

**Schedule 15A**  
**Operating Standards (Volume I)**  
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**TOLL ROAD CONCESSION AGREEMENT  
PR-20, PR-52, PR-53 & PR-66**



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**VOLUME I OF III  
MAINTENANCE MANUAL**

**Execution Version**

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**VOLUME III – ENVIRONMENTAL MANAGEMENT MANUAL**

<u>CHAPTER</u>	<u>TITLE</u>
A.	ORGANIZATION AND GENERAL INFORMATION
B.	ENVIRONMENTAL MANAGEMENT PLAN

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## **A.1 Purpose of Manual**

The Operating Standards are comprised of three (3) separate and unique Volumes, as follows:

- A Volume I – Maintenance Manual
- B Volume II – Operations & Procedures Manual
- C Volume III – Environmental Management Manual

In general, the Operating Standards provide guidelines and criteria to the Concessionaire regarding the standards, specifications, policies, procedures, permits and processes that apply to the operation, maintenance, rehabilitation, tolling of, and improvements to the Toll Roads.

The purpose of this Manual is to provide the general terms and conditions for performing the required maintenance activities on and within the limits of the Toll Roads, as stated in the Toll Road Concession Agreement.


For purposes of the Operating Standards, the terms "PR-52" or "Luis A. Ferré Highway" shall mean all the features, elements, systems, etc., that are present within the boundaries established in accordance with the Toll Road Concession Agreement, without exception. In the same way the following highways: the term "PR-53" or shall mean all "José Celso Barbosa Highway" the features, elements, systems, etc., that are present within the boundaries established in accordance with the Toll Road Concession Agreement, without exception; the term "PR-66" or shall mean all "Roberto Sánchez Vilella" the features, elements, systems, etc., that are present within the boundaries established in accordance with the Toll Road Concession Agreement, without exception; and the term "PR-20" or shall mean all "Rafael Martínez Nadal " the features, elements, systems, etc., that are present within the boundaries established in accordance with the Toll Road Concession Agreement, without exception.

Similarly, the terms "Toll Road" or "Toll Roads" shall mean all the features, elements, systems, etc., that are present within the boundaries established herein that relate to the collective system of PR-52, PR-53, PR-66 and, PR-20 and in accordance with the Toll Road Concession Agreement, without exception.

## **A.2 Abbreviations and Acronyms**

The following abbreviations and acronyms are applicable for both Volume I – Maintenance Manual, and for Volume II – Operations and Procedures Manual.

AADT	Average Annual Daily Traffic
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACM	Automatic Coin Machine
ADA	Americans with Disabilities Act
ADT	Average Daily Traffic
AIA	American Institute of Architects
ANSI	American National Standards Institute
APHIS	Animal and Plant Health Inspection Service
ASME	American Society of Mechanical Engineers
ASQ	American Society for Quality
ASTM	American Society for Testing and Materials
ATD	Automatic Traction Devices
ATIS	Advanced Traveler Information System
AWWA	American Water Works Association
BA	Bachelor of Arts
BS	Bachelor of Science
BSCE	Bachelor of Science – Civil Engineering
CAN	Collision/Accident Notification
CCTV	Closed-Circuit Television
CFR	Code of Federal Regulations
CMA	Calcium Magnesium Acetate
CMS	Changeable Message Sign
COOP	Concept of Operations Plan

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DHS	Department of Homeland Security
DMS	Dynamic Message Sign
DNER	Department of Natural and Environmental Resources of Puerto Rico
DTL	Dynamic Toll Lane
DTPW	Department of Transportation and Public Works
EB	Eastbound
EIT	Engineer in Training
EMDA	Emergency Management and Disaster Administration State Agency
EMM	Emergency Management Manual
EMOP	Emergency Management and Operation Plan
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ETC	Electronic Toll Collection
ESF	Emergency Support Function
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigations
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
GIS	Geographic Information System
GPS	Global Positioning System
GVW	Gross Vehicle Weight
HAL	High Accident Location
HAR	Highway Advisory Radio
HSAS	Homeland Security Advisory System
HVAC	Heating, Ventilation and Air Conditioning
IBC	International Building Code
ICC	International Code Council

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ICS	Incident Command System
ID	Identification
IESNA	Illuminating Engineering Society of North America
IEEE	Institute of Electrical and Electronic Engineers
IMC	International Mechanical Code
IRI	International Roughness Index
ISO	International Standardization Organization
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
KM	Kilometer
KP	Kilometer Post
LEED	Leadership in Energy and Environmental Design
LFD	Load Factor Design
LOS	Level of Service
LRFD	Load Resistance Factor Design
MEP	Mechanical, Electrical and Plumbing System
MIST	Management Information System for Transportation
MOT	Maintenance of Traffic
MPT	Maintenance and Protection of Traffic
MSDS	Material Safety Data Sheet
MSE	Mechanically Stabilized Earth
MTS	Maintenance Testing Specifications
MUTCD	Manual on Uniform Traffic Control Devices
NBIS	National Bridge Inspection Standards
NCHRP	National Cooperative Highway Research Program
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association

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NHI	National Highway Institute
NHS	National Highway System
NIMS	National Incident Management System
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic & Atmospheric Administration
NOTAM	Notice to Airmen
NPDES	National Pollutant Discharge Elimination System
NWR	NOAA Weather Radio
O & M	Operations and Maintenance
OEM	Original Equipment Manufacturer
ORT	Open Road Tolling
OSHA	Occupational Safety and Health Administration
PCC	Portland Cement Concrete
PCMS	Portable Changeable Message Sign
PE	Professional Engineer
PERI	Public Entity Risk Institute
PPPA	Public-Private Partnerships Authority of Puerto Rico
PR	Puerto Rico
PREQB	Puerto Rico Environmental Quality Board
PRHTA	Puerto Rico Highway and Transportation Authority
PRPB	Puerto Rico Planning Board
PRP	Puerto Rico Police
QC	Quality Control
QA	Quality Assurance
QMS	Quality Management System
QMSPM	Quality Management System Policy Manual
QPM	Quality Procedures Manual
RPC	Regional Planning Commission
RCSRS	Rock Cut Slope Rating System
RHRS	Rockfall Hazard Rating System
RPZ	Reduced Pressure Zone
RWIS	Road Weather Information System

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SHRP	Strategic Highway Research Program
SE	Structural Engineer
SSPC	Society for Protective Coatings
SUV	Sport Utility Vehicle
SWPPP	Storm Water Pollution Prevention Plan
TCS	Toll Collection System
TFDS	Traffic Flow Detection System
TMC	Traffic Management Center
TRB	Transportation Research Board
TRWS	Truck Rollover Warning System
UL	Underwriters Laboratory
UPS	Uninterruptible Power Supply
USDA	United States Department of Agriculture
USGS	United States Geological Society
USEPA	United States Environmental Protection Agency
VE	Value Engineering
VHF	Very High Frequency
VMS	Variable Message Sign
VOC	Volatile Organic Compound
VSL	Variable Speed Limit Signs
WAN	Wide Area Network
WB	Westbound
WBS	Work Breakdown Structure
WPOA	Western Plumbing Officials Association

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### **A.3 Toll Road Concession Agreement**

#### A.3.1 Toll Road Concession Agreement

The Operating Standards are governed by the terms and conditions of the Toll Road Concession Agreement, dated as of \_\_\_\_\_, 2023 (the "Toll Road Concession Agreement") by and between the Puerto Rico Highways and Transportation Authority ("PRHTA" or the "Authority") and \_\_\_\_\_ (the "Concessionaire").

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#### **A.4 Maintenance Objective**

The objective of maintenance work within the Toll Roads is to provide motorists a safe and pleasant passage throughout the Toll Roads, while maintaining the Toll Roads as an asset. The major objectives of the Concessionaire's maintenance program include, but are not limited, to the following:

- Maintaining all Toll Road features, elements, components and systems in the best possible condition at all times.
- Improving features that do not meet the requirements of the Operating Standards, with the goal to exceed the minimum stated within the Operating Standards.
- Maintain the Right-Of-Way and each type of roadway, structure, safety convenience or device, planting, signage, illumination equipment and other facility, in a safe and usable condition to which it has been improved or constructed.
- Providing proper maintenance, safety and traffic devices for minimal disruptions and hazards to traffic.
- Identifying and improving safety features and situations.
- Establishing an inventory of maintenance features, including a method of locating and referencing those features.
- Establishing work procedures.
- Maintaining a regular program of maintenance for all aspects of Toll Road maintenance.
- Providing immediate and proper response to emergency and third-party events.
- Performing routine, preventative, on-demand and emergency maintenance activities and work.
- Maintaining the toll revenue systems, dynamic toll lane systems, intelligent transport systems, special safety conveniences and devices, and illumination equipment.

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### **A.5 Review of Construction Projects & As-Built Drawings**

Whenever maintenance, renewal or expansion work requires that a member, component, system or element, etc. be replaced or significantly repaired, the Concessionaire must create a set of Original Construction Documents and Drawings, signed and sealed by a Licensed Professional Engineer in the Commonwealth of Puerto Rico. Such construction drawings and documents are subject to review and approval by the PRHTA.

Upon completion of construction, the Concessionaire must prepare and submit to PRHTA a complete set of original and As-Built drawings in both hard copy and electronic format (in the platform predetermined and prescribed by PRHTA) for the work completed. In addition, the Concessionaire will be responsible for creating a separate Original and As-Built set of drawings for the record. The As-Built drawings shall be stamped or marked "AS-BUILT", dated, and must be saved and placed with all other records maintained with respect to the Toll Roads pursuant to the Agreement.

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## **A.6 Maintenance Management Information System (MMIS)**

The Concessionaire must implement a computer based MMIS to record inventory, failures, repairs, maintenance activities and inspections performed. The Concessionaire must enter all the physical elements of the asset into the MMIS with Element identifications (IDs) consistent with those descriptions and units of measure used by PRHTA. All information must be recorded in a consistent manner and must be searchable by individual attribute.

The Concessionaire must include relevant physical Element information in the MMIS including but not limited to, location, equipment nomenclature, serial number, name, date of installation, technician ID, type of failure, date-time of failure, date-time of response to the site and date-time time returned to service, preventive maintenance work, scheduled work, work repair code, failure and repair history, and statistical data on mean time between failure and mean time to repair. The MMIS must be configured to report work by PRHTA function code, physical Element, reference marker, crew and unit of measurement. In the MMIS, the information for bridges must include National Bridge Inventory (NBI) sheets.

The MMIS must be capable of reporting system performance on a geographical basis to demonstrate compliance with the Operating Standards. The MMIS must incorporate a Geographical Information System (GIS), which must use the same database engine as the MMIS and must use the MMIS for display of physical Element information. All physical Elements must be recorded on the MMIS. The physical Element locations are to be accurate to within one foot in 100 feet. The information displayed geographically must include pavement condition measurements, maintenance limits, average daily traffic, Work performed by roadway segment, type of work, crew/contractor, and any other information relevant to the construction, operation, maintenance and renewal. When a physical Element is constructed, installed, maintained, inspected, modified, replaced, or removed, the MMIS must be updated within three (3) days of completion of such correcting tasks. Defects must be recorded on the MMIS within three (3) days of them coming to the attention of the Concessionaire. All other recording requirements must be recorded on the MMIS within fifteen (15) days of completion or occurrence of the relevant activity.

The Concessionaire must fully populate and make operational the MMIS before two (2) years after the Closing Date and must keep the MMIS updated and operational during the Term. The Concessionaire must provide equipment, facilities and training necessary to permit remote, real-time, dedicated high-speed access to the MMIS, via one terminal for PRHTA.

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## **A.7 Protection of the Environment and Natural Resources**

The protection of natural resources is an essential and significant activity within the Toll Roads. The Concessionaire must comply with all requirements in protecting the natural resources of the region, the environment and any threatened or endangered species.

If a project or activity may affect resources, such as wetlands, flood plains, Department of Transportation Act Section 4(f) properties, or threatened or endangered species, an evaluation of alternatives appropriately addressing avoidance, minimization and mitigation options as required by regulations applicable to those resources must be prepared. In addition, if the preferred alternative will affect such resources, adequate justification must be provided to explain why avoidance alternatives were not selected.

### **A.7.1 Noise Control**

Special efforts must be made in the development of a project or activity to comply with Federal, Commonwealth and municipal requirements for noise control. Efforts must be made to consult with appropriate officials to obtain the views of the affected communities regarding noise impacts and abatement measures and to mitigate any highway-related or construction noise impacts.

### **A.7.2 Water Quality**

The Toll Road system must be constructed, operated and maintained in compliance with all applicable Federal, Commonwealth and municipal requirements relating to the protection of water quality. No construction improvement, maintenance activity, or daily activity may decrease the quality of surface waters, ground waters, or wetlands.

### **A.7.3 Air Quality**

The Toll Road system must be constructed, operated and maintained in compliance with all applicable Federal, Commonwealth and municipal requirements relating to air pollution, including any air implementation plans.

### **A.7.4 Dust Control**

Dust control is essential in maintaining clean air and the prevention of airborne pollutants. Dust must be controlled within the Toll Roads by implementing best management practices for all construction and daily activities including land disturbance, demolition, and material handling processes.

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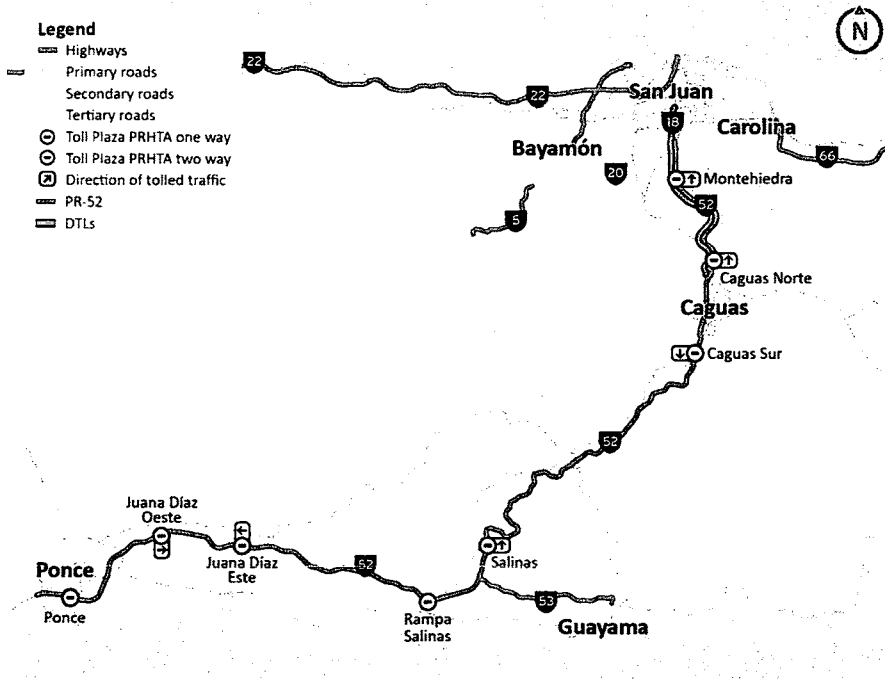
#### A.7.5 Threatened and Endangered Species

In the development of a project, an assessment must be made of the likely impacts on species of plants or animals listed at the Federal and Commonwealth level as threatened or endangered, and on Commonwealth-designated natural areas. Every effort must be made to minimize the likelihood of jeopardizing the continued existence of listed threatened or endangered species or the destruction or adverse modification of a natural area or an area of habitat which has been designated as critical habitat or essential habitat.

