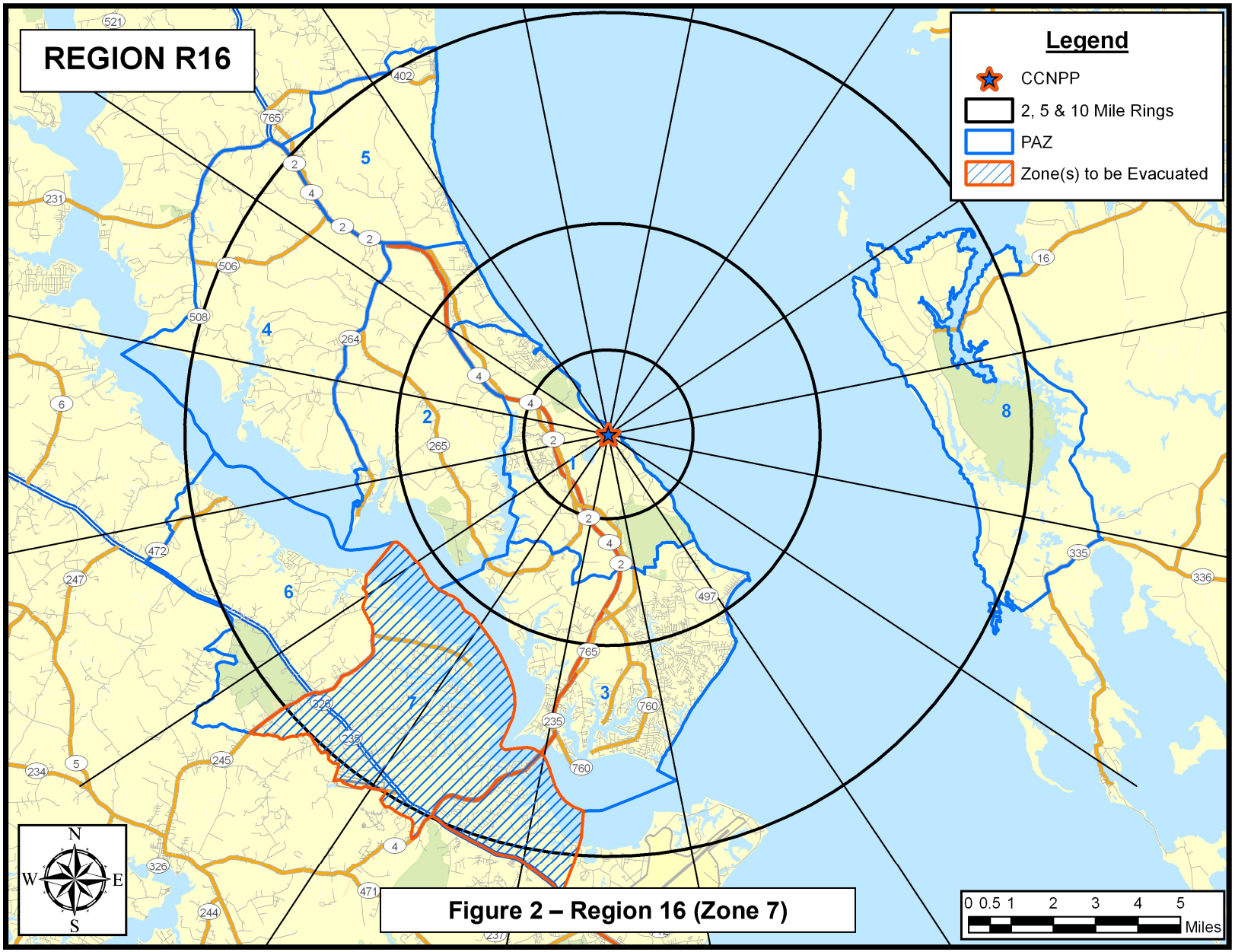


Figure 2 – Region 16 (Zone 7)

