New Jersey Turnpike Authority

P.O. Box 5042, Woodbridge, NJ 07095

September 22, 2023

Document Change Announcement

2007 Design Manual
Precast Concrete Construction Barrier (PCCB) Update
DCA2023DM-01

Subject: Revisions to

Section 10 Traffic Control During Construction, Subsection 10.8 Precast Concrete Construction Barrier, Subsection 10.17 Temporary Attenuator Selection and Design Guidelines

Description of Change:
This DCA updates PCCB and temporary attenuator standards for MASH compliance and is released in conjunction with DCAs for Standard Drawings and 2016 Standard Supplementary Specifications.

Notice to New Jersey Turnpike Authority Staff and Design Consultants
Effective immediately, changes must be implemented in all applicable projects that have not entered Phase C development within one month following the date of this DCA. Contact your New Jersey Turnpike Authority Project Manager for instruction.

The revisions may be accessed on the Authority's webpage: https://www.njta.com/doing-business/professional-services

Recommended By:

Lamis T. Malak, P.E.
Deputy Chief Engineer - Design

Daniel Hesslein, P.E.
Deputy Chief Engineer - Construction

Approved By:

Michael Garofalo, P.E.
Chief Engineer

Distribution: Senior Staff Engineering, Law, Maintenance & Operations Depts., All Prequalified Consultant Firms, File

NOTE: All text herein are REVISIONS, as indicated by the tracked changes, to the latest version of the 2007 Design Manual.

10.8. PRECAST CONCRETE CONSTRUCTION BARRIER

10.8.1. Introduction

In general, Precast Concrete Construction Barrier (PCCB) should be installed only if it is clear that the barrier offers the least hazard potential. Elimination of the warranting obstruction should always be the first alternative considered. Limiting excavations to that which can be backfilled during the same work shift or covering minor excavations are practical examples of how obstructions, commonly encountered during construction, can be eliminated. In some cases, a detour may be the most practical solution, especially on projects that would require large quantities of construction barrier.

~~When construction barrier is not warranted, other traffic control devices such as cones, drums and breakaway barricades are still warranted. The New Jersey Turnpike and Garden State Parkway each require different devices. Refer to the Sample Plans for examples for each roadway.~~

There may be situations where there is not a clear choice as to whether or not a construction barrier is warranted or where site conditions or construction operations will exclude the use of a construction barrier even though one is warranted. The Engineer should constantly be on the lookout for situations where the site conditions and/or the operational characteristics of the road such as adverse geometrics, high operating speed and high traffic volume, will make the use of construction barrier appropriate even though not specifically required by the warrants shown in Subsection 10.8.2. Such cases should be evaluated on an individual basis and, in the final analysis, must usually be resolved by engineering judgment. In such cases, adequate documentation should be included in the job file so that whatever action is taken, it cannot be misconstrued as being arbitrary.

10.8.2. Warrants

The following guidelines are to be used to establish warrants for using ~~Precast Concrete Construction Barrier~~PCCB when developing Traffic Control Plans. Three factors must be considered in determining if an obstruction warrants a construction barrier:

1. The physical characteristics of the obstruction.
2. The distance from the traveled way to the obstruction.
3. How long the obstruction will exist.

For an obstruction to warrant a construction barrier, all three of these criteria must indicate that a barrier is needed.

Physical Characteristics: A warranting obstruction is defined as a non-traversable roadside or a fixed object that is located within the clear zone and whose physical characteristics are such that injuries resulting from an impact with the obstruction would probably be more severe than injuries resulting from an impact with construction barrier.

Also, other examples of using ~~construction barrier~~PCCB to protect patron vehicles from warranting obstructions are:

1. To protect traffic from entering work areas such as excavations.
2. To protect construction such as falsework for bridges and other exposed objects.
3. To separate two-lane, two-way traffic on one roadway of a normally divided roadway. Whenever two-way traffic is to be maintained on one side of a normally divided highway, opposing traffic shall be separated as follows and such separation shall be shown on the Traffic Control Plan.

   Where the two-lane, two-way, one-side arrangement is used, the Traffic Control Plans shall include the above provisions for the separation of opposing traffic except:

   a. Transition Zones - Positive Barrier (~~Pre-cast Concrete Construction Barrier~~ PCCB or approved alternate), with a buffer area equal to the maximum deflection limit of the proposed barrier.
   b. Between Transitions - Positive Barrier, as described in A above or by delineation devices~~, such as drums, cones or vertical panels,~~ as deemed appropriate by the ~~appropriate~~ Operations Department.
   c. Striping and complimentary signing shall be used in conjunction with A and B above.

Duration of Existence: ~~A construction barrier~~PCCB is warranted if an obstruction will remain within the clear zone for more than one work shift.

10.8.3. Applications

Precast Concrete Construction Barrier, Alternates A and B are the only barrier types approved for use on construction projects.

~~Construction Barrier Type 4,~~ Alternates A or- B may ~~should only~~ be used at ~~those~~ all locations where Joint Class A, B, or C are specified; Alternate B must be used where Joint Class D is specified. Refer to the Standard Drawings for details on the alternate barrier types.