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## A.8 Location of the Toll Roads

Figure A.8.1: Location Map, PR-52



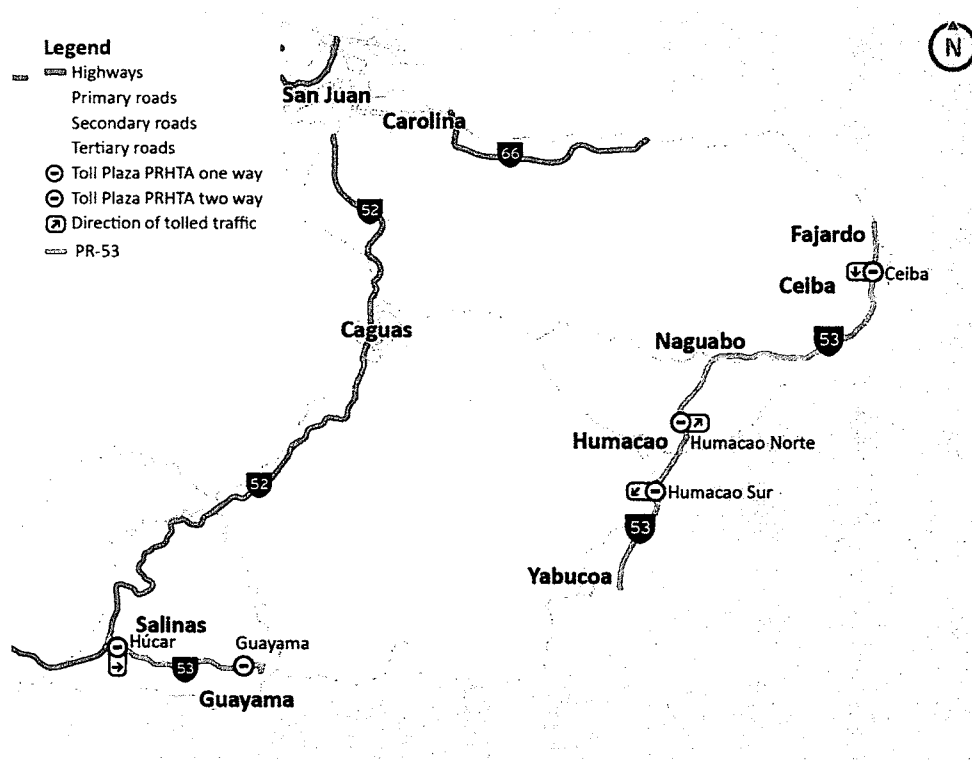
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Also known as the “Luis A. Ferré Highway,” PR-52 is the longest toll road on the island and is designated as part of the National Highway System (“NHS”). PR-52 commences at the intersection of PR-18 (other than the DTLs described below, which start on PR-18) and PR-1 in the municipality of San Juan and runs southwest for a total length of 108.3 km (67.3 miles). PR-52 connects the municipality of San Juan with the municipalities of Trujillo Alto, Caguas and Cayey, leads into Salinas, Santa Isabel and Juana Díaz, and ends in Ponce in the south of the island. PR-52 directly serves a total of fifteen municipalities with an aggregate population of over one million in 2021. PR-52 is a critical route between San Juan, in the north, and the economic activity that takes place in the southern region of Puerto Rico. Construction of PR-52 (other than the DTLs) began in 1968 and was completed in 1975. The DTLs commenced operations in April 2021. In 1993, the Commonwealth enacted Act No. 118-1993, which named PR-52 as the “Luis A. Ferré Highway.”

The dynamic toll lanes on PR-52 (the “DTLs”) consist of a corridor that extends through a portion of PR-52 and also a portion of each of PR-18 and PR-1. The DTLs (including for avoidance of doubt, the PR-52, PR-18 and PR-1 portions) are all included in the Project and constitute part of the Toll Roads.

The DTLs consist of two reversible lanes on a median between San Juan (beginning at PR-18 before the overpass bridge over Americo Miranda Avenue) and Caguas Norte Toll Plaza for a total distance of approximately 16 km (10 miles), and serve passenger cars travelling northbound to San Juan in the morning, and travelling southbound to Caguas in the evening.

Figure A.8.2: Location Map, PR-53

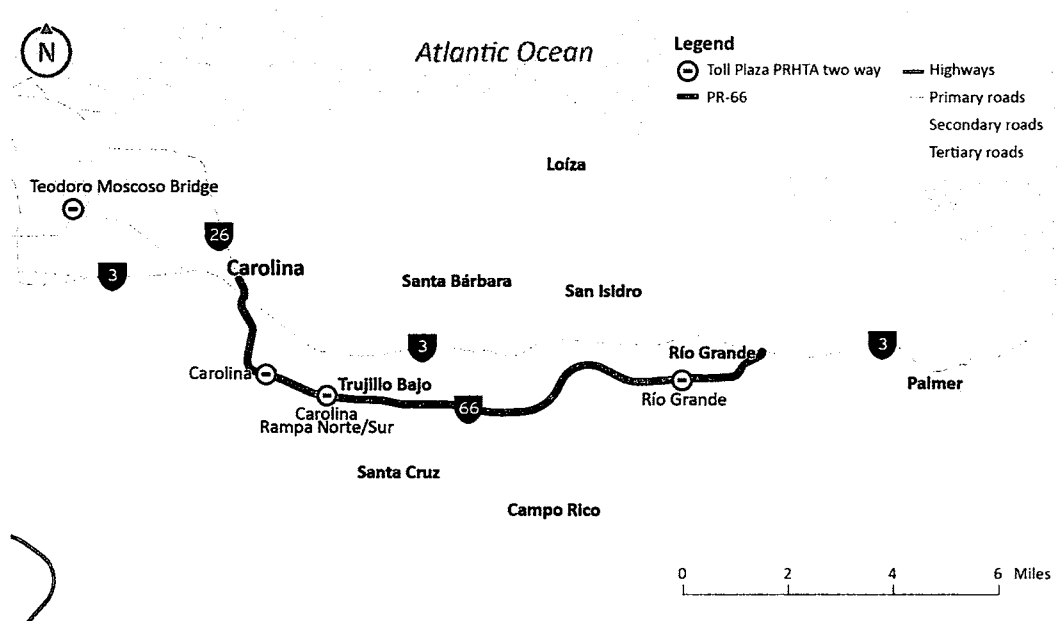


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Officially named the “José Celso Barbosa Highway,” Puerto Rico Highway 53 is part of the NHS and consist of several intermittent segments, commencing in the municipality of Fajardo and ending in Salinas at the intersection with PR-52. The construction of the José Celso Barbosa Highway began in 1998, with its first segment opening to the public in 1994. This highway serves traffic in the easternmost part of the island with direct service to seven municipalities, which had a population of approximately 220,167 as of 2021. It runs parallel to PR-3, which travels from the municipality of Fajardo to the municipality of Salinas.

For purposes of the Project, only the toll road portions of the José Celso Barbosa Highway will constitute part of the Toll Roads, and the Toll Roads will also include a 0.6 km (0.37 mile) segment of Puerto Rico Highway 54 that is adjacent to the José Celso Barbosa Highway. For such reason, as used herein, “PR-53” refers to: (i) a segment commencing at the PR-3 intersection in Fajardo and extending for 43.7 km (27.15 miles) to the PR-9914 intersection in Yabucoa and (ii) a segment commencing at the intersection of PR-7711 and PR-54 in Guayama and extending fo 12.3 km (7.64 miles) to the PR.52 intersection in Salinas.

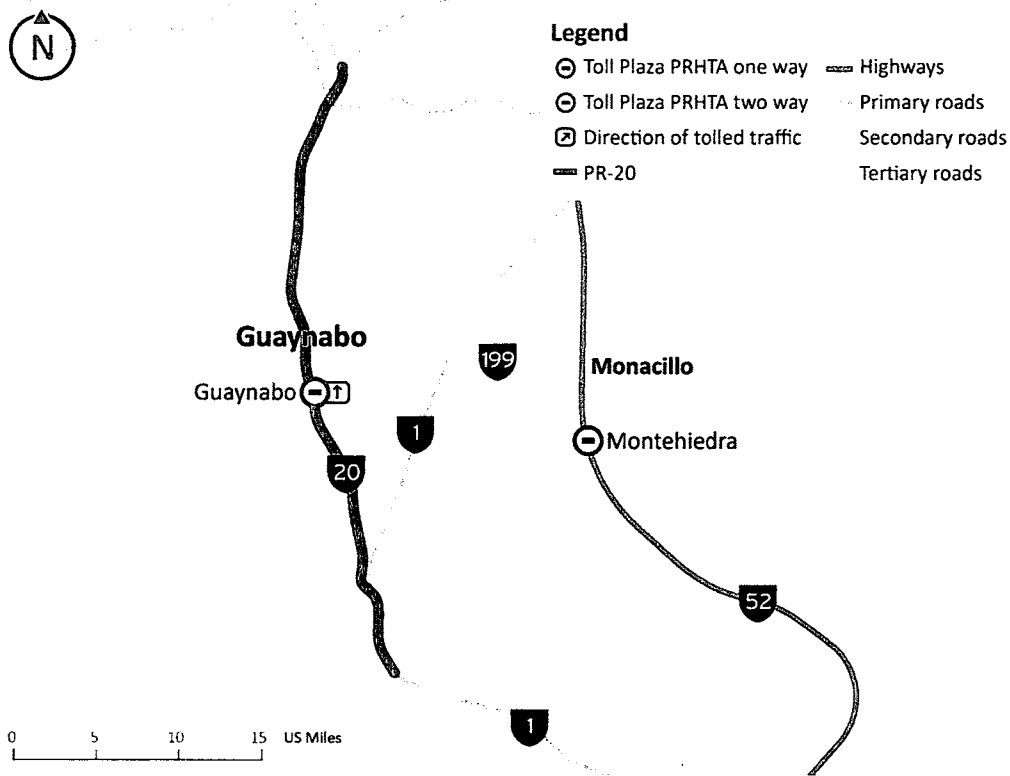
Figure A.8.3: Location Map, PR-66



Officially named the “Roberto Sánchez Vilella Highway,” PR-66 travels east-west for 19.5 km (12.1 miles). PR-66 commences at the PR-3 intersection, extends through the municipalities of Carolina and Canóvanas, and ends in the municipality of Río Grande. PR-66 serves the northeastern portion of Puerto Rico. The three municipalities directly served by PR-66 had a total population of approximately 242,528 in 2021. The municipality of Carolina serves as the home location of Puerto Rico’s Luis Muñoz Marín International Airport and is part of the San Juan Metropolitan Area, which makes PR-66 a key corridor within the San Juan metro transportation system. PR-66 was developed to improve connectivity to the eastern region.

PR-66 was developed in two major phases. The first phase, which crosses the municipalities of Carolina and Canóvanas, began construction in 1997 and opened for operations in 2006. This first phase has the widest bridges in Puerto Rico. Subsequently, the second phase extended PR-66 from PR-188 in Canóvanas to PR-3 in Río Grande. The second phase of PR-66 consisted of an extension of 6.1 km (3.8 miles) that opened to the public in 2012. The competing alternate route, PR-3, is a non-tolled, signaled road with notable congestion.

Figure A.8.4: Location Map, PR-20



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Officially named the "Rafael Martínez Nadal Expressway," PR-20 is a 9.5 kilometer (5.9 miles) urban expressway entirely located in the municipality of Guaynabo. PR-20 runs from an intersection with PR-2 near San Patricio Plaza Mall in Caparra, Guaynabo, to its convergence with PR-1 near the area of La Muda in Guaynabo. The municipality had a population of 89,195 in 2021 and is located between the two most populous municipalities in Puerto Rico, San Juan and Bayamón, which together had a combined population of approximately 519,973 in 2021.

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## **B.1. Definitions**

Access Roads: Those roadways located within the Toll Roads that are closed to the general public and are intended only for use by maintenance, inspection or utility traffic.

Asphalt: A bituminous substance, soluble in gasoline or naphtha; used in liquid form for roadway work in crack and joint sealing and to cement together and coat the surface of mineral aggregates.

Base Course: The layer or layers of a specified material of designed thickness placed on a subbase or a subgrade to support a surface course.

Bituminous Concrete: A designed combination of dense graded mineral aggregate filler and asphalt cement mixed in a central plant, laid, and compacted while hot.

Bleeding: The accumulation of excess bituminous material on the roadway surface, caused by heat or the use of excessive quantities of bituminous material in construction, patching or resurfacing.

Blowup: Displacement of rigid-type pavement by a combination of vertical and horizontal stresses due to expansion. Generally, a blow-up is a heave in a concrete pavement caused by pavement expansion from excessive heat, sometimes resulting in shattering or displacement of the road surface.

Concrete: A mixture usually composed of Portland Cement, an aggregate of hard, inert particles and water.

Composite Pavement: A pavement structure consisting of a Portland Cement Concrete base course overlaid with one or more courses of bituminous surface material.

Course: A layer of road material, separately compacted, used as a wearing surface or as a base for a wearing surface.

Crack: A fissure or open seam potentially extending through the entire depth of the pavement.

Emulsion: A suspension of extremely small droplets of asphalt coated with water in the presence of an agent, which is usually a type of detergent.

Erosion: A slow wearing away of the surface by natural action (weather) or by usage (traffic).

Faulting: is the vertical misalignment of pavement joints in concrete pavements.

Flexible Pavement: A pavement structure which maintains intimate contact with

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and distributes loads to the subgrade and depends on aggregate interlock, particle friction, and cohesion for stability.

Hot Mix: A general term used for hot plant mixed bituminous concrete and sheet asphalt mixtures which are manufactured and laid at temperatures ranging from 250°F and above.

International Roughness Index (IRI): The accepted standard for measuring the roughness (ride quality) of a pavement surface. The IRI measures pavement roughness in terms of the number of inches per mile a laser-based device moves as it is driven along the pavement. The lower the number, the better the ride.

Joints: Designed or designated vertical planes of separation used in placing concrete pavement to aid in contraction, expansion, or construction.

Mainline: The portion of the multi-lane Expressway along the traveled way of the Toll Roads extending from shoulder line to shoulder line.

Median: The portion of a divided highway separating the traveled ways for traffic in opposite directions.

Mud jacking: An operation that raises a section of concrete pavement by hydraulic on pneumatic pressure applied by forcing an approved slurry mortar under the section to be raised.

Overlay: A layer of new bituminous concrete over an existing bituminous or concrete pavement.

Patching: Mending, repairing; especially, to repair a road surface.

Pavement Structure: The combination of subbase, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

Pothole: An area where a piece of pavement has broken free and been removed, leaving a hole.

Portland Cement: A hydraulic cement consisting of compounds of silica, lime and alumina; so called because of its resemblance in color, when set, to the Portland stone of England.

Ramp: The portion of the traveled way that provides access between the mainline and the local street network, or connectivity of different mainlines or other ramp, that extends from shoulder line to shoulder line or from curb line to curb line.

Raveling: The progressive loosening and loss of the aggregate material in the

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surface course of a road as it separates from adjacent material.

Resurfacing: Placing of one or more new layers of material on an existing pavement surface.

Rigid Pavement: A pavement structure which distributes loads to the subgrade and has one course typically constructed with Portland cement concrete, bounded by joints and edges.

Rocking or Pumping Pavement: Conditions in which one or more rigid or composite pavement sections move or rotate under wheel contact, with the slab itself remaining relatively sound.

Roadway: All portions of the mainline pavement along the Toll Roads, including shoulders and ramps, for vehicular users.

Rutted and Shoved Pavement: Deformations in which the bituminous surface of the pavement has worn into longitudinal depressions or heaves due to repetitive passes of vehicle tires, or transverse corrugations due to vehicle deceleration and acceleration.

Shoulder: The portion of the roadway contiguous with the mainline or ramp traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

Subbase: The layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

Subgrade: The layer of a roadbed upon which the pavement structure and shoulders including curbs are constructed.

Surface Course: Layer of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion and the disintegrating effects of climate. This layer is sometimes called the "Wearing Course".

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## **B.2 References**

All stated references must be the most current version of such reference or, if applicable, of the document known to have succeeded or replaced the original reference stated herein:

- Design Directives, PRHTA
- Guidelines for the Selection and Installation of Orientation Signs, PRHTA
- Highway Design Manual, PRHTA
- Signage Guide, PRHTA
- Standard Drawings, PRHTA
- Standard Specifications for Road and Bridge Construction, PRHTA
- Traffic Sign Manual, PRHTA
- A Guide to Standardized Highway Barrier Hardware, AASHTO
- A Policy on Geometric Design of Highways and Streets, AASHTO
- Guide for Design of Pavement Structures, Volume I, AASHTO
- LRFD Bridge Construction Specifications, AASHTO
- LRFD Bridge Design Specifications, AASHTO
- Roadside Design Guide, AASHTO
- Standard Specification for Highway Bridges, AASHTO
- Pavement Management Guide, AASHTO
- Manual Uniform Traffic Control Devices (MUTCD), FHWA
- Methods for Maintaining Traffic Sign Retro reflectivity, FHWA
- National Bridge Inspection Standard Regulation, FHWA
- Publication "SHRP-H-348: Asphalt Pavement Repair Manuals of Practice", FHWA
- Publication "SHRP-H-349: Concrete Pavement Repair Manuals of Practice", FHWA
- Recording and coding guide for the structure inventory appraisal of the Nation's bridge, FHWA
- Distress Identification Manual for Long term pavement performance program
- Standard Operation Procedure Bridges (PRHTA)

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## B.3 Policy for Performing Roadway Pavement & Shoulder Maintenance Work

### B.3.1 Objective

The objective of Roadway Maintenance is to ensure that all pavements within the Toll Roads remain safe, smooth, durable, stable; and that work is conducted in a manner so as to prevent and repair deterioration of the roadway and shoulder pavement, thereby ensuring the safe and orderly movement of traffic.

Roadways require, without limitation, repairs to cracks, spalls, potholes, etc.; removal and replacement of pavement sections; reconstruction of the pavement structure; continual maintenance; and sweeping and cleaning of the roadway surfaces.

### B.3.2 Responsibility of Concessionaire

In order to meet the requirements of this Chapter, the Concessionaire must engage in practices that limit and minimize the times and locations that roadway pavements are not completely open to traffic, to continually remain functional, carry the intended traffic, provide a safe means of passage to Toll Road users, and meet all safety, aesthetic and economic benefits. This requires that the Concessionaire carry out its obligations in accordance with this Chapter in a manner that maintains or improves the condition and functionality of the roadways.