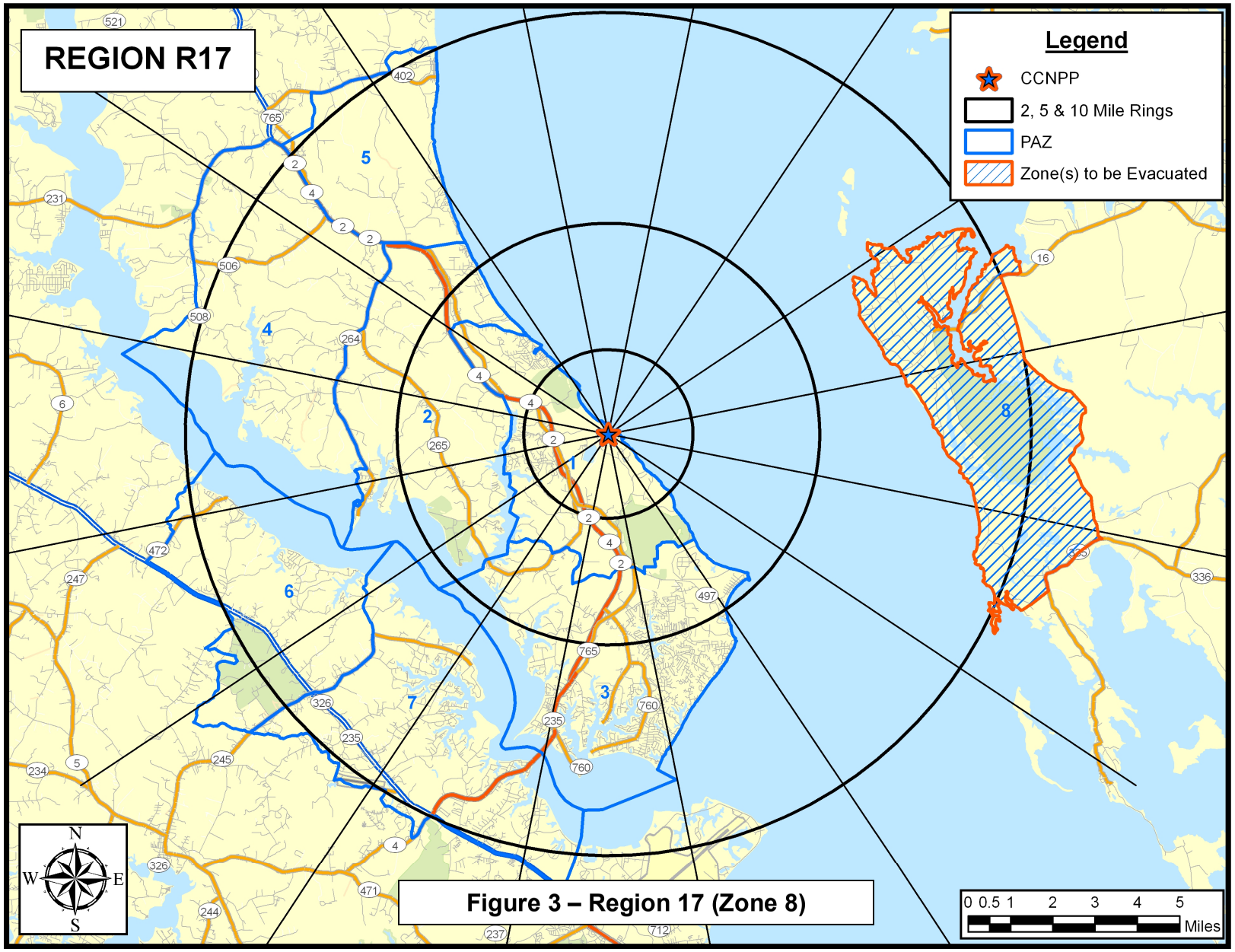


Figure 3 – Region 17 (Zone 8)