~~where an allowable movement of the barrier, when hit, of 11 to 42 inches is acceptable. When the allowable deflection is less than 11 inches, Alternate B shall be used. The type to be used at specific locations should be indicated on the Traffic Control Plans.~~

~~An alternate design to the Construction Barrier, Alternate A has been developed which may be substituted. This alternate Type 4 design, designated as Alternate B, Joint Class D has the same features as Alternate A, but has pockets to receive 1-inch diameter anchor bolts to meet the requirements for the Alternate A Construction Barrier. Refer to the Standard Drawings.~~

When ~~Construction Barrier~~PCCB is specified, the ~~J~~joint c~~C~~lass and limits for the barrier should be indicated on the Traffic Control Plans based on the minimum clear area available behind the barrier as noted in Table 10.8-1. ~~Joint Class A should be specified where an allowable movement of over 16 to 42 inches is acceptable. Joint Class B should be specified where an allowable movement of over 11 to 16 inches is acceptable. Joint Class C should be specified where a maximum allowable movement of 11 inches is acceptable. Joint Class D should be specified when no allowable movement is acceptable.~~ Joint Class B shall not be used as median barrier (traffic on both sides of the barrier) and may only be used to shield traffic on one side of the barrier, with the steel box beam stiffening always attached to the non-traffic side of the barrier. The applicable joint class of ~~Precast Concrete Construction Barrier~~ PCCB shall be provided when ~~the~~ construction barrier is to be used as bridge parapet based on the width of the shelf provided for the required minimum clear area ~~allowable movement~~ of the joint class.

The following chart summarizes the respective joint treatments:

Table 10.8-1 PCCB Joint Treatment

Joint Class	~~Use~~Minimum Clear Area Behind PCCB	Joint Treatment
A	~~Allowable movement over 16 to 42~~39 inches	~~C~~Connection ~~K~~key ~~only~~and barrier end sections fully pinned
B	~~Allowable movement over 11 to 16 inches~~33 inches	Connection ~~K~~key~~ and grout in every joint~~ and non-shrink grout at every joint; 6-inch x 6-inch steel box beam spanning each joint; and barrier end sections fully pinned
C	~~Maximum allowable movement of 11~~12 inches	Connection key and ~~Connection Key~~non-shrink grout at every joint~~,~~; traffic side of all barrier sections pinned; and barrier end sections fully pinned~~ and grout in every joint and pin every other unit. In units to be~~

		~~anchored, pins should be required in every recess.~~
D	0 inches~~No allowable movement (i.e. bridge parapet)~~	Connection ~~K~~key and non-shrink grout at every joint~~;~~ and bolt every anchor pocket hole in every barrier section~~and grout in every joint and bolt every anchor pocket hole in every unit.~~

~~Pinning Alternate B~~Anchoring PCCB to a bridge deck that is High Performance Concrete (HPC) or has a Latex Modified Concrete (LMC) overlay undermines the effectiveness of the HPC or LMC. In addition, the extra costs associated with placement of HPC or LMC make it especially undesirable to lessen its effectiveness by drilling holes through it. The Engineer is advised to investigate alternatives in order to eliminate the need for ~~pinned~~ anchoring barrier on bridge decks, when possible, so as not to compromise the benefits of the HPC or LMC overlay.

Where different joint classifications are required within a section of barrier, the controlling joint class shall extend beyond the area required for limited deflection as noted in table:

Table 10.8-~~1~~2 PCCB - Transition Between Joint Classes

PCCB - Transition Between Joint Classes	
Joint Class Transition	**Transition Requirements**
D to C	Extend one complete barrier section of Joint Class D beyond the work area requiring limited deflection.
D to B D to A	Extend one complete barrier section of Joint Class D beyond the work area requiring limited deflection and pin the first hole of the Joint Class A or B barrier section on the traffic side of the PCCB.
C to B C to A	Extend one complete barrier section of Joint Class C beyond the work area requiring limited deflection and pin the first hole of the Joint Class A or B barrier section on the traffic side of the PCCB.
B to A	Extend Joint Class B box beam stiffing for 50 ft. minimum beyond the work area requiring limited deflection.

Precast Concrete Construction Barrier shall not be installed on side slopes steeper than 10H:1V. The approach end shall either be flared at ~~15:1 on the New Jersey Turnpike and~~ 20:1 on both the New Jersey Turnpike and ~~on the~~ Garden State Parkway beyond the clear distance or, when terminated within the clear zone, the approach end of the barrier shall be shielded with an appropriate attenuator system. Precast

Concrete Construction Barrier shall be placed on a traversable surface, preferably paved. The deflection area behind a barrier shall be able to bear traffic and shall be free from obstructions. When barrier is used as parapet protection the integrity of the surface should be evaluated to ensure adequacy of the barrier anchorage to provide the width of the shelf behind the barrier to accommodate the barrier movement.

Construction barrier systems other than the Authority's standard PCCB may be considered and approved by the Authority on a project-by-project basis. Consideration of an alternative barrier system requires that the barrier satisfactorily demonstrated MASH TL-3 compliance; sources for alternative type barriers include:

https://www.roadsidepooledfund.org/mash-implementation/search/
https://mwrsf.unl.edu/researchhub.php

Contract documents shall include all appropriate details for installation of the alternative barrier system conforming to the conditions under which it received MASH compliance. If an alternative barrier system is identified, the contract documents shall include the maximum deflection per MASH testing for the- specified barrier system.

The approach length of need (L.O.N.) is the minimum length of construction barrier required in front of the warranting obstruction to shield the hazard effectively. See Exhibit 10-1 for instructions on how to determine the L.O.N. ~~of a Precast Concrete Construction Barrier.~~for PCCB.