The Concessionaire must perform roadside maintenance, inspection and work activities at a frequency that ensures uniform and consistent compliance with all PRHTA, Commonwealth and Federal regulations, and the requirements specified within this Chapter.

The roadways to be maintained include all: mainline; ramps; access roads, parking lots at facilities; toll plazas; and mainline and ramp shoulders within the Toll Roads.

All materials and construction requirements for roadway work performed by the Concessionaire must conform to the appropriate and applicable requirements of the Referenced Documents noted in Section B.2 of this Chapter.

To the greatest extent possible, when performing roadway work the Concessionaire must utilize the newest techniques implemented and approved by the PRHTA for major highway contracts to provide longer pavement life, maximize the reuse of materials and to minimize motorist inconvenience.

During all work, the Concessionaire must establish and continually maintain traffic control and protection as addressed by the requirements of Volume II – Operations and Procedures Manual, Chapter H, “Traffic and Travel Management Plan”.

Once a particular maintenance repair has been started, the work must continue during consecutive working days as weather permits until a thorough and workmanlike repair has been achieved. The objective of every repair is to cure all

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roadway deficiencies, to preserve the economic value of the Toll Roads as a capital asset, and to restore a riding quality satisfactory to Toll Road users, in accordance with the requirements of this Chapter.

The Concessionaire must make routine roadway maintenance inspections part of its daily activities and all Concessionaire staff who travel the Toll Roads must be instructed to report any roadway maintenance needs observed.

Work on the roadway and pavements within the Toll Roads that must be performed by the Concessionaire include the following:

- General:

- Investigate, inspect, and rectify the underlying cause or the origin of the defect or damage before commencing repair work.
- Ensure that all pavement repairs are of the required structural thicknesses; are constructed to a minimum depth equal to that of the distressed pavement; and provide a dense, smooth, and level transition between the treated area and the adjacent undisturbed pavement surface.
- Repair all pavement surfaces in a manner to match the profile, grades and cross slopes of the roadway; and ensure that all repair areas are free of depressions or humps, and that there is no separation at the adjacent undisturbed pavement joints.
- Ensure that temporary repairs and patching have been made with appropriate materials and workmanship to withstand traffic loading until a permanent repair can be made.
- Remove and properly dispose of all debris and loose material, and leave the work site in a clean condition.

- Bituminous Surface Repairs:

- Repair bituminous surfaces and pavement when defects, including, but not limited to the following, are present: Rutting, Raveling, Shoving, Bleeding, Depressions, Settlements, Weathering, Fatigue, Loss of Traction, etc., in accordance with the requirements of the Operating Standards, or good engineering and maintenance practices.
- Ensure that all roadway bituminous surfaces are smooth, stable, durable and provide a safe condition for Toll Road users.
- Repair shoulders that have been damaged by erosion, settlement or traffic use.
- Pavement Surfaces that are considered or show indications that would be classified as slippery must be analyzed and corrected with a skid resistant pavement.



- Potholes:
  - All potholes must be repaired with temporary or permanent repairs within the Time Frames indicated in Table B.3.3.1.
  - All temporary pothole repairs must be monitored, and failed areas re-treated until the permanent work can be completed.
  
- Joints & Cracks:
  - Repair all severe pavement cracks, as defined in Section B.4.4.1 of this Chapter.
  - Evaluate and repair all narrow pavement cracks, as defined in Section B.4.4.2 of this Chapter.
  - Repair all joint separations and joint failures in all pavements as they develop, within the Time Frames stated in Table B.3.3.1.
  - Monitor and, if required, reseal cracks and joints that do not withstand the impact of traffic or show signs of failure.
  
- Spalled Pavement:
  - Repair all pits, chips, pop-outs, scaling or other surface defects that can be identified or classified as spalls, and as defined in Section B.4.5 of this Chapter.
  
- Settled and Heaved Pavement:
  - Inspect, evaluate and perform the applicable repair to pavements that have settled or heaved, as defined in Section B.4.6 of this Chapter.
  
- Base and Subbase Repairs:
  - Remove unsuitable materials, complete backfill and compact materials in accordance with the requirements of the Reference Documents noted in Section B.2 of this Chapter.
  - When a cause is determined as to why a repair is required, install drainage appliances or materials that will prevent conditions from redeveloping.
  - Provide a suitable sub grade to ensure effective drainage of the road base in areas where surface damage is evident.
  - Provide adequate support for imposed vehicle loadings where surface damage has resulted from insufficient strength of the road base or subgrade.

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- Grinding and Profiling:
  - When the situation dictates, and the requirements stated in Section B.4.8 of this Chapter require: grind and/or profile pavement to provide a smooth and safe driving surface for Toll Road users.
  
- Access Roads:
  - Maintain the integrity of the shape and driving surface of the access roadways to provide smooth and safe passage.
  - Repair all voids, potholes, erosion, ruts, etc. in a manner and time frame to permit safe and continual passage across the access roads.
  
- Roadway Sweeping & Cleaning:
  - Clean roadway surfaces by removing accumulations of dirt, debris, sand and/or gravel from the travel way, centerlines, shoulders, curbs, toll plazas, ramps, and along medians and/or roadside barriers to provide a safe, clean free-draining condition.
  - Ensure that all waste from the sweeping and cleaning operations are properly disposed of in accordance with Municipal, Commonwealth and Federal Regulations.
  - Sweeping should remove excess material at the edges of the pavement and in the middle of the safety barriers to avoid the accumulation of water and allow proper drainage.
  
- Pavement Smoothness:

Pavement surface smoothness as determined by the International Roughness Index (IRI) must be measured annually on all traveled Mainline surfaces, and reported as an average IRI per 0.1 mile segment throughout the length of the Toll Roads. The maximum of any given one (1) mile section must not exceed 160 IRI, with an overall system average not greater than 120. Bridge structures shall be excluded from this requirement from bridge joint to bridge joint inclusive. For purposes of clarification, the IRI requirement will apply to approach slabs adjacent to Mainline bridge joints. IRI data submissions regarding pavement smoothness shall be provided on an annual basis. All IRI data submissions must be in electronic format and must be capable of being aggregated in various segment lengths.
  
- Pavement Surface Friction:

The Concessionaire must measure the friction of the pavement surface annually, in order to be able to generate a report of the current condition in terms of friction capacity of the existing pavement. The Concessionaire


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must arrange for a Puerto Rico Licensed Professional Engineer to review this report in order to detect slipping risk areas for the users. The concessionaire will have to address those areas found in the report with compromised friction capacity. Both the equipment and the data format used in the monitoring and collection of friction data must be approved by the Puerto Rico Highway Authority. The critical values in the friction data will be according to the manufacturer's methodology.

**B.3.3 Performance Time Frames**

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire) within which the Concessionaire must complete the required maintenance, repair or replacement to the Roadway features (unless weather conditions limit material application):

TABLE B.3.3.1


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<b>Roadway Pavement Work to be Performed</b>	<b>Maximum Time Duration</b>
Bituminous Surface Repairs	10 Days
Pothole Repairs: <ul style="list-style-type: none"> <li>• Temporary</li> <li>• Permanent</li> </ul>	24 Hours 1 Month
Joint & Crack Repairs	3 Months
Spalled Pavement Repairs	4 Months
<u>Settled and Heaved Pavement Repairs:</u> <ul style="list-style-type: none"> <li>- Temporary</li> <li>- Permanent</li> </ul>	24 Hours 3 Weeks
Base and Subbase Repairs	1 Month
Grinding and Profiling Repairs	3 Months
Access Roads	6 Months

The following table establishes the minimum frequency that a particular maintenance operation is to be performed.

TABLE B.3.3.2

<b>Maintenance to be Performed</b>	<b>Minimum Frequency of Occurrence</b>
Pavement Condition Rating (Comprised of IRI, Rutting, Faulting, Cracking Survey, Surface Friction & Visual Inspection)	Once Annually (See Volume II, Chapter L)
<u>Roadway Sweeping &amp; Cleaning:</u> <ul style="list-style-type: none"> <li>- Mainline (Sweeping)</li> <li>- Mainline (Large Debris Pickup)</li> <li>- Ramps (Sweeping)</li> <li>- Ramps (Large Debris Pickup)</li> <li>- Shoulders (Sweeping)</li> <li>- Shoulders (Large Debris Pickup)</li> <li>- Toll Plaza Lanes</li> </ul>	<ul style="list-style-type: none"> <li>Once every 4 Months</li> <li>Daily</li> <li>Once every 4 Months</li> <li>Daily</li> <li>Once every 4 Months</li> <li>Daily</li> <li>Monthly</li> </ul>

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### B.3.4 Acceptance Criteria

Pavement and shoulder maintenance work will be considered acceptable when completed in compliance with the PRHTA Standard Specifications for Road and Bridge Construction, AASHTO Maintenance Manual for Roadways and Bridges and the following criteria are met or exceeded:

- All repairs have been completed with the proper materials, methods, and equipment in full compliance with the requirements stated in the Reference Documents listed in Section B.2 of this Chapter.
- The underlying causes for the pavement defects have been thoroughly evaluated and examined, and the appropriate repairs and remedies taken.
- All repairs restore the integrity to the pavement so that it is safe and capable of supporting the applied loads.
- Repair work provides a continual smooth transition from new to existing pavements, free of all defects and deficiencies.
- Temporary repairs are replaced with the proper and correct permanent repairs in a timely manner, and such temporary repairs can withstand the loads applied for as long as the temporary repair is required.
- The work sites are left in a clean and tidy condition.
- All of the requirements stated and defined in the subsections of Section B.4 of this Chapter are upheld for the determination, removal and repair work required.
- The roadways remain free of dirt, debris, etc., and the roadways are swept at the frequency stated in Table B.3.3.2 of this Chapter.

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## B.4 Additional Requirements

### B.4.1 Temporary Pavement Patching

Temporary patching material may be used in areas that demand immediate attention. Temporary pavement patching will be required when time, location (mainline or ramp), or material constraints dictate that temporary measures be taken immediately to adequately remedy the pavement failure for a short duration. Temporary pavement patching may be partial or full depth. The Concessionaire must utilize methods of temporary pavement patching that will remain serviceable for the duration adequate to make the permanent repair, and the quality of workmanship must be sufficient to facilitate adequate drainage from the temporary repair. All Temporary Pavement Patching will be in accordance with the requirements of PRHTA Standard Specifications for Road and Bridge Construction and the Reference Documents listed in Section B.2 of this Chapter.

## B.4.2 Bituminous Surface Repairs

Bituminous surface repairs are categorized as repairs that are most effectively and commonly permanently corrected by milling and resurfacing of the pavement containing the defect. These defects include rutting, shoving, raveling and stripping, and slippery pavement surfaces. All milling and resurfacing repairs will be made in accordance with the requirements of PRHTA Standard Specifications for Road and Bridge Construction and the Reference Documents listed in Section B.2 of this Chapter.

### B.4.2.1 Wheel Track Ruts

Excessive wearing of the surface into ruts in the wheel tracks must be considered to be a safety issue because storm water may be trapped in the ruts, contributing to hydroplaning.

Bituminous surfaces must be milled and replaced in sections adequate in length, and one full lane width when correcting this type of surface defect. Adjoining pavement sections must also be evaluated to determine if the repair area should be widened to include and connect other nearby repair areas.

Correction of wheel ruts is required when either:

- The maximum rut depth at any single point on a travel lane is 0.80 inches or greater.
- The average rut depth for any 0.1 mile-long section of a single lane is 0.40-inch or more.

### B.4.2.2 Ruts (Shoving) Transverse

Bituminous surfaces that have been shoved or deformed into transverse corrugations must be considered to be a safety issue, because trapped storm water may contribute to hydroplaning and may accelerate pavement deterioration. In addition, the corrugated surface could contribute to loss of vehicle control at higher speeds.

Bituminous surfaces must be milled and replaced in sections adequate in length, and by one full lane width when correcting this type of surface defect. Adjoining pavement sections must also be evaluated to determine if the repair area should be widened to include and connect other nearby repair areas.

Correction of transverse ruts is required when either:

- The maximum amplitude at any single point in a travel lane is 1-inch or greater.
- The average amplitude measured along any 50-foot-long section of a single lane is 0.75 inch or more.

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#### B.4.2.3 Raveling and Stripping

Once raveling has begun, this type of defect can develop rapidly. Stripping and raveling surface defects can become a safety issue due to loose aggregates, or surface depressions that may hold water and contribute to hydroplaning or other hazardous conditions.

Bituminous surfaces must be milled and replaced in sections adequate in length, and by full one lane width when correcting this type of surface defect. Adjoining pavement sections must also be evaluated to determine if the repair area should be widened to include and connect to other nearby repair areas.

Correction of a surface that shows raveling or stripping is required when either:

- A rough or pebbly texture extends along a 100 foot-long section of a single lane or a 50foot-long section of neighboring lanes.
- Two (2) locations are noted in a 150 foot-long section of a single lane in which a rough-textured surface shows heavy cracking or missing pieces of the surface.

#### B.4.2.4 High Accident Locations (HAL)

Slippery pavement surfaces can contribute to a high wet-pavement accident rate at locations where vehicles must decelerate or turn, and create unsafe conditions for Highway users. The Concessionaire must obtain and review the annual accident statistics compiled from accident records and compare the rates at specific locations and roadway segments.

The Concessionaire must identify wet- pavement High Accident Locations (HAL) on an annual basis. The Concessionaire must arrange for a Puerto Rico Licensed Professional Engineer to review the accident reports and to conduct a field inspection of the HAL sites to examine slipperiness when the pavement is wet or dry, crash damage or skid marks at each scene, visibly polished pavement, and the like.

If the field inspection confirms that a site is a wet-pavement HAL, the site must be immediately scheduled for pavement repairs. The appropriate repair will involve milling the surface and replacing it with the recommended surface mix as defined in the PRHTA Standard Specifications for Road and Bridge Construction and the Reference Documents listed in Section B.2 of this Chapter. Any required milling and patching must cover the entire wet-pavement HAL site as revealed by accident data and field inspections.

#### B.4.3 Pothole Repairs

Potholes occur in pavements and are most prevalent during the rain season (May through November). Once a pothole is identified, the Concessionaire must dispatch work or repair crews to make temporary repairs within the Time Frames

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stated in Table B.3.3.1.

Temporary repairs must be constructed in a workmanlike manner using appropriate material, so that the patch will have the best possible survivability under continuing traffic loadings.

Temporary repairs must be replaced with permanent bituminous concrete pavement patches, which must be in conformance with requirements of PRHTA Standards Specifications for Road and Bridge Construction and the Reference Documents listed in Section B.2 of this Chapter.

#### B.4.4 Cracks & Joints

The following sections summarize the work that must be performed to correct crack and joint defects in the PCC and bituminous concrete pavements.

Cracking and joint defects that recur may be attributable to volume changes, temperature changes, or moisture content changes in the base support. The Concessionaire must restore and stabilize base support when this has been identified as the cause of pavement surface cracking.

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##### B.4.4.1 Large Pavement Cracks

Large pavement cracks are often large-scale defects that allow water and foreign material to enter the pavement structure, subbase, and subgrade, and which may contribute to poor rideability.

When the Concessionaire is performing crack sealing work as preparation for the construction of a bituminous concrete overlay, the Concessionaire must incorporate the appropriate reflective crack control treatment in the rehabilitation.

Crack sealing materials, methods and equipment must be in accordance with requirements of PRHTA Standard Specifications for Road and Bridge Construction, AASHTO Maintenance Manual for Roadways and the Reference Documents listed in Section B.2 of this Chapter.

Correction of large cracks in a bituminous or PCC pavement is required when either:

- The pavement surface contains visible cracks greater than 0.125 inch”.
- One (1) location shows a vertical displacement faulting 0.15 inch in any 0.1 mile long segment of a single lane.
- The length of the correction must extend a distance such that the entire defect has been addressed.

#### B.4.4.2 Narrow Pavement Cracks

Narrow cracking (crack widths less than 0.15 inch) of flexible and rigid pavements is an inevitable consequence and may be hastened or worsened if not addressed and repaired.

Narrow cracks may be filled with emulsion, emulsion and rejuvenator mixture, or liquid asphalt. Also, can be address using pavement preservation techniques. When using emulsion, light grade liquid asphalts or asphalt rejuvenators for crack repairs, fine sand should be mixed with the liquid or applied to the surface of the crack immediately after it has been filled.

Narrow pavement cracks need not be routed before being sealed, although the service life of any crack repair will be extended.

Small cracks that extend over a larger area, such as alligator-type cracking, may be repaired by tacking a blocked-out area and applying chips or other similar material, or a thin patch of hot plant mix so long as the repairs are in compliance with PRHTA Standard Specifications for Road and Bridge Construction, AASHTO Maintenance Manual for Roadways and the Reference Documents listed in Section B.2 of this Chapter. Such patches should be blocked out to give a uniform rectangular appearance.

#### B.4.4.3 Pavement Joint Separation

Joint separation in pavements or between adjacent sections of pavement is detrimental to the pavement structure. Individual joints in pavement or PCC base course that are separated by a 0.25-inch gap or wider must be repaired.