Table 4-1A. Time To Clear The Indicated Area of 50 Percent of the Affected Population													
Season	Summer		Summer		Summer	Winter		Winter		Winter	Summer	Summer	Season
Day of Week	Midweek		Weekend		All	Midweek		Weekend		All	Midweek	Weekend	Day of Week
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario
Time of Day	Midday		Midday		Evening	Midday		Midday		Evening	Midday	Midday	Time of Day
Region Zone Evacuating	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Good Weather	Rain	Good Weather	New Plant Construction	Air Show at Base	Region Zone Evacuating
R15 Zone 6	1:25	1:25	1:10	1:10	1:05	1:25	1:25	1:10	1:10	1:05	1:25	1:15	R15 Zone 6
R16 Zone 7	1:30	1:35	1:20	1:25	1:15	1:30	1:35	1:20	1:25	1:15	1:35	1:05	R16 Zone 7
R17 Zone 8	1:20	1:20	0:50	0:50	0:55	1:25	1:25	0:55	0:55	0:55	1:20	0:45	R17 Zone 8

Table 4-1B. Time To Clear The Indicated Area of 90 Percent of the Affected Population													
Season	Summer		Summer		Summer	Winter		Winter		Winter	Summer	Summer	Season
Day of Week	Midweek		Weekend		All	Midweek		Weekend		All	Midweek	Weekend	Day of Week
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario
Time of Day	Midday		Midday		Evening	Midday		Midday		Evening	Midday	Midday	Time of Day
Region Zone Evacuating	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Good Weather	Rain	Good Weather	New Plant Construction	Air Show at Base	Region Zone Evacuating
R15 Zone 6	2:30	2:40	2:05	2:20	1:55	2:30	2:40	2:05	2:20	1:55	2:30	2:40	R15 Zone 6
R16 Zone 7	2:40	2:50	2:35	2:45	2:20	2:40	2:50	2:25	2:40	2:20	2:50	2:20	R16 Zone 7
R17 Zone 8	2:45	2:45	1:40	1:40	1:50	2:50	2:50	1:50	1:50	1:50	2:45	1:30	R17 Zone 8

Table 4-1C. Time To Clear The Indicated Area of 95 Percent of the Affected Population													
Season	Summer		Summer		Summer	Winter		Winter		Winter	Summer	Summer	Season
Day of Week	Midweek		Weekend		All	Midweek		Weekend		All	Midweek	Weekend	Day of Week
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario
Time of Day	Midday		Midday		Evening	Midday		Midday		Evening	Midday	Midday	Time of Day
Region Zone Evacuating	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Good Weather	Rain	Good Weather	New Plant Construction	Air Show at Base	Region Zone Evacuating
R15 Zone 6	2:50	3:00	2:30	2:40	2:10	2:50	3:00	2:30	2:40	2:10	2:50	3:10	R15 Zone 6
R16 Zone 7	3:00	3:05	2:45	3:00	2:30	3:00	3:05	2:40	2:50	2:30	3:05	2:30	R16 Zone 7
R17 Zone 8	3:20	3:20	2:10	2:10	2:20	3:20	3:20	2:20	2:20	2:20	3:10	2:00	R17 Zone 8

Table 4-1D. Time To Clear The Indicated Area of 100 Percent of the Affected Population													
Season	Summer		Summer		Summer	Winter		Winter		Winter	Summer	Summer	Season
Day of Week	Midweek		Weekend		All	Midweek		Weekend		All	Midweek	Weekend	Day of Week
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario
Time of Day	Midday		Midday		Evening	Midday		Midday		Evening	Midday	Midday	Time of Day
Region Zone Evacuating	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Good Weather	Rain	Good Weather	New Plant Construction	Air Show at Base	Region Zone Evacuating
R15 Zone 6	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	R15 Zone 6
R16 Zone 7	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	R16 Zone 7
R17 Zone 8	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:00	R17 Zone 8