EXHIBIT 10 -1 LENGTH OF NEED OF PRECAST CONCRETE CONSTRUCTION BARRIER

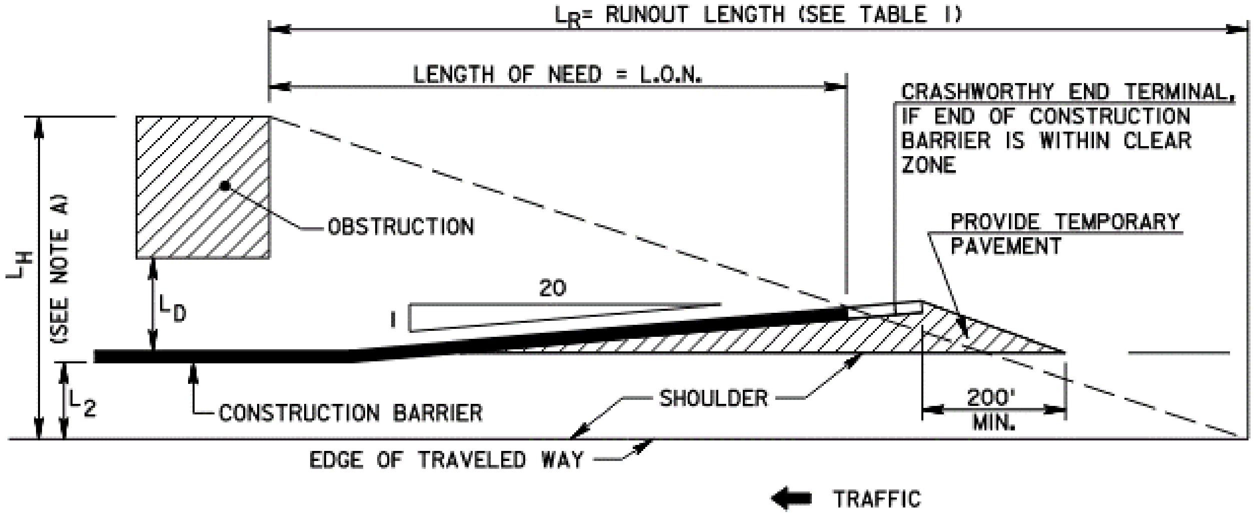


TABLE - I				
	TRAFFIC VOLUME (A.D.T.)			
	OVER 6,000	2,000-6,000	800-2,000	UNDER 800
DESIGN SPEED (M.P.H.)	L_R	L_R	L_R	L_R
70	480	440	400	360
60	400	360	330	300
50	320	290	260	240
40	240	220	200	180
30	170	160	140	130

NOTE A. IF OBSTRUCTION EXTENDS BEYOND CLEAR ZONE, MAKE L_H EQUAL TO CLEAR ZONE EXCEPT IF OBSTRUCTION IS A CRITICAL SLOPE, SEE EXHIBIT 4-7.

NOTE B. IF ROADWAY IS CURVED, DRAW LAYOUT TO SCALE AND OBTAIN L.O.N. DIRECTLY BY SCALING FROM DRAWING.

NOTE C. IF BARRIER END IS PARALLEL TO ROADWAY (NO FLARE), THEN CHANGE "1/20" IN FORMULA TO "0".

NOTE D. SEPARATION BETWEEN BARRIER TO OBSTRUCTION, $L_D \geq$ MAXIMUM BARRIER DEFLECTION.

EXAMPLE

$$L.O.N. = \frac{L_H - L_2}{\frac{1}{20} + \frac{L_H}{L_R}}$$

$L_2 = 15'$

$L_H = 25'$

$L_R = 480'$

$$L.O.N. = \frac{25 - 15}{\frac{1}{20} + \frac{25}{480}}$$

DESIGN SPEED = 70 MPH
ADT = 26,000

L.O.N. = 98.0

10.17. TEMPORARY ATTENUATOR SELECTION AND DESIGN GUIDELINES

10.17.1. General

Once it has been determined that an attenuator is to be used to prevent errant vehicles from impacting a fixed object, a choice must be made as to which attenuator is best for the particular location under consideration. The attenuators presently recommended for temporary installations on Authority projects are MASH Test Level 3 (TL-3) compliant inertial barrierredirective (non-gating) or non-redirective (gating). Redirective (non-gating) attenuators are designed to redirect a vehicle that impacts at any location along the face of the device. Non-redirective (gating) are designed to capture a vehicle or to allow it to pass through when hit along the face of the device. Temporary attenuators are typically non-redirective arrays due to the ease of installation and cost effectiveness; there are circumstances where redirective attenuators may be the better choice. and any attenuators on the Authority's website approved for temporary use. See Section 4 (Guide Rail / Median Barrier / Attenuator Design) of this Manual for the design parameters associated withof permanent attenuators. The Authority maintains a list of approved redirective and non-redirective attenuators on the QPL.

Several factors must be evaluated when determining the appropriate type of attenuatorwhich of the recommended attenuators should be used. The number and type of factors to be evaluated precludes the development of a simple, systematic selection procedure. The factors which normally should be considered are briefly discussed below. In many cases, evaluation of the first few items will establish the type of attenuator to be used. When designing an attenuator, take the time to review the design instructions and product limitations in the manufacturer's design manual thoroughly before performing the necessary work. The Engineer shall review the manufacturer's design instructions and product limitations before specifying this product.

10.17.2. Dimensions of the Obstruction

Inertial Non-redirective attenuators barriers canshould be designed to prevent errant vehicles from impacting a fixed object of practically any width as needed.