All joint repairs in pavements must conform to the repairs for cracks and joints in accordance with the requirements of PRHTA Standard Specifications for Road and Bridge Construction, AASHTO Maintenance Manual for Roadways and the Reference Documents listed in Section B.2 of this Chapter.

#### B.4.4.4 Pavement Joint Failure

Joint failure in rigid pavement or PCC base pavement is a severe joint breakdown resulting in raised joints caused by curling of the pavement slab, faulting at the joint or vertical displacement of concrete pavement slabs relative to each other or to the adjacent shoulder.

Joint failure may result in unexpected heaving or blowups at the joint. These failures must be addressed upon detection. Repairs may be made with temporary patching until permanent full depth pavement repairs can be made.

Repairs to failed joints must be made by the methods, materials and equipment for removal and replacement of the failed joint in accordance

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with the requirements of PRHTA Standard Specifications for Road and Bridge Construction, AASHTO Maintenance Manual for Roadways and the Reference Documents listed in Section B.2 of this Chapter.

Correction of joint failure in a PCC pavement is required when:

- One (1) location shows a vertical displacement (faulting) of 0.15 inch in any 50-foot-long segment of a single lane.
- One (1) location shows a vertical displacement (faulting) of 0.15 inch in any 50-foot-long segment of a single lane.

#### B.4.5 Spalled Pavements

Spalls in PCC pavements are defects that leave a hole or gap in the roadway surface which may contribute to poor rideability as well as loss of vehicle control.

Spalled PCC pavement may be repaired using either plant mixed bituminous material or PCC materials, whether they occur in PCC pavements, or PCC base courses. When temperatures or inclement weather prohibit permanent repairs, temporary repairs are permitted, and shall be in accordance with all requirements for temporary repairs.

Repairs to spalled pavements must be in accordance to the requirements of PRHTA Standard Specifications for Road and Bridge Construction, AASHTO Maintenance Manual for Roadways and the Reference Documents listed in Section B.2 of this Chapter.

Correction of spalls in a PCC pavement is required when either:

- One (1) location shows a transverse spall that either exceeds 4-inches in length in the direction of travel, 3inch width or 0.25 inch depth; or has cause to adversely affect driver safety.
- One (1) location shows a longitudinal spall that has been noted by maintenance staff or Toll Road users as adversely affecting riding quality.

#### B.4.6 Settled and Heaved Pavement

The following sections summarize the work that must be performed to correct settlement and heave in PCC and bituminous concrete pavements.

##### B.4.6.1. Tolerances for Abrupt Vertical Variations

Vertical variations may occur at the joint between two adjacent slabs of a rigid pavement; at a transverse crack or joint in the bituminous surface of a composite pavement; or at any crack or joint in a flexible pavement. Vertical variations may also occur between the pavement and adjoining construction such as concrete curb, shoulders, ramps, the center median, bridge



approach slabs, etc. Such vertical offsets can be caused by a number of factors, and may appear abruptly or more gradually.

Settlement and heave must be considered to be a safety concern due to the possible loss of vehicle control when a vehicle impacts these defects, and the excessive impact loading is imparted to bridges and slabs. When this type of pavement distortion creates tears and cracks, the resulting penetration of water into underlying base courses, subbases or subgrade can rapidly escalate the problem until the pavement structure fails entirely.

Correction of a bituminous surface broken by settlement or heave is required when either:

- One (1) location shows a vertical or horizontal displacement of 0.75 inch in any 50-foot long segment of a single lane.
- Three (3) locations show vertical or horizontal displacements that exceed 0.50-inch in any 200-foot long segment of a single lane or a 100-foot long segment of one travel direction of the Highway.

Correction of a rigid pavement showing settlement and heave of individual slabs is required when either:

- One (1) location shows a vertical or horizontal displacement of 0.50-inch between adjacent slabs in a single lane or between two lanes in one travel direction.

When an abrupt vertical differential is found between the traveled way and the adjacent paved shoulder, repairs to correct one or both of the surfaces will be required when:

- One (1) location shows a vertical or horizontal displacement of 0.5-inch.

#### B.4.6.2. Partial Depth Pavement Patching

If, after examining the settlement and heave in a flexible or composite pavement section, the Concessionaire determines that a base course repair is not warranted, the Concessionaire must mill and replace the bituminous surface course. The repair areas will be a minimum of 10' long by one full lane in width. The repair area must be carefully determined so that the constructed patch will provide a smooth transition as it eliminates the vertical displacement. In general, a patch should be a minimum 40' long for every one inch (1") of vertical displacement spanned by the patch, after the normal profile grade of the road has been taken into consideration.

Whenever settlement and heave has caused the difference in vertical elevation between the pavement and the adjacent shoulder, the Concessionaire must mill and patch the shoulder in order to avoid affecting the mainline or ramp roadway profiles. However, the Concessionaire must not pave against the center median barrier wall, and must restore the intended and acceptable cross slope of the shoulder.

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#### B.4.6.3. Full Depth Pavement Patching

Full depth pavement patching will be required when settlement and heave has caused sufficient movements and stresses to physically break up the pavement section. Full depth pavement patching will also be required when the pavement must be removed in order to replace unsuitable subsurface soils, to undertake underground appurtenance repair or construction, or to address other defects beneath the pavement.

Repeated surface repairs will not be an acceptable substitute for a remedy involving full depth patching, when the causes or impacts of severe pavement heave or settlement can only be remedied by making a thorough reconstruction.

All work to construct full depth pavement patches must conform to the requirements of PRHTA Standard Specifications for Road and Bridge Construction, AASHTO Maintenance Manual for Roadways and the Reference Documents listed in Section B.2 of this Chapter. The material quality and depth of repair must match or exceed those properties of the existing adjacent cross section.

#### B.4.6.4. Settlement of Bridge Approach Pavements

Settlement of bridge approach pavements is most often detected at the expansion joint between the bridge deck and the approach slab, and is commonly caused by consolidation of the structural backfill behind the bridge abutment and beneath the approach slab. A vertical variation between the approach slab and the deck is highly undesirable because, when the ability of the expansion joint to accommodate the variation is exceeded, water will readily enter the expansion joint to the detriment of the deck, beams, abutment backwall and abutment face. Such settlement is also undesirable because the vertical variation causes heavy vehicles to impact the end of the bridge deck when crossing onto the bridge or impact the approach slab when leaving the bridge deck, which is detrimental to both structures and traffic.

The Concessionaire must conduct geotechnical evaluations using a qualified Geotechnical Engineer to determine if the problem is attributable to settlement and repair all voids that are discovered.

Correction of a settled PCC bridge approach slab, whether or not it is currently overlaid with asphalt or concrete overlay, is required when:

- One (1) location shows a vertical displacement of 0.75-inch between the approach slab and the bridge deck.

#### B.4.7 Pavement Base and Subbase

The following sections summarize the repairs that must be undertaken to address defects and deficiencies in pavement base courses and subbases.

#### B.4.7.1. Evaluation and Determination of Pavement Base Distress

Whenever surface cracks or pavement joints are accompanied by a severe vertical variation, the Concessionaire must evaluate the site to determine if the underlying subbase or subgrade has failed.

When severe settlement or heave occurs at one or more slabs of a rigid pavement, the likeliest cause of the vertical dislocation will be a defect in the subbase or a deeper foundation layer. The Concessionaire must evaluate all heaved or settled rigid pavement slabs to determine the manner in which underlying structural support has weakened or failed. The slab must be inspected under traffic to determine if it is rocking or pumping when loaded.

Whenever the base course failure is attributed to the cracking, crushing, or partial collapse of any utility conduit, sewer pipe, drainage structure, or similar appurtenance, the Concessionaire must make a full repair of the appurtenance. The Concessionaire must not repair the distressed pavement section until proper support has been restored, and the Concessionaire can conclude that the subbase or subgrade can support the traffic loads.

If the geotechnical sampling, testing and studies conclude that sections of the pavement were caused to heave or settle due to improper supporting soils, the Concessionaire must make a thorough reconstruction in the area to permanently repair the cause of the pavement movement.


If a broken base course is unexpectedly revealed during the milling of existing bituminous surface courses, the Concessionaire must promptly evaluate the extent of the base failure, and select and implement an appropriate, permanent remedy. The Concessionaire must not repeatedly patch or overlay the problem area as it recurs but must repair the base course.

#### B.4.7.2. Investigation of Rocking or Pumping Rigid Pavement

Individual slabs of a PCC pavement or PCC base course that rock, move or pump subbase materials through joints and cracks when subjected to traffic loadings, must be analyzed to determine the cause of the reduced pavement structural support, and the extent of the damage done to the pavement structure.

The Concessionaire must evaluate surface defects in bituminous overlaid composite pavement or flexible pavement to determine if the defect is attributable to base failure or subgrade problems. If a base failure is evident, the Concessionaire then must perform the base repair as specified above.

Rigid pavement slabs that rock under wheel impacts may still be sound but may have lost foundation support due to subbase consolidation, washout, settlement of embankment, or other causes. If the rocking pavement slabs are found to be sound and whole, but their underlying support is deficient, the Concessionaire may attempt to repair such slabs by means of subbase

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or subgrade reinforcement techniques, or by removal and replacement of the pavement or base.

Pumping pavement slabs exhibit a type of base failure that will rarely be corrected by measures such as mud jacking or overlays. When the Concessionaire's inspections furnish evidence that support soils are being pumped out from under PCC base course slabs, the Concessionaire must schedule a removal and replacement of the failed base and pavement structure.

#### B.4.7.3. Pavement Subbase Reinforcement

Subbase reinforcement may be a suitable repair strategy when there is evidence of void or hollow space under rigid pavement slabs, or in cases when rigid pavement settlement is attributable to failure or compressibility of pavement support soils.

When a qualified Geotechnical Engineer concludes that a particular PCC base slab should be stabilized, reinforced or raised, the Concessionaire may attempt these methods in order to re-establish the subbase without removing and reconstructing the slabs. Methods such as mud jacking, or pressure-injecting a PCC cement grout underneath the slab in order to replace lost or sunken subbase material, etc., should be done by a qualified Contractor experienced in this specific type of roadway construction work.

Sub sealing involving pumping a bituminous mixture under the slab to seal the subgrade from further water penetration is not allowed.

#### B.4.8 Grinding and Profiling

The Concessionaire must not grind PCC bridge approach pavements or any reinforced concrete pavement in such a way that the reinforcement is exposed, concrete cover over reinforcing bars is substantially reduced, or the structural thickness of the concrete section is so reduced. However, there may be occasions where minor pavement grinding can be effective in repairing small-scale surface irregularities, small vertical faults at joints, or concrete patches that have slightly faulted.

The grinding must not remove the finish from more than minor areas of the riding surface, so that most of the original roughened texture is maintained.

#### B.4.9 Access Roads

Access roadways located within each Highway System need not be maintained to the same standards as those roadways open to the public. The requirements for access road maintenance are to ensure that access roads provide safe and convenient access to specific areas.

#### B.4.10 Roadway Sweeping and Cleaning

Regular and effective pavement and shoulder sweeping and cleaning is the responsibility of the Concessionaire. The Concessionaire must maintain the traveled ways of the Toll Roads in such a manner that the roadways are kept clear of litter, leaves, debris, wind-borne soil and trash, vegetation, droppings and loose material that might pose a safety hazard to Toll Road users, and which has a negative impact on the aesthetics and appearances of the Toll Roads.

The Concessionaire is responsible for all sweeping and cleaning work in accordance with the frequencies stated in Table B.3.3.2 of this Chapter, and in determining any other special needs as a reaction to different circumstances or events.

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All debris and spoil must be legally disposed of in accordance with Federal, Commonwealth and Municipal solid waste disposal laws and ordinances.

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## **C.1 Definitions**

Pavement Delineation: Devices designed and installed to assist in guiding motorists, or which express, by symbolism, certain traffic laws and use prohibitions. Delineation includes, but is not limited to, pavement striping, pavement markings, raised pavement markers and prismatic reflectors.

Pavement Markings: Materials applied to the roadway surface, such as pavement striping, letters or symbols. Markings consist of paint, plastic tape and films, epoxy, or thermoplastic materials serving as a binder and substrate for reflective glass beading.

Pavement Striping: Materials applied to a roadway surface in a linear manner as a means to delineate, guide and control the movement of traffic.

Prismatic Reflectors: Products consisting of molded housings and reflective elements, applied to parapets, metal posts (roadside delineators), barrier walls and temporary concrete barrier to improve the nighttime visibility of devices by reflecting light back toward the light source (i.e. vehicle headlamps).

Raised Pavement Markers: Products consisting of metal or plastic castings and raised elements set into the roadway surface as a lane delineation that work by reflecting a light pattern back toward the light source (i.e. vehicle headlamps).



## **C.2 References**

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA
- Guidelines for the Selection and Installation of Orientation Signs, PRHTA
- Highway Design Manual, PRHTA
- Signage Guide, PRHTA
- Standard Drawings, PRHTA
- Standard Specifications for Road and Bridge Construction, PRHTA
- Traffic Sign Manual, PRHTA
- A Guide to Standardized Highway Barrier Hardware, AASHTO
- A Policy on Geometric Design of Highways and Streets, AASHTO
- Roadside Design Guide, AASHTO
- Manual Uniform Traffic Control Devices (MUTCD), FHWA

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### **C.3 Policy for Performing Pavement Delineation Maintenance**

#### **C.3.1 Objective**

The objective of Pavement Delineation maintenance is to ensure that all pavement markings, pavement striping, prismatic reflectors and pavement markers are properly maintained to facilitate the safe and orderly movement of traffic.

Pavement Delineation requires repairs due to wear, construction, sunlight degradation, etc.; maintenance; removal; and replacement.

#### **C.3.2 Responsibility of Concessionaire**

To meet the requirements of this Chapter, the Concessionaire must engage in practices and inspection survey intervals to ensure that all Pavement Delineation functions properly, is clearly displayed to ensure the safe and orderly movement of traffic, and meets other safety, aesthetic, and economic benefits. This requires that the Concessionaire carry out its obligations in a manner that maintains and/or improves the condition and functionality of the Pavement Delineation.

Each delineation must be kept visible, legible, and properly functioning under both day and nighttime conditions. It should be noted that all Pavement Delineation will gradually deteriorate to a point where the delineation must be repaired or replaced. The Concessionaire is responsible for all repair and replacement determinations, required resources, work assignments and oversight for all work associated with or described for Pavement Delineation.

The Concessionaire must make routine Pavement Delineation inspections part of its daily activities and should be watchful for missing, damaged and worn Pavement Delineation.

Once work on Pavement Delineation has been started, the work must continue until a thorough, complete, and workmanlike product has been achieved. All work that affects Pavement Delineation must conclude with a restoration of all delineation to a like-new condition.

All materials and construction requirements for Pavement Delineation work performed by the Concessionaire must conform to the appropriate and applicable requirements of the PRHTA Standard Specifications for Road and Bridge Construction, AASHTO Maintenance Manual for Roadways and Bridges and the Reference Documents listed in Section C.2 of this Chapter.

Pavement Delineation for public and private roadways that pass beneath or above the Toll Roads and not included in the Toll Roads pursuant to the Toll Road Concession Agreement are excluded.

Work on Pavement Delineation on the Toll Roads that must be performed by the Concessionaire includes the following:

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- Ensure that all pavement striping, and markings are well-defined, clear, legible, distinct and in full accordance with the requirements of this Chapter and the Reference Documents listed in Section C.2 of this Chapter.
- Replace all faded, worn, debonded, damaged, non-reflective and/or missing pavement striping and markings.
- Repair and replace all damaged, non-functioning, broken, missing or obstructed raised pavement markers, prismatic reflectors, and roadside delineators.
- Ensure that all pavement markings are reapplied or replaced when the required levels of retro-reflectivity are not in accordance with PRHTA, Commonwealth and Federal guidelines.
- Remove and replace all Pavement Delineation as required by PRHTA, Commonwealth or Federal regulations.
- Replace all pavement striping and markings that require alteration due to changing needs or conditions.
- Maintain the Pavement Delineation for all parking stall lines, handicap stall markings, and related pavement markings within the Toll Plazas and Service Facilities for the Toll Roads or other adjacent to the parking or travel areas.
- Ensure that all replaced Pavement Delineation matches the existing Pavement Delineation unless otherwise dictated by updates in the Reference Documents noted in Section C.2 of this Chapter or requested by PRHTA or the Commonwealth.
- Install all new Pavement Delineation in full compliance with the Reference Documents listed in Section C.2 of this Chapter, or as requested by PRHTA or the Commonwealth.
- Dispose of all removed materials in full compliance with all Municipal, Commonwealth and Federal disposal and environmental requirements.
- Remove and completely eradicate all pavement markings which are superfluous or obsolete, or as requested by PRHTA and the Commonwealth.
- Ensure that pavement and other surfaces are not damaged as a result of grinding or other eradication techniques, and that the work is in compliance with the Reference Documents listed in Section C.2 of this Chapter.
- Replace all pavement markings and striping that are covered, obliterated, or removed due to construction or maintenance work with temporary Pavement Delineation prior to reopening to traffic, and maintain the temporary delineation until permanent Pavement Delineation is installed.
- Ensure that all temporary Pavement Delineation is in full compliance with the Reference Documents listed in Section C.2 of this Chapter.