Closure of the Thomas Johnson (TJ) Bridge

A sensitivity study was conducted to study the effects of closing the Thomas Johnson Bridge. This bridge serves as one of the major evacuation routes for Zone 3 (the most populous zone within the EPZ). In the event the bridge is closed, all evacuees from Zone 3 will be routed northbound on MD 2/4. The results are presented in Table 5. The scenarios considered are summer and winter, Midweek (Workday), and Midday (Business Hours). The ETE presented are for an evacuation of Region 3 (Full 10-Mile EPZ).

Table 5. Time (hr:min) to Evacuate the Indicated Percentage of the 10-Mile EPZ

Scenario	Condition	50%	90%	95%	100%
Summer, Midweek, Midday	Base	2:15	4:20	4:50	6:10
	TJ Bridge Closed	2:25	5:30	6:05	6:40
Winter, Midweek, Midday	Base	2:15	4:20	4:45	6:10
	TJ Bridge Closed	2:25	5:30	6:05	6:40

As seen in Table 5, the closing of the TJ Bridge results in increased ETE for all percentiles. The increase is most significant for the 90th and 95th percentiles suggesting a dispersed evacuation curve compared to the base case. This is attributed to the increased congestion at MD 2/4 at MD 497 (Cove Point Road). The major evacuation routes servicing Zone 3 are westbound along MD 497 and MD 760 and then northbound along MD 2/4. The traffic along these routes converges at the intersection of MD 2/4 and MD 497 (See Figure 4) resulting in pronounced congestion. Vehicles evacuating Zone 3 have 3 lanes available in the base case – 2 lanes northbound on MD 2/4 and 1 lane southbound across the TJ Bridge. The closing of the bridge reduces the available capacity, thereby increasing congestion, reducing the rate of the egress and prolonging the ETE. This phenomenon is shown graphically in Figure 5 as the ETE plot is skewed towards longer ETE (dispersed evacuation curve) for the 90th and 95th percentiles.

Appendix I of TR-421 includes a sensitivity study where all traffic from Zone 3 is diverted towards the TJ Bridge and northbound movement along MD 2/4 is not permitted, as doing so would route vehicles towards CCNPP. The resulting ETE was 10:50 for the Full EPZ, under those conditions. The TJ Bridge Closure sensitivity study considered here is similar except all evacuees are routed northbound rather than southbound along MD 2/4; however, as previously noted there are 2 lanes northbound and only 1 lane southbound. This additional capacity explains the difference in ETE between these seemingly similar studies.

These results indicate that the routing considered in the Base case, which involves a balance of routing southbound and northbound along MD 2/4, represents an optimal use of the available roadway capacity.