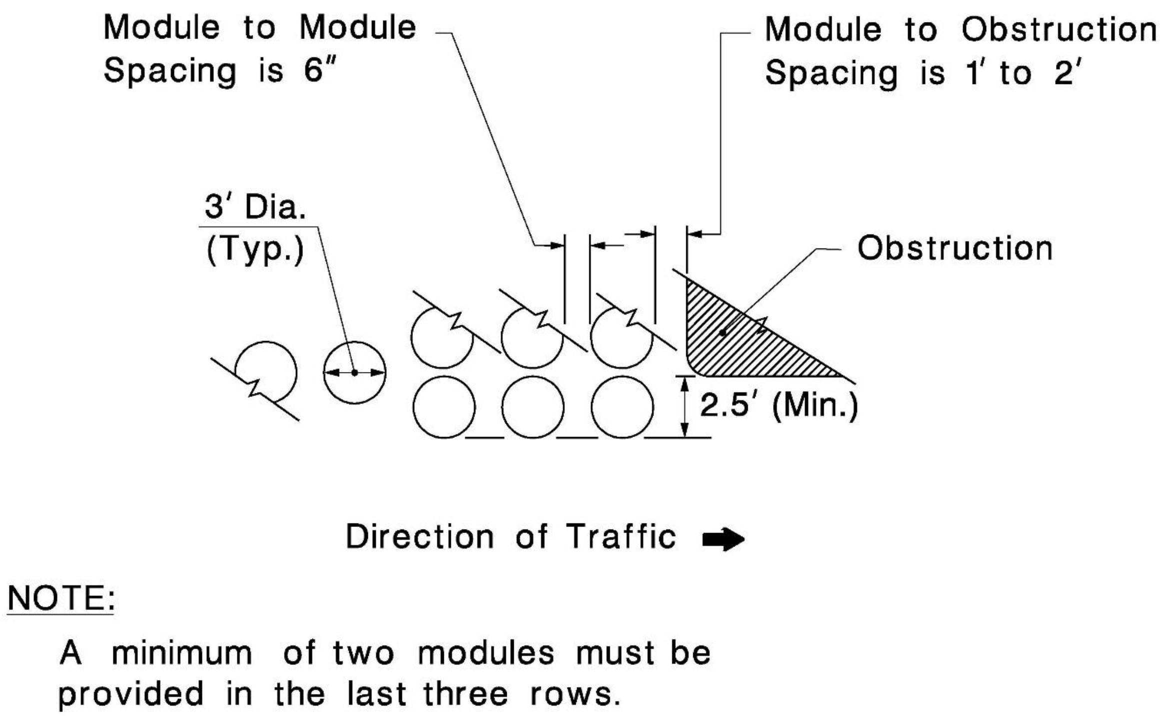
10.17.3. Space Requirements

Area occupied by the attenuator:

All attenuators should be installed as directed by the manufacturer of the attenuator and in accordance with the MASH compliant testing. Non-redirective attenuators typically require a wider footprint than redirective attenuators. A general layout for non-redirective attenuators is depicted in To meet the requirement of Exhibit 10-2. , Non-redirective attenuators ~~inertial barriers~~ will have a minimum width of approximately 6.5 feet (two barrels each at 3 feet wide plus a 6-inch space between them).

~~Exhibit 10 – 2~~

EXHIBIT 10-2 LAYOUT FOR LAST THREE MODULE~~-~~ ROWS IN ~~AN INERTIAL BARRIER~~NON-REDIRECTIVE ATTENUATORS



10.17.4. Geometrics of the Site

The vertical and horizontal alignment, especially curvature of the road and sight distance, are important factors to be considered. Adverse geometrics could contribute to a higher than normal frequency of impacts.

10.17.5. Physical Conditions of the Site

See Section 4 (Guide Rail / Median Barrier / Attenuator Design) of this Manual.

10.17.6. Redirection Characteristics

Non-redirective attenuators shall be designed to capture an errant vehicle to avoid impact with the obstruction. Redirective attenuators shall be designed to redirect an errant vehicle away from the obstruction and back to the travel way. ~~Since sandfilled plastic barrels have no redirection capabilities, it is important that the recommended placement details shown in Exhibit 10-2 be adhered to so as to minimize the danger of a vehicle penetrating the barrier from the side and hitting the obstructions.~~

~~10.17.7. Allowable Deceleration Force~~

~~See Section 4 (Guide Rail / Median Barrier / Attenuator Design) of this Manual.~~

10.17.8.10.17.7. AnchorageInstallation Requirements

Some approved systems require an anchorage which is capable of restraining the crash cushion during an impact. The attenuator system shall be installed as directed by the manufacturer of the attenuator and in accordance with the MASH compliant testing parameters. manufacturer's standard designs of these crash cushions include the necessary anchorage. Refer to the Authority's websiteQPL for currently approved temporary attenuators.

10.17.9. Flying Debris Characteristics

Impact with an inertial barrier will produce some flying debris, but not enough to deter their use.

10.17.10.10.5.1. Initial Cost

Compare initial costs of approved attenuators.

10.17.11.10.17.8. Maintenance

Inertial barriersNon-redirective attenuators are particularly susceptible to damage during minor impacts. At locations where nuisance hits may be common or there is a high probability of crashes, attenuators with redirection capabilities should be considered as a means of reducing maintenance requirements.

10.17.9. Cost

Compare initial costs of approved attenuators. The Engineer should consider reducing the number of unique attenuators used throughout a project design.

10.17.12. Design Procedure

10.17.12.1. Inertial Barrier

The design of an inertial barrier is based on the law of conservation of momentum. It can be shown that:

Equation 1

$V_F = W(V_O / (W+W_S))$

V_F = velocity of vehicle after impact with M_s, in fps

V_O = velocity of vehicle prior to impact with M_s, in fps

W = weight of vehicle, in lbs.

W_S = weight of sand actually impacted by a 6 foot wide vehicle, in lbs.

This equation is used to calculate the velocity of a vehicle as it penetrates the inertial barrier. When a vehicle has been slowed to approximately 10 mph or less (14.7 fps) per Equation 1, it will actually have been stopped because of deceleration forces that have been neglected in Equation 1.