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- Install temporary pavement markings and striping to delineate traffic at locations where the absence of or deficiencies in the Pavement Delineations create unsafe conditions or have the potential to become unsafe conditions for Toll Road users.

### C.3.3 Performance Time Frames

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire), within which the Concessionaire must complete the required maintenance, repair, replacement, or relocation work to the Pavement Delineation (unless weather conditions limit material application):

Pavement Delineation Item	Maximum Time Duration
Raised Pavement Markers	14 Days
Roadside Delineators	14 Days
<u>Prismatic Reflectors:</u>	
- Attached to barriers, guardrail, etc.	60 Days
- Attached to Piers and Fenders on structures over Navigable waters	1 Week
<u>Pavement Markings:</u>	
- Letters or symbols	30 Days
- Striping	30 Days

The Concessionaire must, from the time a deficiency is detected by discovery or report:

- Install temporary markings and striping within eight (8) hours.

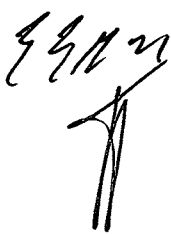
The Concessionaire must also:

- Ensure that temporary pavement markings and striping be clear, legible, and bonded to the surface upon which they are placed for the length of time that they are required.
- Remove and properly dispose of all waste materials from Pavement Delineation removal at the end of each day.
- Remove and replace temporary pavement markings and striping with permanent delineation within seven (7) days after it was installed or is no longer required; unless temporary delineation is for a pre-planned construction work period which, when concluded, the above stated requirement applies.

### C.3.4 Acceptance Criteria

Pavement Delineation will be considered acceptable when the following criteria are met or exceeded:

- Prismatic Reflectors and Raised Pavement Markers:
  - The pavement marker bases are flush with the pavement surface and securely set into the pavement.
  - The reflector and markers are unbroken and clearly visible to traffic.
  - The markers are at the correct interval and are at the correct alignment.
  
- Pavement Markings and Striping:
  - Markings and striping have been properly applied at the correct application rates, location, color, size, alignment, and symbol, are free of distortion or damage, and have the correct reflectivity.
  - Incorrectly applied or placed markings and striping are not present.
  - Glass beads for reflectivity are applied at the specified amounts and meet the requirements of the Reference Documents as listed in Section C.2 of this Chapter.
  - Pavement and other surfaces are not damaged by installation or eradication.
  - Temporary markings and striping are present where the absence of or deficiencies of markings create unsafe conditions.
  - All pavement markings achieve full bond, with no separation from the applied surface.
  - Materials do not deteriorate when in contact with sodium chloride, calcium chloride, or traffic residues.
  - Pavement markings indicate no appreciable deformation or discoloration under exposed traffic and road temperatures between 0°C and 40°C (32°F and 104°F).
  - Pavement markings maintain their original dimension and placement without chipping, peeling or cracking.
  
- Roadside Delineation:
  - Supports are plumb and level.
  - Intervals and locations are in accordance with the requirements of the Reference Documents.
  - Reflectors are unbroken, reflective, and clearly visible to traffic.



## **C.4 Additional Requirements**

### **C.4.1 Pavement Markings and Striping**

Pavement markings and striping are critical for motorist guidance and public safety and must be maintained and/or replaced in accordance with the requirements of Section C.3 of this Chapter. Pavement markings that are missing or have lost their effectiveness would constitute a safety hazard if not replaced.

Temporary replacement striping is permitted if there is no substitution of colors or substandard marking dimensions. Temporary or permanent replacement delineation must conform to the layout, patterns, lengths and spacing found in the Reference Documents listed in Section C.2 of this Chapter. All delineation constructed under a lane closure must be inspected by the Concessionaire and approved before the lanes are reopened to traffic.

The use of paint on curbs solely for the purpose of supplementing or replacing signing is prohibited. The Concessionaire is authorized and encouraged to delineate for warning purposes curbs, headwalls, abutments, piers, roadside hazards, access roads, etc.

### **C.4.2 Raised Pavement Markers**

Missing or deficient raised pavement markers must be replaced when pavement striping alone will not ensure that critical Pavement Delineation is visible at night and during inclement weather.

Temporary raised pavement markers must not be used as substitutes for traffic control and protection during maintenance or construction operations.


### **C.4.3 Roadside Delineators**

Roadside delineators exist at various locations, including at the tops of embankments where guide rail is not warranted due to height and grading criteria.

Replacement of roadside delineators must be located and spaced in accordance with the requirements of the Reference Documents of Section C-2 of this Chapter.

### **C.4.4 Prismatic Reflectors**

Prismatic reflectors have been installed at various locations which must be maintained by the Concessionaire. These reflectors vary in location including, on barriers, walls, bridge railings, parapets, or retaining walls. In addition, certain reflectors exist along access roads, to assist in preventing the accidental intrusion of vehicles into neighboring properties.



Prismatic reflectors mounted to piers, fenders or other devices that are portions of the Toll Roads within or adjacent to the navigable waterways must be replaced exactly in kind and to the satisfaction of all governing agencies including the U.S. Army Corps of Engineers and the U.S. Coast Guard.

#### C.4.5 Pavement Delineation Layout

For short lengths (less than 200 feet) of pavement striping replacement, the new markings must be placed in the same location as the removed markings. The Concessionaire may place up to 200 feet of edge line without formal layout.

Longer lengths of striping, delineation in areas where lanes are diverging or converging with the mainline, and areas where lane widths are tapering, must be laid out in conformance with the Reference Documents listed in Section C.2 of this Chapter for both temporary and permanent markings.

No reference marks made to guide the installation of Pavement Delineation may be used as a temporary Pavement Delineation.

#### C.4.6 Pavement Delineation Removal

Paint or asphalt emulsion must not be used to cover Pavement Delineation except as a temporary measure until the proper removal can be made.

Leaving scars or damage to the pavement surface shaped like the former markings is not acceptable and can cause unsafe conditions.

#### C.4.7 Surface Preparation

Surface preparation for all Pavement Delineation must conform to the requirements of the Reference Documents listed in Section C.2 of this Chapter.

Before applying any pavement marking material, the Concessionaire must sweep the pavement and must ensure that no loose material, water or debris is present that would reduce the adhesion of the markings to the pavement.

#### C.4.8 Construction

When construction activities alter or cause Pavement Delineation to be removed, the Concessionaire must reinstall properly functioning delineation prior to opening the work zone to traffic. Temporary delineation must be installed only if permanent delineation cannot be installed immediately. When temporary delineation is required the maximum duration that it may be present before the permanent delineation is installed must not exceed that specified in Section C.3.3 of this Chapter.

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#### C.4.9 Materials

The materials, production, transportation, and storage of all Pavement Delineation must fully comply with the requirements of the Reference Documents listed in Section C.2 of this Chapter. In particular, the photo-reflectivity requirements must be met for all materials furnished by the Concessionaire for installation on the Toll Roads.

The Concessionaire must log and maintain all manufacturers' certifications for material delivered and installed for Pavement Delineation.

Specific additional material requirements, above those stated within the Reference Documents, are as follows:

##### C.4.9.1 Hot Melt Thermoplastic

Acceptable types of thermoplastic are supplied in granular or block form for spray, ribbon, or extruded application. The Concessionaire is responsible for selecting the delivered form of the material and for ensuring the manufacturer's storage, handling and application requirements are met.

Hot melt thermoplastic is typically applied only to bituminous concrete (asphalt) surfaces but may be applicable to PCC pavements, slabs and bridge decks, when used in accordance with the Reference Documents listed in Section C.2 of this Chapter and per the manufacturer's recommendations.

##### C.4.9.2 Cold Preformed Plastic Tape

Preformed plastic tape markings must form a complete stripe or pavement marking legend, ready to be applied to the pavement. Such markings must be applied to the pavement by being rolled into the surface by means of a pressure sensitive precoated adhesive, or liquid contact cement.

Preformed plastic pavement markings are typically applied to P.C.C. pavements, slabs and bridge decks. The Concessionaire must replace existing preformed plastic tape with similar material, and must not substitute preformed thermoplastic, paint or other pavement marking materials for preformed plastic without the Approval of PRHTA and the Commonwealth.

##### C.4.9.3 Preformed Thermoplastic

This material must be capable of being installed on either bituminous or P.C.C. surfaces by using a heating element. The use of this material is limited to emergency repair locations where reducing traffic delays and inconvenience is of primary importance.

##### C.4.9.4 Traffic Paint

The Concessionaire is permitted to use paint as temporary delineation only, which must be replaced with permanent markings as soon as practical and possible, consistent with the requirements stated in Section C.3.

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#### C.4.9.5 Environmental Concerns

Solvent-borne traffic paint and marking materials can pose an environmental hazard unless handled in full accordance with the manufacturer's requirements. The residue of paint from color changes or cleaning tasks must be properly disposed of in conformance with the Puerto Rico Environmental Quality Board or Federal EPA requirements for liquid hazardous wastes. Paint guns may not be purged on shoulders or earth surfaces, and no residues may be tipped or flushed into the drainage system.

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## **D.1 Definitions**

Curb: A concrete or bituminous device with a given cross section, constructed along the edges of pavements or shoulders that collects storm water runoff from the traveled way and conveys it to an intended discharge point.

Culvert: A structure made of steel, concrete, aluminum, natural stone, High Density Polyethylene, or other material, covered by embankment material that allows a creek, stream or roadway to pass under a roadway or fill. Culverts are typically box or arch in shape and may or may not have slabs under the creek or stream flow-line. Culverts may be of any size up to 20 feet in span length.

Debris: Litter, rubbish, vegetation, rocks, dead animals, spilled materials, brush or other items which are not part of or which impede drainage.

Ditch: A trough-shaped excavation made to collect and transport water; includes unpaved and paved ditches. Unpaved ditches are protected from erosion by turf, grasses or rock. Paved ditches are protected from erosion by concrete or asphalt.

Downspout: A pipe or conduit attached to a bridge to direct water away from a collection feature.

Drain: An aperture through a wall, curb or bridge deck to provide egress for water that would otherwise be trapped on the roadway.

Drainage System: An appurtenance that is intended to collect, convey, store or discharge storm water runoff. Drainage systems include structures in or under the roadway, such as curb, manholes, inlets and catch basins, storm sewers, and pipe base drains; systems through the embankments such as culverts, and systems parallel to the embankments such as ditches, swales, berms, erosion control devices and outlet channels.

Embankment: An unpaved slope leading either to or from the earth supported traveled way that is covered by turf or natural plant life.

Erosion Control: A device or material used to limit the erosion of earth away from the site.

Flowline: The bed or lowest point of a pipe, conduit, ditch, stream or culvert.

Headwall: A vertical wall at the end of a pipe that retains earth.

Pavement Base-Drain: A system built under pavements or with bridge approach slabs that collects storm or ground waters that penetrate the roadway subbase or that percolate through the ground and collects and discharges the water.

Pipes: Circular, arched, or elliptical shaped conduits varying in size that are utilized to convey water from point to point. Most drainage pipes are made of steel, concrete, aluminum or high-density polyethylene.

Ponding: An undesirable condition in which standing or slow draining water is trapped on the roadway surface or in ditches.

Re-shaping: Re-grading of the earth from ditch line to ditch line in order to reestablish the proper shape and profile of the ditch.

Scour: Erosive action of flowing water that removes soil and can undermine foundations, create void space behind walls or under slabs, lower riverbeds, and destabilize embankments.

Scupper: A drainage structure associated with bridges, present in the deck, also referred to as floor drains. Scuppers provide a means for rain or other water to drain off the bridge roadway surface and lead to downspouts and enclosed drainage systems.

Storm Sewer: An underground conduit, pipe or tunnel constructed to receive storm water from pavement and bridge drains and convey such water to a distinct outlet point.

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## **D.2 References**

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA
- Highway Design Manual, PRHTA
- Standard Drawings, PRHTA
- Standard Specifications for Road and Bridge Construction, PRHTA
- A Guide to Standardized Highway Barrier Hardware, AASHTO
- A Policy on Geometric Design of Highways and Streets, AASHTO
- Roadside Design Guide, AASHTO
- Manual on Uniform Traffic Control Devices (MUTCD), FHWA
- Storm Water Pollution Prevention Plan (SWPPP), USEPA
- PRPB Regulation #4 - Puerto Rico Zoning Regulation
- PRPB Regulation #13 - Puerto Rico Regulation on Special Areas at Risk of Flood.
- Regulation for the Erosion Control and Sedimentation Prevention, PREQB
- Regulation of Water Quality Standards, PREQB
- Culvert Inspection Manual, Report No. FHWA-IP-86-2
- "General National Pollutant Discharge Elimination System (NPDES)", USEPA



### **D.3 Policy for Performing Drainage Maintenance and Erosion Control Work**

#### D.3.1 Objective

The objective of drainage maintenance and erosion control is to ensure that all elements of the drainage system (curb, inlets, catch basins, manholes, sewers, scuppers, downspouts, ditches, outlet structures, stormwater management basins, and miscellaneous drainage devices, as well as erosion control features) are properly maintained so as to eliminate ponding, flooding, scour and erosion as potential hazards to the safe and orderly movement of traffic; and all roadway and bridge surfaces along the Toll Roads are efficiently, properly and continually drained.

Drainage Systems require repairs due to age, corrosion, soil loading, traffic weight or impact, flood damage, etc.; maintenance; cleaning to remove blockage caused by vegetation, debris, litter, or sediment; and replacement.

Erosion control devices are classified as permanent installations, or temporary measures erected during construction to limit erosion from disturbed and stripped surfaces. These devices require maintenance to remove trapped sediment; clean; and for final removal or replacement.

Drainage pipes and culverts are permanent structures conveying runoff water, and creeks and streams along or under roadways and fills within the Toll Roads. Such structures must handle all design flow conditions including flood conditions.

#### D.3.2 Responsibility of Concessionaire

To meet the requirements of this Chapter, the Concessionaire must engage in practices to ensure that all roadway and bridge drainage devices, and erosion control systems remain functional, operate to direct and convey the flow of storm waters, and meet other requirements.

The Concessionaire is responsible for any work required to alleviate flooding, repair flood damage, or to solve any drainage problems that may arise.

To the greatest extent possible, when performing drainage maintenance and erosion control work the Concessionaire must utilize the newest techniques and materials that have been approved and implemented by PRHTA within the Commonwealth for major highway contracts to minimize the environmental impact of the Toll Roads on the neighboring lands and waters while optimizing: cost, recycling and public convenience.

The Concessionaire must recognize drainage pipes and culverts have finite lives and deteriorate as a result of abrasion, chemical attack, and aging of materials. Maintenance of drainage pipes and culverts involves both maintenance of hydraulic capacity and structural integrity. Constant vigilance is required for pipes and culverts as deterioration can occur on the soil side of such structures and non-destructive testing is limited in determining remaining life of such structures.

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All materials and construction requirements for the Drainage Systems and Erosion Control maintenance work performed by the Concessionaire must conform to the appropriate and applicable requirements of the Reference Documents listed in Section of this Chapter.

Work on Drainage Systems, and Erosion Control Systems within the Toll Roads that must be performed by the Concessionaire includes, but is not limited to, the following:

- Roadway Drainage System:
  - Ensure that frames and grates are properly and securely fastened, set and anchored.
  - Clear, repair or replace all frames, grates, structures, slotted pipes and pipes that are clogged, damaged or missing.
  - Clear catchment areas that have become clogged.
  - Remove trapped or ponding water to prevent damage to the roadway pavement structure.
  - Remove sediments, vegetation and debris from all Roadway Drainage System Components that reduce their capacity to convey stormwater runoff.
  - Repair and replace the Roadway Drainage System components that have deteriorated to a condition that is unsafe or has the potential to become unsafe for Toll Road users; and to prevent further deterioration of the pavement and the pavement structure.
  
- Bridge Drainage System:
  - Ensure that frames and grates are properly and securely fastened, set and anchored.
  - Clear, repair or replace all frames, grates, downspouts, pipe reducers, etc. that are clogged, rusted, damaged, separated or missing.
  - Clear catchment areas that have become clogged.
  - Remove trapped or ponding water to prevent damage to bridge decks, bearings, Superstructure and Substructure.
  - Repair and replace Bridge Drainage System components that have deteriorated to a condition that is unsafe or has the potential to become unsafe for Toll Road users; and to prevent further deterioration of the bridge structure.

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- Ditches:
  - Remove and clean debris, vegetation, dams and all other obstructions from the ditches.
  - Restore, repair, and stabilize ditches that have eroded, scoured and/or slumped, or have the potential to do so if not remedied.
  - Restore and maintain the full capacity and/or profile of the ditches within the Toll Roads.
  - Inspect ditches during periods of heavy rainfall to ensure the ditch shape is maintained, and the flowlines are not undergoing scour or erosion.
  - Dispose of waste materials from ditching operations in a manner and location that is in full compliance with all Municipal, Commonwealth and Federal Laws and Regulations.
  