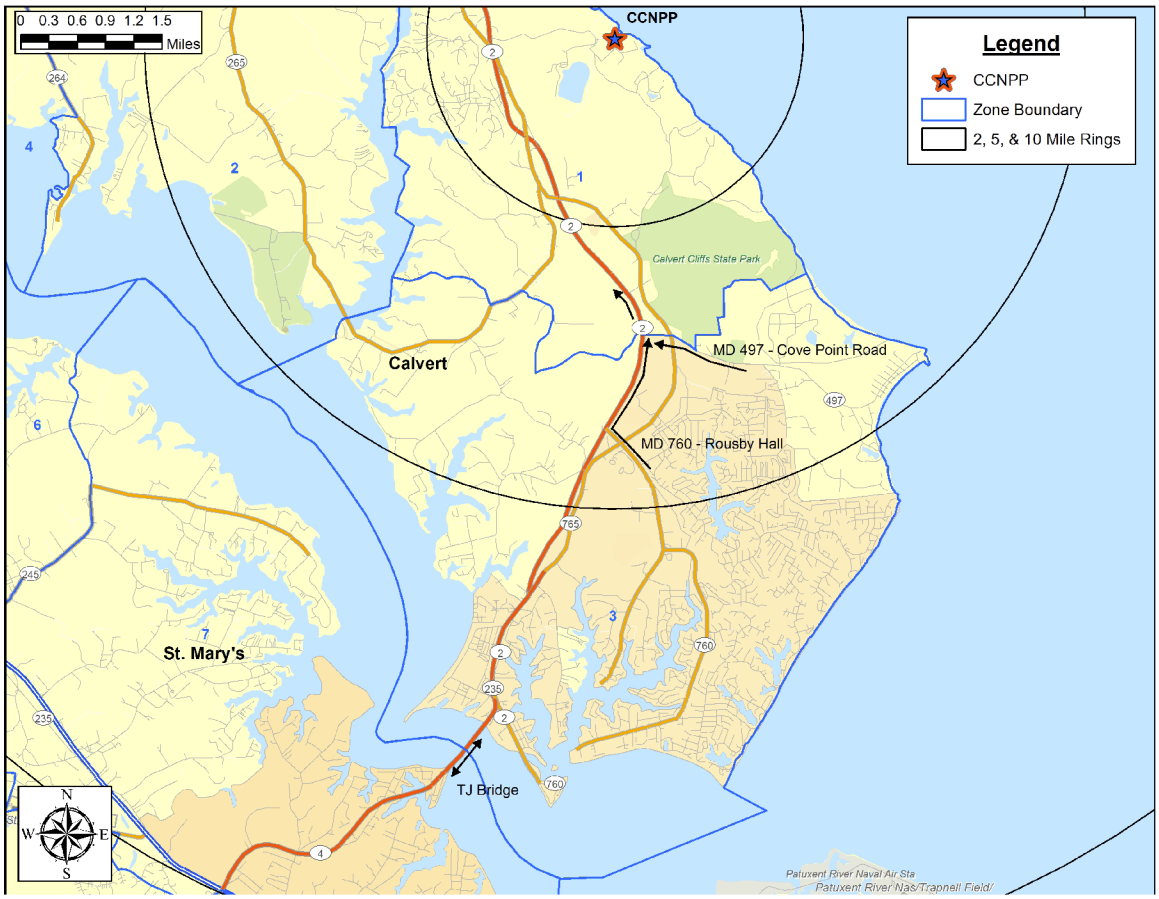
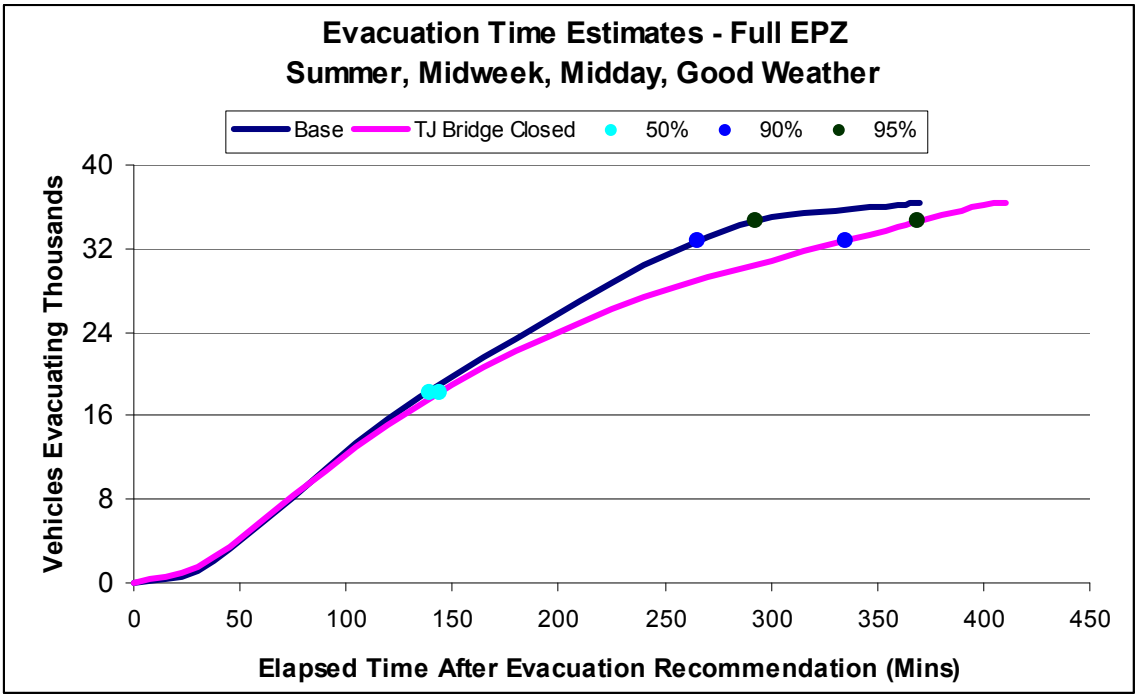