Slowing of the vehicle must take place gradually so that the deceleration force is 6G desirable, 8G maximum. The deceleration force is calculated using Equation 2. Note that velocity is in feet per second (fps).

Equation 2

$$G = (V_O^2 - V_F^2) / 2Dg$$

G = deceleration force in G's

V_O = velocity of vehicle prior to impact, in fps

V_F = velocity of vehicle after impact with one row of modules, in fps

D =distance traveled in decelerating from V_O to V_F (Usually **D** = width of a module = 3 ft.)

g =32.2 ft/s²

All temporary impact attenuators shall be designed for the posted regulatory speed limit prior to the start of the construction zone plus an additional 5 MPH.

The standard weights of modules used are 200 lbs., 400 lbs., 700 lbs., 1,400 lbs., and 2,100 lbs. However, the use of 2,100 lbs. module is not recommended unless site conditions are restricted and the use of 1,400 lbs. modules would not stop the vehicle from striking the obstruction.

A minimum of 2 modules are required in the last 3 rows of the barrier array to meet the 2.5 foot criteria shown in Exhibit 10-2. An additional last row of 1,400 lbs. modules is provided after required reduction in speed is obtained. When a wide obstruction is being shielded, the modules may be spaced up to 3 feet apart. However, this spacing must be accounted for in the design. W_S in Equation 1 is the weight of sand impacted by a 6-foot wide vehicle. Therefore, if 1,400 lbs. modules (3-foot diameter) were spaced 2 feet apart, W_S would equal 1,867 lbs.

Exhibit 10-3, Exhibit 10-4, Exhibit 10-5, and Exhibit 10-6 illustrate typical sand barrel configurations for narrow barrier arrays.

In the following two examples, first check the sand barrel configuration shown in Exhibit 10-5 for an 1,800 lb. vehicle and then make the same check for a 4,500 lb. vehicle. Assume a design speed of 60 mph (88 fps).

Example of Inertial Barrier Design for 1,800 lb. Vehicle:

ROW	**W_S**	**V_O**	**V_F***	**G***
1	200	88	79.2	7.6**

2	200	79.2	71.3	6.2
3	200	71.3	64.2	5.0
4	400	64.2	52.5	7.1
5	700	52.5	37.8	6.9
6	700	37.8	27.2	3.6
7	1400	27.2	15.3	2.6
8	2800	15.3	6.0	1.0
9	2800	--	--	--
10	2800	--	--	--

* V_F and G are calculated using Equations 1 & 2.

** It is desirable to limit G for each row to a maximum of 6. However, since 200 lbs. is the lightest module recommended for use, the 7.6 cannot be decreased.

Example of Inertial Barrier Design for 4,500 lb. Vehicle:

ROW	W_s	V_o	V_F*	G*
1	200	88	84.3	3.3
2	200	84.3	80.7	3.1
3	200	80.7	77.2	2.9
4	400	77.2	70.9	4.8
5	700	70.9	61.4	6.5
6	700	61.4	53.1	4.9
7	1400	53.1	40.5	6.1
8	2800	40.5	25.0	5.3
9	2800	25.0	15.4	2.0
10	2800	--	--	--

Initial Cost

Compare initial costs of approved attenuators.

ALL ARRAYS SHALL BE DESIGNED TO ACCOMMODATE BOTH 1800 LB AND 4500 LB VEHICLES.

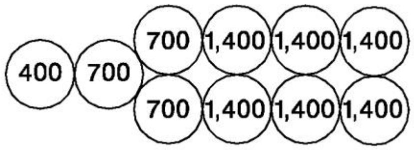
Since the assumed configuration (shown in Exhibit 10 - 5) meets all the requirements specified in the previous examples, no changes are necessary.

Manufacturers of inertial barriers have developed designs for various obstructions. Most of these designs are based on a maximum deceleration force of 6G's. However, the space required for a 6G design will not always be available, especially in gore areas, in which case, a design for higher deceleration forces (8G's maximum) may be used.

A layout of the modules including the weight of each module must be included as a construction detail in the contract plans.

~~Sand barrel layouts for wide obstructions are to be designed in accordance with the manufacture's instructions.~~

~~EXHIBIT 10 -3 TYPICAL SAND BARREL CONFIGURATION – 40 MPH DESIGN~~



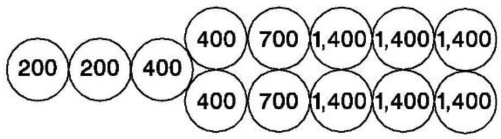
40 MPH DESIGN - 4,500# VEHICLE

ROW	W_S (LB)	V_O	V_f	G
1	400	58.7	53.9	2.8
2	700	53.9	46.6	3.8
3	1,400	46.6	35.5	4.7
4	2,800	35.5	21.9	4.0
5	2,800	21.9	13.5	1.5
~~6~~	~~2,800~~	~~-~~	~~-~~	~~-~~

40 MPH DESIGN - 1,800# VEHICLE

ROW	W_S (LB)	V_O	V_f	G
1	400	58.7	48.0	5.9
2	700	48.0	34.6	5.7
3	1,400	34.6	19.5	4.2
4	2,800	19.5	7.6	1.7
5	2,800	-	-	-
6	2,800	-	-	-