- Curb:
  - Ensure that all curb remains unobstructed and is free to provide drainage as designed and intended.
  - Repair and replace all broken, settled, damaged, cracked, spalled, and deteriorated sections of curb with “in-kind” materials and configurations as the intent of the original design.
  - Replace curb sections so that all work is in conformance with PRHTA Standard Drawings for the required type of curbing; and ensure that the section type matches the adjacent curb and gutter.
  
- Base-Drain System:
  - Ensure that the roadway and bridge base-drain system is free from vegetation, silt deposits, clogs and other defects that would impede the system from functioning as designed.
  
- Erosion Control Systems:
  - Maintain, clean, repair, restore, replace, and monitor all of the temporary and permanent erosion control features and systems within the Toll Roads.
  
- Stormwater Management Basins:
  - Remove and clean debris, vegetation, dams, and all other obstructions from the outlet structures.
  - Restore, repair and stabilize basin embankments that have eroded, scoured and/or slumped, or have the potential to do so if not remedied.
  - Restore and maintain the full storage capacity of the stormwater management basins within the Toll Roads.

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- Dispose of waste materials from cleaning operations in a manner and location that is in full compliance with all Municipal, Commonwealth and Federal Laws and Regulations.
- Pipe Drainage Systems
  - Ensure that pipes are clean and functioning to full capacity.
  - Evaluate abrasion in pipes to determine the need for liners or replacement.
  - Inspect visually, or by camera, all pipe and pipe connections to determine that infiltration is not occurring, or flows are diverting out of the pipe at joints.
  - Ensure that inlets and outlets have adequate velocity protection and grates are provided to prevent debris from entering the pipe and causing clogging.
- Culvert Systems
  - Ensure that culverts function in accordance with approved hydrologic/hydraulic studies, and plans.
  - Evaluate exposed culvert walls and roofs to determine if adequate cover remains for reinforcement or coatings on metal are adequate for corrosion or abrasion protection.
  - Inspect joints to determine if sections are shifting, infiltration of solids is occurring, or diversions of flows outside of the culvert barrel exist.
  - Ensure inlets and outlets have adequate velocity protection to prevent debris from entering the culvert and causing clogging.
  - Evaluate upstream and downstream conditions for free flow, with emphasis on fences which may impede flows.
  - Be aware of cracks and patterns of cracks which may be indicators of serious structural deficiencies.
  - Evaluate and maintain roadway protection devices to comply with Federal, Commonwealth and Municipal Safety Standards, and ensure errant vehicles do not end up in creeks and streams passing through culverts.

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D.3.3 Performance Time Frames

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire) within which the Concessionaire must complete the required cleaning, adjustment, repair or replacement of the deficient element or component to full operation (unless weather conditions limit material application):

Item	Maximum Time Duration
<u>Roadway Drainage System:</u>	
- Frames & Grates	24 Hours
- Structures	30 Days
- Pipes & Conduits	30 Days
Bridge Drainage System	24 Hours
Curb	30 Days
Ditches	30 Days
<u>Base-Drain System:</u>	
- Roadway	30 Days
- Bridge	20 Days
<u>Erosion Control System:</u>	
- Temporary	24 Hours
- Permanent	60 Days
Stormwater Management Basins	60 Days
<u>Drainage Pipes</u>	
- Blockage	12 Hours
- Inlet or Outlet Failure	48 Hours
- Functional Failure	30 Days
<u>Culverts</u>	
- Blockage	12 Hours
- Inlet or Outlet Failure	48 Hours
- Functional Failure	30 Days

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#### D.3.4 Acceptance Criteria

All roadway and bridge drainage systems, ditches, curb, base-drain, and erosion control systems will be considered acceptable when the following criteria are met or exceeded:

- All Roadway and Bridge Drainage Systems including base-drains are maintained unblocked and function as designed to keep roadway and bridge surfaces free of standing water.
- Missing, broken or unsecured grates and frames and other castings are promptly repaired and/or replaced.
- Curb is maintained free of vegetation, litter, and debris; all damaged and deteriorated curb has been repaired or replaced; and all work conforms to the requirements of this Chapter and the Reference Documents listed in Section D.2 of this Chapter.
- Design, construction, backfill, repair and replacement of drainage structures and system components in conformance with the requirements of the applicable Reference Documents listed in Section D.2 of this Chapter.
- Roadside ditches are maintained free of debris, litter and excess vegetation, and function as designed to collect and transport storm water runoff to designated outfalls.
- Permanent erosion control systems are maintained to function as designed and any repair, replacement, and cleaning of trapped sediment from system components is performed when required.
- Permanent and temporary erosion control systems are adequately designed, properly installed, serviced, and removed as appropriate to fulfill their design intent; and to meet all applicable requirements of the Commonwealth, the EPA Storm Water Pollution Prevention Plan (SWPPP), NPDES Requirements, and the Environmental Quality Board Erosion and Sedimentation Control Plan Regulation.
- All Stormwater Management Basins are maintained unblocked, free of vegetation and debris, and function as designed to manage storm water runoff as designed.
- Drainage pipes are free of vegetation and debris such that under headwall control, the pipe can flow full.
- Drainage pipes that are partially filled in due to upstream and downstream sedimentation need not be cleaned below the upstream bed elevation. Downstream evaluations must be made to determine if pipe extensions are necessary or removal of fallen trees is required to allow normal exit flows.
- Drainpipes must be free of infiltration that would cause subsidence of roadway or embankments. Drainpipe joints are to be tight and aligned to

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create laminar water flows and reduce trapping of solid objects that might flow through the pipe.

- Drainpipes are to have intact bottoms and functioning inlet and outlet aprons or devices that direct flows through the pipe as opposed to under the pipe.
- Culverts must be maintained considering needs for both low flow and storm flow. The primary opening of a culvert is to be maintained free of debris such that under headwall control, the culvert can flow full.
- Multiple cell culverts are to be maintained so that they remain open and fulfill the original hydraulic design capacity of the structure for its original flood frequency.
- Culvert joints are to be maintained such that infiltration does not occur that would cause subsidence of the roadway above or undermining of the culvert below.
- Upstream and downstream aprons, wingwalls and scour control measures are to be maintained such that headwall and end walls are not undermined, stream flows are directed to established channels, and joints in culvert segments do not "open up".
- Culverts over 8 foot in span must be maintained adequately to carry both flood flows and support roadway and fill above. Adequate maintenance requires that a Licensed Professional Engineer in the Commonwealth of Puerto Rico certifies every two years that all culverts maintain their required structural capacity.

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#### **D.4 Additional Requirements**

##### **D.4.1 Drainage Frames and Grates**

Missing, broken or fractured frames, rims and grates on drainage structures must be replaced promptly when detected by or reported to the Concessionaire. Rims and grates must be replaced with devices having the appropriate size and thickness, and made of appropriate materials. The Concessionaire should order in advance and have on hand a sufficient number of replacement parts to make repairs when required. To the greatest extent possible, the Concessionaire must use iron castings that are legibly stamped to identify ownership and identification of the utility.

##### **D.4.2 Drainage Structures**

The Concessionaire must inspect all drainage structures such as inlets, manholes and catch basins, and repair all defective components. Particular attention must be given to the following:

- Inlets, manholes or catch basins that are blocked due to cracking, an in fall or collapse of their adjusting rings, masonry units, or precast barrel sections.
- Failed or subsided roadway or shoulder pavement at drainage structures, attributable to a partial failure or collapse of the drainage structure. This deficiency must be promptly repaired to avoid safety hazards, prevent growth of the localized pavement failure due to impact pounding, stop water infiltration, and avoid loss of the pavement subbase and subgrade.

When these above conditions arise, the Concessionaire must not patch or repair the failed pavement or shoulder without first making a thorough inspection of the condition of the drainage structure.

After the drainage structure has been repaired, rehabilitated or reconstructed, the damaged pavement and/or shoulder must be replaced with a full-depth patch. Pavement patches must be constructed in accordance with the requirements of Volume I, Chapter B, "Roadway Maintenance". In addition, pavements, shoulders and berms must be correctly sloped after the repairs, and must properly drain storm water runoff away from the pavement and into the intended inlet structure without ponding.

Whenever a full depth patch is constructed at a drainage structure, the work must be done in accordance with the PRHTA Standard Specifications for Road and Bridge Construction.

#### D.4.3 Drainage Pipes and Conduits

The Concessionaire must inspect all drainage pipes and conduits within the Toll Roads such as storm sewers, cross pipes, and culverts, and must perform the necessary maintenance work or repairs. Particular attention must be given to the following:

- Whenever pavement flooding, washout of underlying soil layers, or other situations indicate that there is a collapse or blockage of drainage pipe or conduit.

Blocked or collapsed pipes and conduits must not be allowed to cause local area flooding, embankment undermining, movement of structural foundations, or other failures. The Concessionaire must evaluate all pavement defects where underlying slabs have apparently heaved or settled, all instances of heavily fractured or subsided pavement, all off-roadway sinkholes or areas of sudden subsidence, and all rotated or shifted structural walls and foundations in order to determine if a collapsed underground conduit is responsible.

When replacing any failed pipe or conduit, the Concessionaire must maintain and restore all connections, outlets, taps, and the like during the work.

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When the collapse, blockage or failure of any drainage pipe or conduit results in incidental damage to any other element of the Toll Roads infrastructure, the Concessionaire is responsible for repairing those elements within the timeframe noted in Section D.3.3 of this Chapter.


- The Concessionaire must inspect all culverts, pipe ends, outfalls, headwalls, end- sections and associated devices and perform the necessary maintenance repairs.

Headwalls end-sections and end-grates that have suffered damage, either due to traffic impact, corrosion, excessive loading, settlement, etc. must be repaired to restore full functionality or must be replaced if repair would be impracticable.

#### D.4.4 Drainage Culverts

The Concessionaire must inspect all culverts conveying water or with the potential to convey water in accordance with requirements of Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports". Adequate inspection and documentation must be provided to maintain PRHTA and FHWA data bases. In addition, particular attention must be given to the following:

- Culverts requiring inspection are more than 8 foot in span and may be single cell or multiple cells.
- Culverts are to be numbered in accordance with the PRHTA structure element and kilometer naming convention.
- Inspection requirements can be found in the National Bridge Inventory Standards developed by the Federal Highway Administration and in Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports".
- If inspection should reveal collapse, or near term expectation of collapse, creating a significant impact to the traveling public, the Concessionaire is to notify PRHTA and the Commonwealth in accordance with the requirements stated in Volume I, Chapter I, "Third Party Damages and Emergency Maintenance".
- Culverts inlets and outlets, along with culverts with open bottoms, must beevaluated for scour.
- Culverts which are near the roadway surface or directly support the roadway pavement must be evaluated relative to safety features such as Guard Rail, Barrier or Parapet. Such safety devices must be anchored properly to deflect vehicles away from creeks and streams. Such devices must have proper transitions along the roadway for safe vehicular operation.

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#### D.4.5 Bridge Drainage Systems and Downspouts

The Concessionaire must inspect Bridge Drainage Systems including scuppers, deck drains, and downspouts and must clean these components; repair damaged components; and replace missing or broken elements of the systems. The Concessionaire must pay particular attention to the following deficiencies:

- Broken, missing, fractured and leaking scuppers and grates; broken grout around scuppers; defective or leaking pipe connections; and similar deficiencies.
- Blocked or clogged bridge downspouts, particularly following construction or maintenance activities that may have caused vegetation and debris to accumulate.
- Loose, unattached or severely leaking bridge downspouts that can cause erosion, flooding, or a falling debris hazard.

Replacement parts for Bridge Drainage Systems must be equivalent to the existing drain size or diameter, material type, wall thickness, and material strength, and/or must be painted to match the rest of the system as appropriate. The paint system must conform to the Reference Documents listed in Section D.2 of this Chapter. Whenever practicable, cleanouts must be installed on older downspouts to aid future maintenance efforts.

- When the Bridge Drainage System outlets onto the ground, the Concessionaire must examine the condition of the outlet and perform all required repairs. Defects to examine include loss of riprap protection, soil erosion and water accumulations, etc.

#### D.4.6 Stormwater Management Basins

The Concessionaire must inspect all stormwater management basins within the Toll Roads, and must pay Particular attention to the following deficiencies:

- Stormwater management basin embankment slopes that show erosion or undercutting at inflow or outflow points. Severely eroded or undercut slopes must be repaired to avoid potential failure or movement of the slope and possible undermining of the roadway.

Correction of eroded or undercut embankment slopes is required when the slope is measured to be 25% steeper than the undisturbed slope, or steeper. Undercut slopes must be evaluated and calculated based upon a professional survey.

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The placing of embankment material to build up undercut slopes is to be done in accordance with the requirements of the Reference Documents listed in Section D.2 of this Chapter. The Concessionaire must protect the newly constructed embankment from erosion by placing erosion control blanket, temporary seed and mulch, sod, or other measures.

The embankment repair must not restrict the stormwater management basin cross section as designed, alter the low flow profile, or block existing legal discharges into the Toll Roads from neighboring lands.

- The integrity of the basin structures must be maintained to ensure the basins function as designed. The Concessionaire must restore, reset, and stabilize concrete riser structures or standpipes as designed when shifting or undermining of the structures has occurred.
- Sediment and debris that collects within stormwater management basins reduce the storage volume available for storm water runoff. The Concessionaire must remove trash, vegetation and debris periodically to prevent clogging of the outlet structures. Sediment must be removed a minimum of every 5 years, or as needed to ensure the basins design storage operates as designed and retains its intended capacity.

#### D.4.7 Roadway and Roadside Ditches

The Concessionaire must inspect all open drainage channels including ditches and swales, as well as their associated erosion control devices, and must pay particular attention to the following deficiencies:


- Earth ditches that cannot convey design storm water flows due to soil settlement, erosion, embankment sloughing, sediment accumulation, etc. must be evaluated. Ditch re-grading may be required in order to restore a constant and uniform slope in accordance with the original design intent. Re-grading to eliminate channel pinch points or flat sloped sections may be required to reduce flooding, ponding and deposited sediments while enhancing free flow.

Bare soil must be reseeded to re-establish vegetative cover and prevent erosion. When appropriate, temporary erosion control measures such as mulch or erosion control blankets must be used while the grass seed is being established.

#### D.4.8 Curb

The Concessionaire must maintain bituminous and concrete curb as an important part of the overall Drainage System, since they collect storm water runoff, convey runoff to sewer inlets or designed outfall points, and protect embankments from erosion. Curb also serves as a structural support for the shoulder, provides delineation of the edge of the traveled way, and can help redirect errant vehicles.

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The Concessionaire is responsible for making repairs and replacement of segments of bituminous and concrete curb that are deficient due to excessive break up, settlement or heave. The Concessionaire must remove and replace, or otherwise repair segments of bituminous and concrete curb that show extensive cracking, open transverse cracks, missing expansion joint filler, or spalls.

All broken bituminous and concrete must be properly disposed of in conformance with all laws and regulations.

Replacement of curb must conform to PRHTA Standard Plans and the neighboring sections of curb. The gutter elevation and grades of the replacement curb must be flush with the adjoining pavement or shoulder, and must be set to convey flows to drainage structures without ponding.

The Concessionaire must restore and stabilize base support when this has been identified as the cause of bituminous and concrete curb cracking. The Concessionaire must re-grade the earth berm behind the curb when erosion or settlement results in the earth surface settling three (3) inches below the top of curb at any location.

Missing expansion joint filler must be replaced with new preformed joint filler conforming to the material requirements of the Reference Documents listed in Section D.2 of this Chapter.

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#### D.4.9 Pavement and Bridge Base-Drain Systems

All base-drains and their associated outlet pipes must be in accordance with the requirements of the Reference Documents listed in Section D.2 of this Chapter. Bridge base-drains including abutment back wall pipes and outlets or weep holes must be inspected to ensure that discharge is free-flowing, and that no outlet is clogged or crushed.

Pavement base-drains must be inspected to assure that they are functioning, and to verify free-flow and unobstructed discharge.

New installations of pavement base-drain must be considered in areas where pavement surface distress, surface blowups, excessive potholing, or other signs indicate that subsurface drainage would tend to reduce pavement maintenance needs. All new base-drain must conform to the requirements of the Reference Documents listed in Section D.2 of this Chapter.

#### D.4.10 Permanent Erosion Control Systems

The purpose of permanent erosion control measures and systems is to minimize or eliminate the erosion of soil into ditches, drainage systems and Waters of the Commonwealth. The objective of permanent erosion control repairs and maintenance is to prevent topsoil loss, maintain turf cover to anchor the soil and prevent erosion, and to ensure conformance with all applicable laws and regulations.

When a new permanent erosion control system is required, the Concessionaire must perform all design, agency coordination and construction in order to obtain the necessary permits and approvals.

The Concessionaire's Puerto Rico Licensed Professional Engineer should perform a thorough review of available permanent erosion control systems and their correct application given the anticipated water flow volumes and velocities, prevailing wind patterns and other specific field conditions.