Figure 4 – Primary Evacuation Routes Servicing Zone 3 with the TJ Bridge Closed



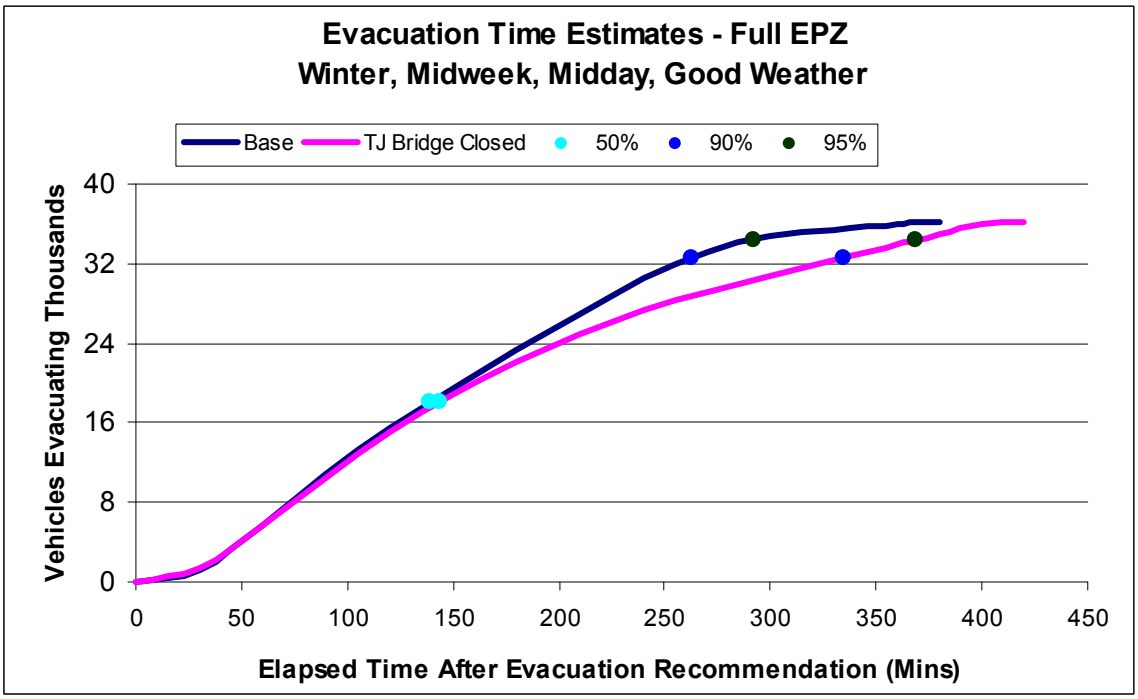


Figure 5 – Evacuation Time Estimate Plots for CCNPP Evacuation of Region 03 (Entire EPZ)