~~EXHIBIT 10 – 4 TYPICAL SAND BARREL CONFIGURATION – 50 MPH DESIGN~~



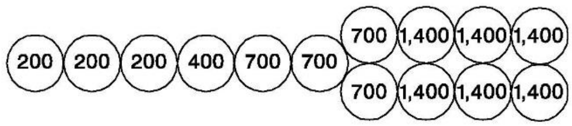
50 MPH DESIGN - 4,500# VEHICLE

ROW	W_s (LB)	V_o	V_f	G
1	200	73.3	70.2	2.3
2	200	70.2	67.2	2.1
3	400	67.2	61.7	3.7
4	800	61.7	52.4	5.5
5	1,400	52.4	40.0	5.9
6	2,800	40.0	24.7	5.1
7	2,800	24.7	15.2	2.0
~~8~~	~~2,800~~	~~-~~		

50 MPH DESIGN - 1,800# VEHICLE

ROW	W_s (LB)	V_o	V_f	G
1	200	73.3	66.0	5.3
2	200	66.0	59.4	4.3
3	400	59.4	48.6	6.0
4	800	48.6	33.6	6.4
5	1,400	33.6	18.9	4.0
6	2,800	18.9	7.4	1.6
7	2,800	-	-	-
8	2,800	-	-	-

~~EXHIBIT 10 -5 TYPICAL SAND BARREL CONFIGURATION – 60 MPH DESIGN~~



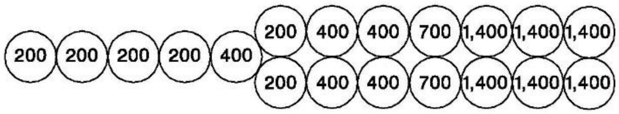
60 MPH DESIGN - 4,500# VEHICLE

ROW	W_S (LB)	V_O	V_f	G
1	200	88.0	84.3	3.3
2	200	84.3	80.7	3.1
3	200	80.7	77.2	2.9
4	400	77.2	70.9	4.8
5	700	70.9	61.4	6.5
6	700	61.4	53.1	4.9
7	1,400	53.1	40.5	6.1
8	2,800	40.5	25.0	5.3
9	2,800	25.0	15.4	2.0
~~10~~	~~2,800~~	~~-~~	~~-~~	~~-~~

60 MPH DESIGN - 1,800# VEHICLE

ROW	W_S (LB)	V_O	V_f	G
1	200	88.0	79.2	7.6
2	200	79.2	71.3	6.2
3	200	71.3	64.2	5.0
4	400	64.2	52.5	7.1
5	700	52.5	37.8	6.9
6	700	37.8	27.2	3.6
7	1,400	27.2	15.3	2.6
8	2,800	15.3	6.0	1.0
9	2,800	-	-	-
10	2,800	-	-	-