Erosion and sediment control measures to be considered include new roadside ditches, riprap, ditch checks and settling basins.

#### D.4.11 Temporary Erosion Control Systems

The purpose of temporary erosion control measures and systems is to minimize or eliminate the loss of topsoil during construction and maintenance projects.


The Concessionaire must implement the appropriate level of erosion control throughout all construction and maintenance activities. The Concessionaire's erosion control for construction and maintenance operations must comply with all applicable PRHTA requirements, Commonwealth and Federal laws and regulations, and municipal ordinances. In order to so comply, the Concessionaire must plan to control the amount, location and quality of discharges from its work sites into sewers, culverts, wetlands, streams, channels, and public waters or onto adjacent properties. When required for compliance with agency requirements, the Concessionaire must perform studies, submit permit applications, create detail drawings, prepare specifications, attend meetings, etc.

To ensure that temporary erosion control measures are furnished when needed, the Concessionaire must screen all construction or maintenance projects for erosion impacts. The screening must identify if the following potential impacts may occur:

- The operations will temporarily or permanently alter the manner of discharge of any waters outside the Toll Roads.
- The operations have the potential to convey topsoil from the Toll Roads into any drainage system, stream or channel.

Whenever the above potential impacts are identified, the preparation and filing of a written "Erosion and Sediment Control Plan" to the Environmental Quality Board may be required by present regulations.

Temporary erosion control measures and systems that may be considered for implementation include, but may not be limited to, filter fabric fence, silt socks, inlet protection, erosion control blankets, rock filters, temporary seeding, mulching, sediment traps, sediment basins, sediment filter bags, rock construction entrances, outlet protection, etc.

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#### D.4.12 Creek and Stream Requirements

The Concessionaire is responsible for the well-being of waters flowing along or across the Toll Roads. In the operation of both man-made and natural occurrences relative to creeks and streams within the Toll Roads can occur that require proactive measures by the Concessionaire. Natural erosion must be monitored so as to not be detrimental to the Toll Roads. Emergency situations and Accidents on the Toll Roads can severely impact creeks and streams.

The Concessionaire may be required to do the following as part of maintenance for creeks and streams within the Toll Roads Evaluate toe of slope adjacent to creeks and streams to determine if mitigation measures are necessary to prevent loss of slope supporting roadways.

- In limestone prone areas determine if counter measures are necessary to prevent sinkholes from forming under the roadway. Countermeasures may take the form of impervious linings for streams or creeks. Such linings presently exist in local areas and require periodic review and maintenance.
- Periodically evaluate streams and creeks to determine if diversion ditches or stone lined swales are necessary to divert drainage which has migrated to the top of slopes above roadways.
- In mountainous areas, maintain drains at natural springs and seeps that can cause slope erosion which can be hazardous to the roadway below.
- Develop emergency plans for containment of spills of solids or liquids carried over or under the Toll Roads. Such emergency plans should utilize storm water management basins, pipes and culverts as much as possible to contain contaminants in a confined area until they can be collected and disposed of properly. Emergency plans for spills should focus on containment in as small of an area as practical with due consideration to the safety of first responders.

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#### D.4.13 Emergency Inspections

Emergency inspections are required following rainfall events in which rapid runoff may occur that can be detrimental to either the Toll Roads or adjacent property owners. Such events should be focused relative to watersheds and drainage courses that are parts of said watersheds. The Concessionaire must maintain an awareness of public and private agencies which historically provide the most accurate information relative to rainfall intensity and other meteorological measures that can indicate creeks and streams are rising above their banks. During such events, the Concessionaire must safely view pipes and culverts to determine that they are functioning properly or determine that if corrective action is necessary which may involve the pipe or culvert, or temporary closure of a road segment or direction.

Following major storm events, Toll Road areas where rainfall exceeds the equivalent of 4 inches per hour, inspections of creeks and streams are to be performed when they pass parallel to or under the Toll Roads. These inspections must be undertaken to determine if any elements of the Toll Road operation should be adjusted by examining the following:


- Determine if any creeks or streams have changed course resulting in erosion of embankments.
- Determine if any failures of storm water detention ponds have occurred.
- Determine if debris has clogged the opening of a drainage pipe or culvert causing backwater build up that could cause significant property damage to upstream properties or impound a significant body of water that could cause a downstream wash out.
- Determine if creeks or streams are flowing around as opposed to through pipes or culverts intended to convey water alongside or under the Toll Roads.
- Determine if debris in the form of trees, tree limbs, or other solid objects are significantly blocking inlets to pipes or culverts creating high velocities that can cause failure from scour action.
- Head walls and end walls must be viewed to determine if they are submerged, and if velocities are bypassing scour protection devices.
- For culverts make similar determinations as to pipes when only one barrel is associated with the culvert. For multi-cell culverts determine if primary flows are through the intended barrel. In addition, determine if the other barrels are taking water according to expected water surface elevations.

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## **E.1 Definitions**

Bagged & Bur lapped Stock: A plant transplanted with the root ball secured in burlap.

Bald Stock: A plant transplanted with its roots in a ball of earth

Deciduous: Trees or woody shrubs which lose their leaves after each growing season.

Debris: Litter, rubbish, nuisance or dead vegetation, rocks, dead animals, spilled (nonhazardous) materials, brush, or other such items.

Erosion: A wearing away of the surface by natural action of wind and water.

Fencing: Fabric, posts, gates, guy wires and braces configured to create a boundary or provide access control.

General Use Chemicals: Agents used to destroy pests and plant growth that will not cause unreasonable effects to the user or the environment when used in accordance with their registered labeling instructions. These products are generally available to the public without restrictions other than those specified on the labeling.

Herbicide: An agent used to destroy or inhibit plant growth.

Landscaping: All vegetation, including turf and grasses, trees, intentional plantings, as well as incidental items including block walls, planter boxes, planting beds, lawn edging, street furniture and irrigation sprinkler systems.

Litter: Trash, debris, waste, refuse, accident and construction residue, etc.

Noxious Weeds: Uncultivated plant growth that is harmful or destructive to other plant growth.

Nuisance Vegetation: Large types of weeds, and vegetation not desirable to the Landscape. Examples include medium height shrubs, vines, and brush such as buckthorn, honeysuckle, kudzu, purple loosestrife, multiflora rose and leafy spurge.

Pesticides: Agents used to destroy insects, rodents and other pests.

Restricted Use Chemicals: Agents used to destroy pests and plant growth governed by Local, State and Federal regulations that require special training and/or licensing.

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Systemic: Passing through and affecting the whole body of the plant system.

Turf: Surface earth ground cover containing a dense growth of grass and matted roots.

Weeds: Uncultivated plant growth. Examples include crabgrass, dandelions, etc.

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## E.2 References

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA
- Highway Design Manual, PRHTA
- Standard Drawings, PRHTA
- Standard Specifications for Road and Bridge Construction, PRHTA
- A Policy on Geometric Design of Highways and Streets, AASHTO
- Roadside Design Guide, AASHTO
- "ANSI A300 - Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance: Standard Practices", ANSI.
- "Illegal Dumping Prevention Guidebook, EPA905-B-97-001", USEPA.
- "American Standard of Nursery Stock", AAN.
- Consolidated Permit (DS-3, Fugitive Dust & CES Plan), PREQB
- Regulation No. 25, PRPB

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### **E.3 Policy for Performing Landscape & Roadside Maintenance**

#### **E.3.1 Objective**

The objective of Landscape Maintenance is to: preserve all trees and vegetation as an enhancement to the Toll Roads; provide aesthetically pleasing areas of lawns, shrub, flowers, and trees; eliminate dangerous and overhanging trees and vegetation; provide erosion control and allow unimpeded drainage flow; ensure safe sight distances; and control weeds and eliminate nuisance vegetation.

The objective of Roadside Maintenance is to: remove litter that prevents a clean and tidy appearance to the Toll Roads or creates an unsafe situation; and to maintain all fencing along or within the Toll Roads to preserve a property boundary, control pedestrian and animal access, and maximize the safety and security of the Toll Road users.

#### **E.3.2 Responsibility of Concessionaire**

To meet the requirements of this Chapter, the Concessionaire must engage in practices to ensure that Landscape and Roadside Maintenance is completed in a regular, systematic and timely manner to ensure the safe and orderly movement of traffic, and to meet the safety, aesthetic and economic benefits of the Toll Roads. This requires that the Concessionaire carry out its obligations in a manner that maintains and/or improves the overall Landscape and Roadside.

All materials and construction requirements for Landscape and Roadside work performed by the Concessionaire must conform to the appropriate and applicable requirements of PRHTA and the Reference Documents listed in Section E.2 of this Chapter.

The Concessionaire must make routine Landscape and Roadside inspections part of its daily activities, and must be watchful for obstructions from Landscape features, locations of illegal dumping, damage to fencing, full and overflowing litter receptacles, and all situations that detract from a neat and tidy appearance of the Toll Roads.

Work on Landscape and Roadside features within the Toll Roads that must be performed by the Concessionaire includes the following:


- Landscape:
  - Mow, trim and edge turf areas.
  - Repair and/or replace all damaged, diseased, dead and worn turf areas.
  - Aerate turf areas.
  - Water landscaped areas so that healthy plant life is maintained.
  - Control and remove weeds, insects, pests and diseases in plants, trees, shrubs and turf areas.



- Keep all portions of the traveled lanes, shoulders, curbs, gutters, drainage structures, sidewalks, and bridges free of plant growth, and vegetation waste.
- Fertilize plants, trees, shrubs and turf areas.
- Mulch around plants, trees and shrubs.
- Obtain, hold, and keep current all licenses required for the use of General Use and Restricted Use Chemicals.
- Assure that all employees utilizing General Use and Restricted Use Chemicals are properly trained and licensed as required by Law.
- Recognize, diagnose, and take measures to control all insects, rodents and other pests.
- Apply General Use and Restricted Use Chemicals in a manner so as to prevent spray-drift and encroachment into non-target areas.
- Properly remove and dispose of landscape control cuttings that represent a hazard, obstruct drainage or create a nuisance.
- Ensure that all trees and shrubs are pruned neatly and are maintained in a manner to minimize danger to the traveling public, or which pose a threat to adjacent lands.
- Remove vegetation that causes sight distance obstructions; obscures the visibility of signs, delineators, or other Roadside features; constitutes noxious or nuisance weeds; or impedes drainage.
- Remove all dead, damaged, overhanging and unstable trees and tree limbs.
- Replace all dead and damaged plantings and trees.
- Inspect health and growth of all plants, shrubs and plants.
- Ensure that all equipment used for landscaping conforms and is operated in compliance with all applicable Municipal, Commonwealth and Federal Requirements and Laws.

• Litter & Debris Control:

- Remove debris and litter from the roadway, roadside and planted areas.
- Empty litter receptacles.
- Remove, dispose of and report all illegal dumping.

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- Fencing:
  - Repair or replace all damaged or deficient fencing or its components as a result of motor vehicle collisions; rust, normal wear and weather damages; acts of vandalism; fallen trees; embankment shifts; fires and other occurrences.
  
- Irrigation:
  - Repair or replace all damaged or deficient irrigation, sprinkler heads, controllers, pumps, and their components.
  - Seasonal maintenance shall be performed pursuant to the requirements stated in the Irrigation System Operation and Maintenance Manuals.

### E.3.3 Performance Time Frames

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire) within which the Concessionaire must complete the required maintenance, repair or replacement to the Landscape and Roadside features.

TABLE E.3.3.1

<b>Landscape or Roadside Feature</b>	<b>Maximum Time Duration</b>
<u>Landscape:</u>	
- Sight Distance Obstruction	2 Hours
- Vegetative Waste	24 Hours
- Trees	7 Days
- Plants, Shrubs, Flowers, Turf	7 Days
<u>Roadside Litter:</u>	
- Illegal Dumping	2 Hours
<u>Fencing:</u>	
- Temporary Repairs	24 Hours
- Permanent Repairs	20 Days
<u>Irrigation System(s)</u>	7 Days

The following table establishes the minimum frequency that a particular maintenance operation is to be performed.

TABLE E.3.3.2.

Maintenance to be Performed	Minimum Frequency of Occurrence
<u>Landscape:</u> - Removal of Nuisance Vegetation	Monthly
<u>Roadway and Facilities Mowing:</u> - Mainline & Interchanges - Facility Lawns	Monthly  Weekly (or more frequently, if needed)
<u>Litter Control:</u> - Roadside Litter Collection - Emptying of Litter Receptacles	Every 3 Days  Every 2 Days, or when full; whichever occurs first

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The Concessionaire also must:

- Aerate all turf areas once yearly; recommended in the autumn.
- Establish a mowing frequency so that the criteria established in Table E.3.3.2 above is maintained.
- Cut and remove weeds and nuisance vegetation prior to reseeding.
- Trim trees and shrubs to ensure visibility, to prevent shading of signs and safety devices, and/or when less than seventeen (17) feet of vertical clearance above the traveled way and shoulder is not provided.


**E.3.4 Acceptance Criteria**

The Landscape and Roadside will be considered acceptable when the following criteria are met or exceeded:

- Landscape:
  - Turf height does not exceed that specified in Table E.3.3.2.
  - Turf, flowers, shrubs, and all plant life are trimmed, edged, pruned, disease and pest free, fertilized, watered and healthy.
  - Turf is free from brown-patches, missing-patches and damage.
  - No sight distance obstructions from trees and vegetation are present.

- Trees are trimmed, and free from dangerous, damaged, and overhanging limbs.
- Landscape is free from weeds and nuisance vegetation.
- All portions of the traveled lanes, shoulders, curbs, gutters, bridges, drainage structures, and sidewalks are free of plant growth and vegetation waste.
- No areas outside the target areas show chemical damage.
  
- Roadside Litter:
  - Roadside is free from litter, and in a neat and tidy condition.
  - Litter receptacles are emptied at a rate that meets that stated in Table E.3.3.2.
  - Locations of illegal dumping are not present.
  
- Fencing:
  - Fence posts are plumb.
  - Top rails are level with no sags or deflections.
  - The fence fabric is taut and securely attached.
  - The fabric is free from holes, section loss, wear, and vegetation.
  - The work site is left in a clean condition.
  
- Irrigation System:
  - All irrigation piping, sprinkler heads, controllers, pumps, and their components must function properly, shall be unbroken and must not leak.
  - Water spray patterns must adequately cover the Specialty Landscape areas.

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## **E.4 Additional Requirements**

### **E.4.1 Roadside Litter Collection & Removal**

The Concessionaire must perform litter collection and removal along the Toll Roads at a frequency complying with that stated in Table E.3.3.2. The Concessionaire should be aware that for specific segments of the Toll Roads the frequency of litter collection should be increased if it is found that litter is prone to collect so that the roadside always remains in a clean and tidy condition. In addition, areas beneath Toll Road structures and areas around all Toll Road Facilities must be included in litter collection.

The Concessionaire's litter collection operations must be designed to minimize disturbance to motorists and to maximize safety for both users and maintenance crews at all times.

Litter must never be transferred to a spot outside the Toll Roads for pickup.

Under no conditions will the Concessionaire use water to flush litter onto property outside of the Toll Roads.

Litter bags should be carried in maintenance vehicles at all times, for use as needed.

All litter and refuse must be legally disposed of in accordance with all Municipal, Commonwealth and Federal Waste Disposal Laws and Ordinances.

The requirements for pavement and shoulder sweeping are specified in Volume I, Chapter B, "Roadway Maintenance".

The Concessionaire's response to accidental spills, release of hazardous materials, removal of large-scale debris, and similar situations are to be addressed as described in Volume II, Chapter J, "Emergency Management and Operations Plan".

The Concessionaire's disposition of abandoned vehicles and breakdowns, animal removal, and repair of vandalism and graffiti is discussed in Volume I, Chapter I, "Third Party Damages & Emergency Maintenance".

### **E.4.2 Litter Receptacles**

Receptacles located at toll booths, toll plazas, rest areas and all other Toll Road Facilities must be emptied at a frequency complying with that stated in Table E.3.3.2. Receptacles may be relocated and added only where adequate space is available and provisions have been made for safe entry and exit. In addition, new receptacles must closely match the color, type and size of existing receptacles in order to preserve a uniform appearance.

Emptying litter receptacles and trash/garbage collected from inside the Toll Road buildings and other facilities is addressed in Volume I, Chapter N, "Facility Maintenance".

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#### E.4.3 Reporting Illegal Dumping

When incidents such as fly-dumping and unlawful trash disposal occur within the Toll Roads, the Concessionaire must contact and file reports with the Puerto Rico Police so that the location can be monitored.

#### E.4.4 Weed Control

Weeds should be eradicated no matter where they are found within the Toll Roads. The USDA Animal and Plant Health Inspection Service (APHIS) publishes a Federal Noxious Weed List, which can be found at their website ([www.aphis.usda.gov](http://www.aphis.usda.gov)) and can be used as a reference.