EXHIBIT 10- 6 TYPICAL SAND BARREL CONFIGURATION – 70 MPH DESIGN



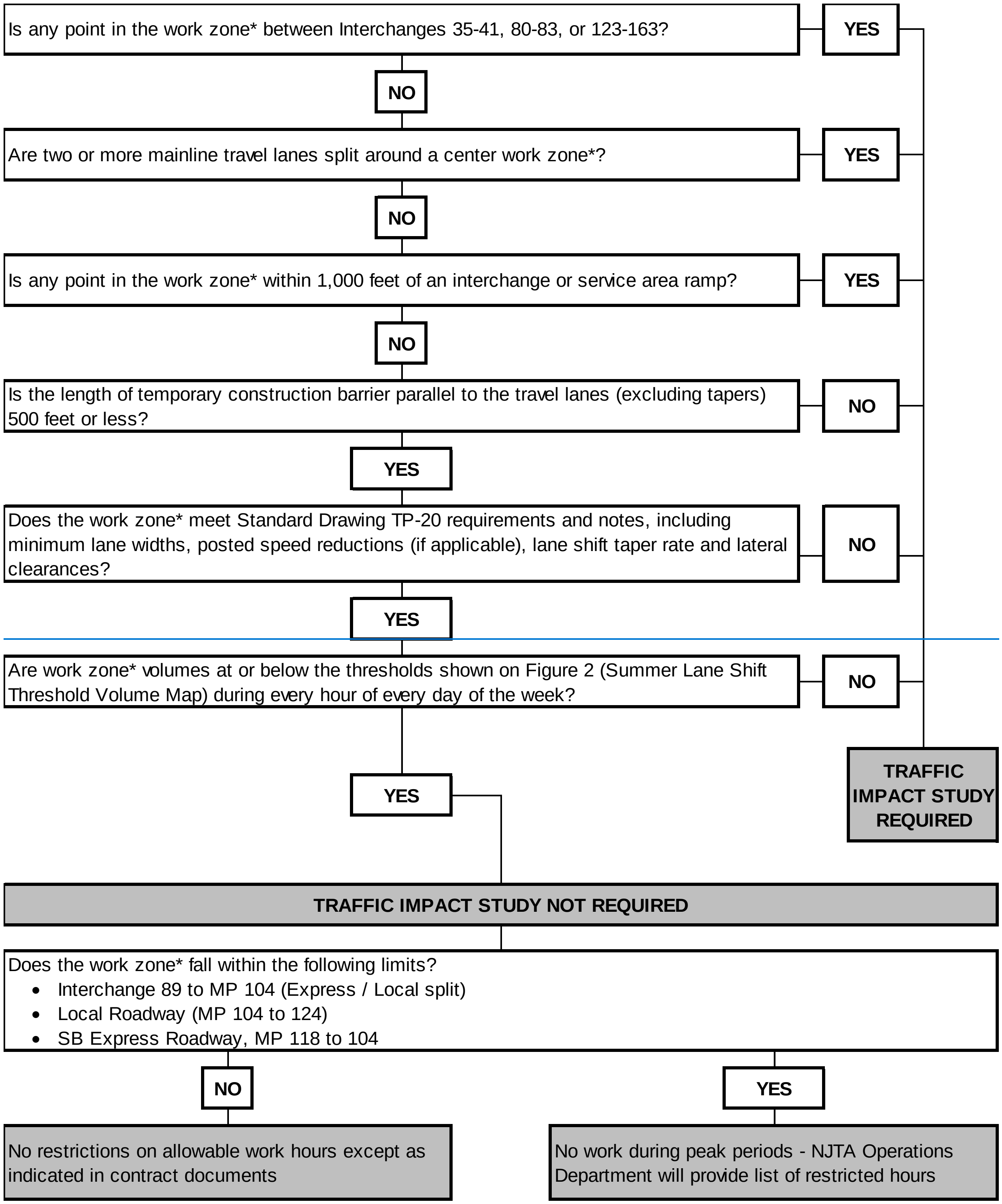
70 MPH DESIGN - 4,500# VEHICLE

ROW	W_S (LB)	V_O	V_f	G
1	200	102.7	98.4	4.5
2	200	98.4	94.2	4.2
3	200	94.2	90.2	3.8
4	200	90.2	86.4	3.5
5	400	86.4	79.2	6.0
6	400	79.2	72.7	5.1
7	800	72.7	61.7	7.7
8	800	61.7	52.5	5.5
9	1400	52.5	40.0	6.0
10	2800	40.0	24.6	5.1
11	2800	24.6	15.3	2.0
12	2800	-	-	-

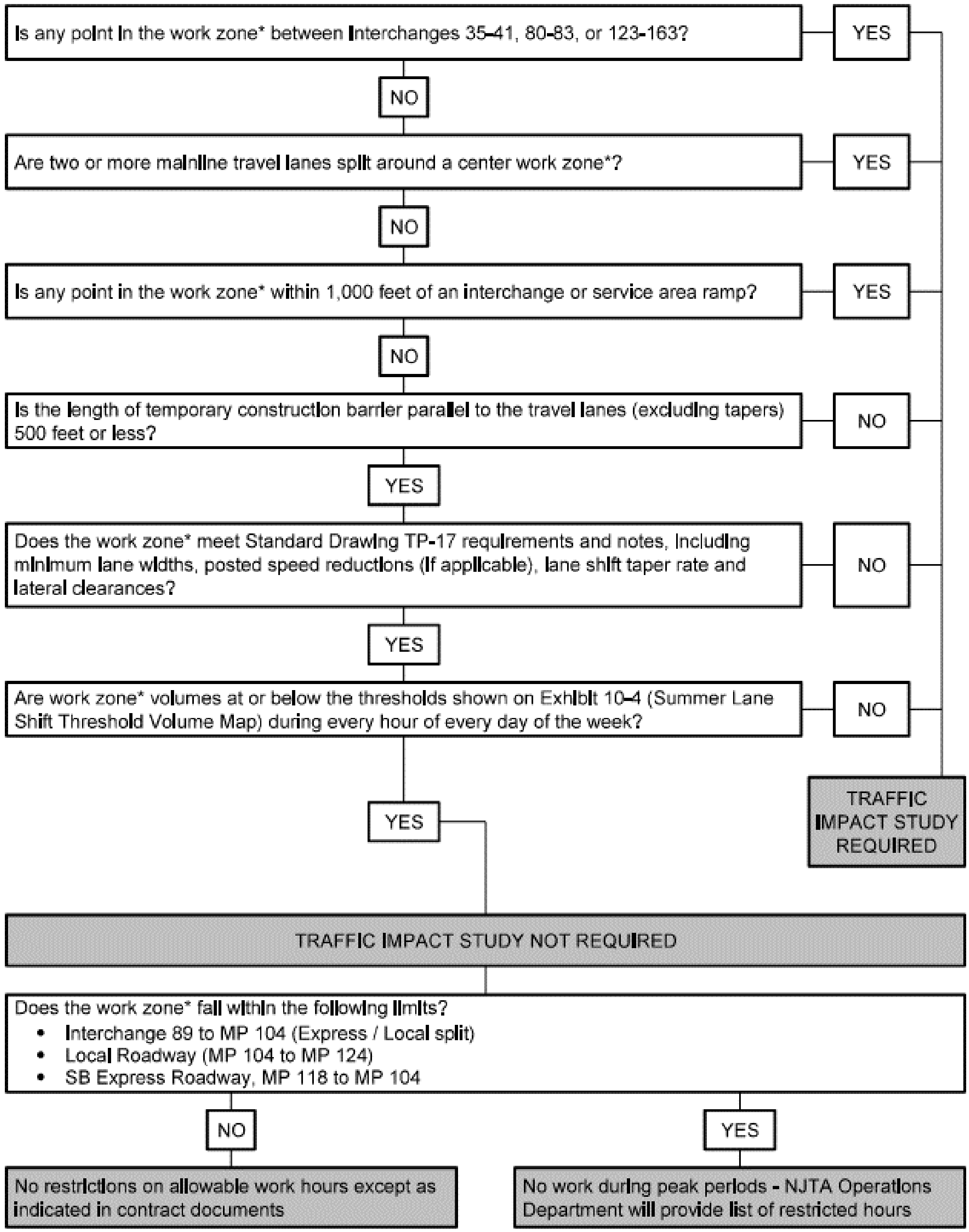
70 MPH DESIGN - 1,800# VEHICLE

ROW	W_S (LB)	V_O	V_f	G
1	200	102.7	92.4	10.4
2	200	92.4	83.2	8.4
3	200	83.2	74.9	6.8
4	200	74.9	67.3	5.5
5	400	67.3	55.1	7.8
6	400	55.1	45.2	5.2
7	800	45.2	31.2	5.5
8	800	31.2	21.6	2.6
9	1400	21.6	12.2	1.7
10	2800	12.2	4.7	.6
11	2800	4.7	1.9	.1
12	2800	-	-	-

EXHIBIT 10 -~~7~~ 3 GARDEN STATE PARKWAY SUMMER LANE SHIFT RESTRICTIONS FLOW CHART

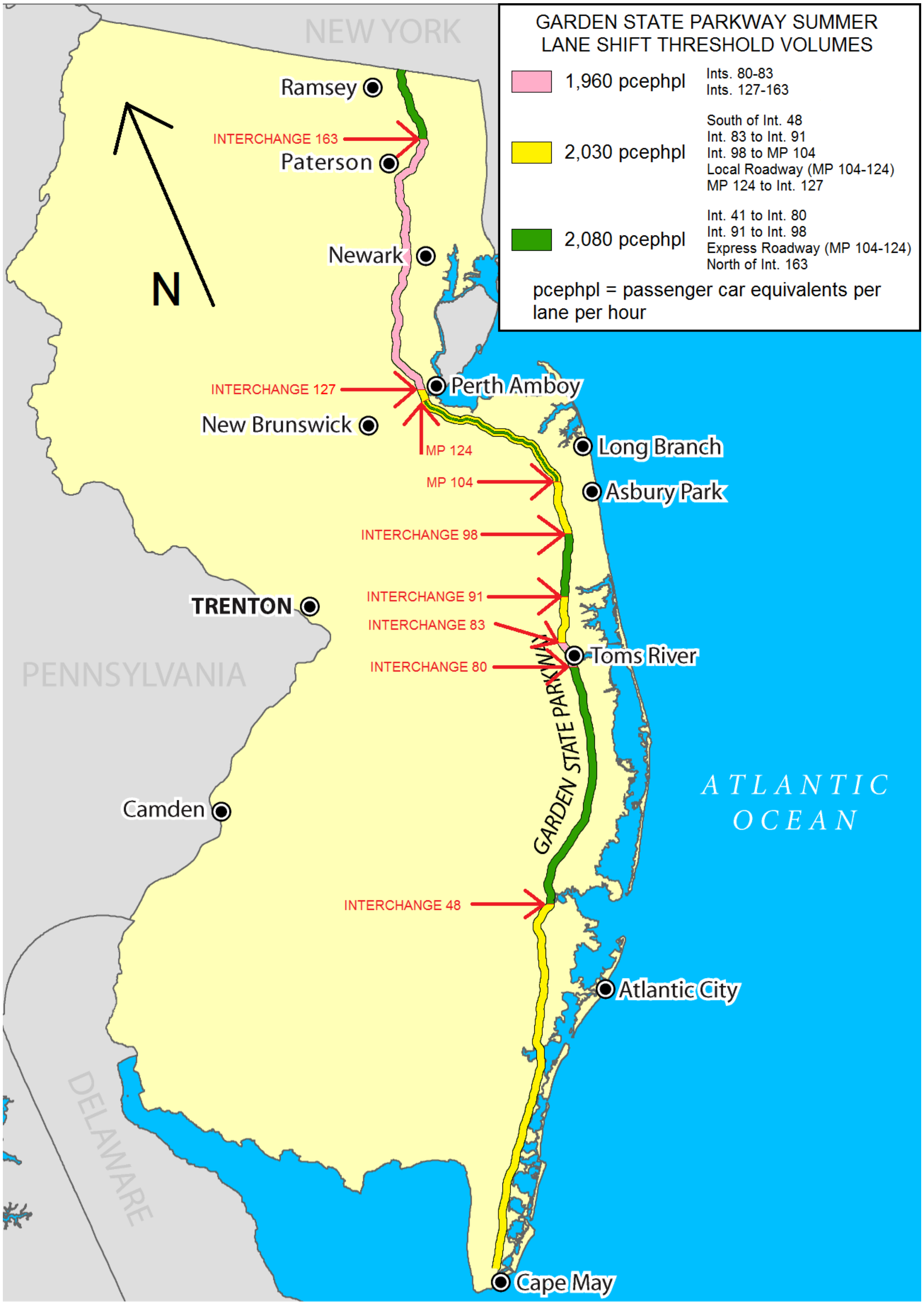


* "Work zone" is measured from the beginning of the shoulder closure taper to the last cone or barrier segment in the closure.



* "Work zone" is measured from the beginning of the shoulder closure taper to the last cone or barrier segment in the closure.

EXHIBIT 10 -8 4 GARDEN STATE PARKWAY SIUMMER LANE SHIFT THRESHOLD VOLUME MAP


GARDEN STATE PARKWAY SUMMER LANE SHIFT THRESHOLD VOLUMES
1,960 pcephpl
Ints. 80-83
Ints. 127-163
2,030 pcephpl
South of Int. 48
Int. 83 to Int. 91
Int. 98 to MP 104
Local Roadway (MP 104-124)
MP 124 to Int. 127
2,080 pcephpl
Int. 41 to Int. 80
Int. 91 to Int. 98
Express Roadway (MP 104-124)
North of Int. 163
pcephpl = passenger car equivalents per lane per hour
NEW YORK
N
Ramsey
INTERCHANGE 163
Paterson
Newark
INTERCHANGE 127
Perth Amboy
New Brunswick
MP 124
Long Branch
MP 104
Asbury Park
INTERCHANGE 98
INTERCHANGE 91
TRENTON
INTERCHANGE 83
Toms River
INTERCHANGE 80
PENNSYLVANIA
GARDEN STATE PARKWAY
ATLANTIC OCEAN
Camden
INTERCHANGE 48
Atlantic City
DELAWARE
Cape May