#### E.4.5 Nuisance Vegetation Control

Nuisance vegetation that must be removed as part of Landscape Maintenance includes vegetation which has taken root at locations such as turf areas, at the base of retaining walls, in shoulders, in clogged drainage grates, or along the fence lines. The Concessionaire must completely remove all nuisance vegetation to the greatest extent possible, which shall include the root systems.

Nuisance vegetation must be removed so that it does not interfere with drainage, or the establishment of slope stabilizing turf and such vegetation does not lower the aesthetic appeal of the Toll Roads.

#### E.4.6 Required Measures for Using General Use Chemicals

The selection of General Use Chemicals used as herbicide types (contact, pre-emergent, systemic), specific manufacturer(s), application rates and times of day, variations for soil type and the time of year, etc. are the responsibility of the Concessionaire and must be selected with regard to fulfilling the performance specifications.

Trees and shrubs that are killed or injured by over-application of herbicide must be replaced with similar plants.

The use of broad-spectrum herbicides on pavements, shoulders and sidewalks to control weeds growing through cracks and presenting an unsightly appearance is permitted.

The use of growth retardants or chemicals that reduce the growth rate in order to extend the periods between pruning, edging or mowing will not be permitted.

Weeds should be removed from turf areas where grass has been weakened by competition, but excessive use of weed killers on turf areas is discouraged.

The Concessionaire is responsible for ensuring that all staff who apply General Use Chemicals within the Toll Roads are properly trained and licensed.

#### E.4.7 Required Measures for Using Restricted-Use Landscape Chemicals

The purchase, storage, transportation, disposal, application and conformance with all laws concerning Restricted-Use chemical compounds, including pesticides, herbicides, insecticides, fungicides and rodenticides is the Concessionaire's responsibility.

The Concessionaire is responsible for ensuring that all staff who apply Restricted-Use chemicals within the Toll Roads are properly trained and licensed as follows:

- All persons who apply Restricted-Use chemicals must be licensed as a Commercial Applicator by the Puerto Rico Public Service Commission.
- The Puerto Rico Department of Public Health must certify and license any individual who applies pesticides in or on man-made structures for purposes including but not limited to bird control, rodent control, wood treatment and insect control.

#### E.4.8 Burning

Burning of select areas to control or eliminate weeds or nuisance vegetation is strictly prohibited. In addition, the Concessionaire is prohibited from burning trash, refuse, litter, landscape waste, oil, grease, unused paint, or any other waste or chemical product.

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#### E.4.9 New and Replacement Plantings

The Concessionaire is responsible for ensuring that only healthy stock is used for new and replacement planting.

All plants must be healthy, shapely, and well rooted. Roots must show no evidence of having been stressed, restricted or deformed at any time. The stems or trunks of trees must show no signs of having been cut, broken, mutilated or restricted by plant ties or supports.

The Concessionaire is prohibited from eliminating or choosing not to replace plantings without documented cause, or as a means to reduce the maintenance workload.

#### E.4.10 Turf

The Concessionaire is responsible for maintaining all turf within the Toll Roads and must perform the necessary work to preserve its health and appearance, including but not limited to: mowing, edging, applying landscaping chemicals and replacing all lost, diseased or dead turf and eroded topsoil in order to maintain proper grades and vegetative cover.

The Concessionaire must evaluate the need for seeding, over-seeding or sodding in locations of disturbed, thin or weakened turf.

#### E.4.11 Trees and Shrubs

The Concessionaire must perform maintenance to promote the growth of trees and shrubs. This work includes pruning, mulching, watering, fertilizing, removing and disposing, and replacing trees and shrubs with new plantings.

##### E.4.11.1 Inspections

The Concessionaire must keep aware of damaged trees and limbs that may be a hazard to traffic, pedestrians, highway appurtenances, electric utility lines, or adjacent property. Trees and limbs subject to such conditions must be inspected frequently to ensure they do not compromise safety.

The Concessionaire must evaluate the shrubs along fence lines in order to provide a neat appearance to the Toll Roads.

##### E.4.11.2 Pruning

The Concessionaire must prune growing trees and shrubs in order to maintain their structure and health, to maintain sight lines of visibility to prevent traffic hazards, to prevent damage to property, and to preserve the aesthetics of the landscaping.

To alleviate slippery conditions on pavements, tree branches located over the roadway or ramps must be removed.

Trees and shrubs too close to the edge of pavement or Right-of-Way fence should be constrained. Such plantings must be thinned or removed if the plant spreads.


All tree and shrub pruning must be consistent with ANSI Standard A300 and the Puerto Rico Electric Power Authority Regulations, which include guidelines for distances from trees to electrical and utility wires.

##### E.4.11.3 Mulching

Mulching around trees and shrubs with wood chips, green waste material, bark, straw or sheets of landscape fabric is required in order to conserve soil moisture, preserve a neat appearance to the landscaping, simplify mowing, and prevent weeds. Care must be taken to avoid excessive amounts of mulch, which may rot plant stems, and to use local products whenever possible to lower the chances of importing pests.

##### E.4.11.4 Fertilizing

The Concessionaire must fertilize young trees to promote proper growth and must apply fertilizer to trees and shrubs in order to maintain steady growth.

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The Concessionaire must not apply fertilizer in order to stimulate plant growth when underlying causes for lack of color or slow growth may be present. The Concessionaire must inspect distressed plants for evidence of such underlying problems and take all necessary steps to cure the plant.

All fertilizer application methods and rates must be consistent with the current ANSI Standard A300.

#### E.4.12 Fences

Toll Road fences have been erected to control access and prevent indiscriminate crossing by vehicles, pedestrians, or animals. The Concessionaire is responsible for inspecting, maintaining, and promptly repairing all fencing and its components.

Owners of private property fences bordering Toll Road property must be promptly notified when their fences need repair.

Fencing that has been damaged as a result of Third-Party damages, must be repaired or replaced as required in Volume I, Chapter I, "Third Party Damages & Emergency Maintenance". Fencing that has been vandalized must be repaired, reported to the Puerto Rico Police and monitored.

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### **F. ROCK AND SOIL SLOPES MAINTENANCE**

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## **F.1 Definitions**

Karst Topography: Karst topography consists of solution cavities and caverns in underlying limestone or rock formations, which may result in local sinks or settlements.

RCSRS: Rock Cut Slope Rating System, developed by the Oregon Department of Transportation.

RHRS: Rockfall Hazard Rating System, developed by the Oregon Department of Transportation.

Rockfall: According to the USGS (2004), rockfalls are abrupt movements of masses of geologic materials, such as rocks and boulders, that become detached from steep slopes or cliffs, Separation occurs along discontinuities such as fractures, joints, and bedding planes, and movement occurs by free-fall, bouncing, and rolling.

Landslides: According to the USGS (2004), landslides are mass movements, where there is a distinct zone of weakness that separates the slide material from more stable underlying material. The two major types of slides are rotational slides and translational slides.

Slope Inventory: A georeferenced database of slope locations.

Retainment Feature: Any structure, grading, barrier, netting or other appurtenance designed to retain or otherwise keep rock falls from encroaching on the traveled way.

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## F.2 References

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA
- Highway Design Manual, PRHTA
- Standard Drawings, PRHTA
- "Standard Specifications for Road and Bridge Construction", PRHTA
- LRFD Bridge Design Specifications, AASHTO
- "Maintenance and Management of Roadways and Bridges", AASHTO
- "Standard Specifications for Highway Bridges", AASHTO
- "National Bridge Inspection Standards (NBIS)", FHWA
- Publication FHWA-TS-79-208: "Rock Slope Engineering", FHWA
- Publication FHWA-TS-89-045: "Rock Slopes: Design, Excavation, Stabilization", FHWA
- Publication FHWA-SA-93-057: "Rockfall Hazard Rating System – Participant's Manual", FHWA
- "Landslides: Investigation and Mitigation", Special Report 247, Transportation Research Board, National Research Council, Washington, DC.
- Publication FHWA-FLH-19-002: "Unstable Slope Management Program for Federal Land Management Agencies", FHWA
- "Soil & Rock Classification Manual", Oregon Department of Transportation.

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### **F.3 Policy for Performing Slope Stability, Rockslide & Sinkhole Maintenance**

#### **F.3.1 Objective**

The objective of Unstable Slope Management Program (USMP) is to ensure that all elements of rock cut slopes are properly maintained and that the roadway is properly protected from rockfall and/or landslide events to ensure the safe and orderly movement of traffic. The type of events and accidents that can result from down slope rock movements range from minor debris that can damage tires and bodywork, to larger falls that impact vehicles or cause vehicles to swerve off the road, to substantial slope failures that block the roadway. The effect of these events can cause damage to vehicles, injury, or death to drivers, and adversely affect the Toll Roads due to road closures.

#### **F.3.1.2 Sinkholes**

The objective of sinkhole repairs is to promptly mitigate the effects of ground collapse related Karst activity within regions that are underlain by carbonate (i.e., limestone) rock formations. Sinkholes can pose an immediate hazard to motor vehicles when located within the Right-Of-Way footprint of the Toll Roads and can have serious impacts on traffic. As such, it is imperative that damage caused by sinkholes be treated quickly and that the repairs are performed in a manner that acts to prevent further collapse and/or monitor future sinkhole activity.

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#### **F.3.2 Responsibility of Concessionaire**

##### **F.3.2.1 Slope Stability and Rockslide Maintenance Landslide and Rockfall Maintenance**

To meet the requirements of this Chapter, the Concessionaire must undertake and maintain an inventory of stability conditions, plan and execute slope remediation operations, and perform regularly scheduled slope and slope retainment feature maintenance operations.

To the greatest extent possible, when performing slope maintenance and slope repairs, the Concessionaire must utilize the newest techniques that have been approved and implemented by PRHTA and within the Commonwealth for major highway contracts to minimize the environmental impact of the Toll Roads on the neighboring lands and waters while optimizing cost, recycling, and public convenience.

All materials and construction requirements for Landslide and Rockfall Maintenance work performed, including maintenance of retainment features, by the Concessionaire must conform to the appropriate and applicable requirements of the Reference Documents listed in Section F.2 of this Chapter.

Work performed by the Concessionaire for Landslide and Rockfall Maintenance includes the following:

- Unstable Slope Management Program Georeferenced Database:

The Concessionaire will be required to continue developing and maintaining a data base for unstable slopes and will keep the Soils Engineering Office of the PRHTA and the Commonwealth informed on all unstable cut/fill slopes observed within the Toll Roads. The Georeferenced Database must be active and represent the most current conditions so that a proactive program to identify and stabilize slopes before rock falls and landslides occur.

The Unstable Slope Management Program (USMP) to be used will be in compliance with the Unstable Slope Management Program for Federal Land Management Agencies, as established in publication number FHWA-FLH-19-002. The USMP is used to convey the potential that the slope has for creating traffic hazards due to rockfalls or landslides and the slope's priority relative for remediation.

- USMP Classifications:

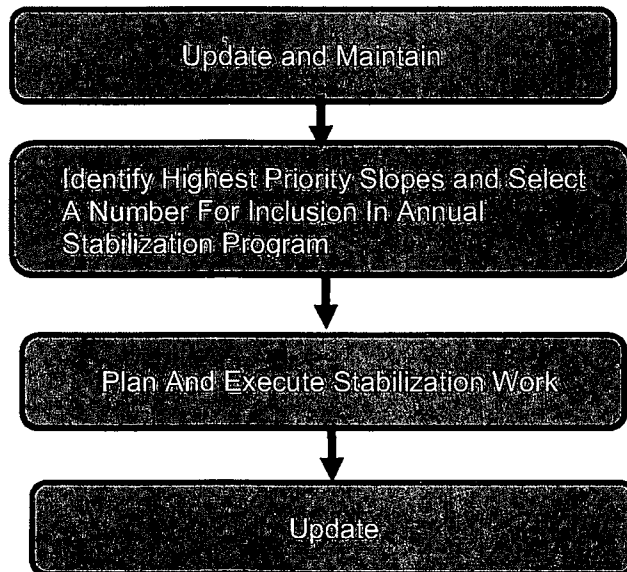
Table 3.2.1. Good, Fair, and Poor Classifications for USMP Slopes (modified from FHWA-FLH-19-002)

Good Condition	Slope Asset is free of significant defects, and has a condition that does not adversely affect its performance. This level of condition typically only requires preventive maintenance activities such as routine, occasional ditch cleaning. USMP Preliminary Scores are typically 15 to 21 points.
Fair Condition	Slope Asset has minor deterioration, erosion/raveling of cut slope, rockslides or rockfall, or infrequent subsidence of the embankment slope. This level of condition typically could be addressed through maintenance or risk reduction mitigation efforts, such as installation of barriers at road level and draped mesh to direct rock to the ditch or occasional subgrade improvement/strengthening with asphalt patching and/or drainage improvements. USMP

	Preliminary Scores are typically 22 to 161 points.
Poor Condition	Slope Asset exhibits advanced deterioration and conditions that impact ability of slope to remain intact. This level of condition typically requires narrowing the roadway, risk reduction slope repair, rehabilitation, reconstruction or replacement. Potential mitigation may include robust barriers, draped or anchored wire mesh, landslide stabilization techniques such as horizontal drains or buttresses, or cable net to hold rock on slope or direct it to ditches. USMP Preliminary Scores are typically >161 points.

The Concessionaire will be required to develop a slope remediation program to annually reduce the number of Fair and Poor condition slopes to Good condition slopes. This work will be as illustrated in the Flow Chart as follows:

Flow Chart 3.2.1



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**F.3.2.2 Sink Hole Maintenance**

Immediately upon notification of a sinkhole that has formed in or near the roadway, the minimum typical procedure outlined below is required by the Concessionaire in remediating the situation in a safe and timely manner:

- Employ appropriate temporary traffic control measures to keep traffic away from damaged area and to provide sufficient space for construction equipment.
- Survey and record sinkhole location. Remove damaged pavement as necessary and then excavate to expose the "throat" of the sinkhole, which consists of the near-vertical opening through which soil has collapsed downward into voids in the underlying rock. Remove unstable soils and loose rock and enlarge hole in order to expose the throat to the greatest extent possible. If bedrock is within reach of the excavating equipment, expose the top of rock surface by removing soil and loose rock materials to expose the throat of the sinkhole leading into the bedrock. Water may be flushed into the sinkhole as an aid to locating the throat.
- If the bedrock surface is too deep to be reached with the excavating equipment, then excavate as deeply as possible to expose the throat of the sinkhole as deeply below the ground surface as can be reached.
- If the sinkhole is not located within an area of roadway pavement, backfill the excavation with concrete up to a level no higher than four (4) feet below the ground surface, and then complete backfilling with soil up to the ground surface. If the sinkhole is located within an area of roadway pavement, then backfill the excavation with concrete up to a level of two (2) feet below the roadway subgrade elevation, and then place compacted subbase and finally the new pavement in order to reestablish the roadway surface within the repaired area.
- Allow concrete to fully set before beginning the placement of backfill materials above. Backfill soil is to be tamped using mechanical methods, i.e., a mechanical tamper which can reach down into the excavation. Alternatively, the excavation is to be widened and the sides of the excavation sloped as necessary to allow a worker to safely enter the excavation and hand-tamp the soil into place.

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**F.3.3 Performance Time Frames**

The following table establishes the minimum frequency for surveying and updating the RCSRS database. In the event of a rainstorm with an intensity of 4 inches of rain in one hour or more; all cut slopes must be inspected to verify their condition after the storm.

Table F.3.3.a

Priority Designation	Minimum Frequency of Occurrence
High Priority	Every year or after an event of rainstorm
Moderate Priority	Every year or after an event of rainstorm
Low Priority	Every three years

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire) within which the Concessionaire must complete the required maintenance, repair or replacement:

Table F.3.3.b

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Maintenance to be Performed	Maximum Time Duration
<u>Rock debris:</u> - Located in travel lane. - Located in shoulder area	1 Hour  24 hours
<u>Rock Slope Instability:</u> - Evident hazards - Remediation Projects	7 Days  Annually
<u>Rock Retainment Features:</u> - Debris removal behind feature <sup>1</sup> - Repair to feature	Twice Annually  30 Days
Sink Holes	30 Minutes (Initial Response)

(1) - Provide more frequent removal as necessary to ensure safe conditions are maintained.

#### F.3.4 Acceptance Criteria

All Rock Slope and Rock Slope Maintenance will be considered acceptable when the following criteria are met or exceeded:

- The RCSRS database is maintained and updated in accordance with the schedule noted in Section F.3.3 of this Chapter.
- The number of High Priority Slopes and Moderate Priority Slopes decrease on an annual basis.
- Rock retainment features are cleaned and maintained in a timely fashion, and in accordance with Table F.3.3.b.

Sinkhole repair work will be considered acceptable when the roadway has been stabilized and indications of ongoing sinkhole activity at the ground surface have ceased.

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## G.1 Definitions

Abutment: Earth retaining structures which support the superstructure at the beginning and end of a bridge.

Admixture: A substance added to a concrete mixture to produce a specific result.

Allowable Stress Design: A design method which computes stresses based on un-factored loads and compares such stresses to reduced allowable loads associated with structural materials. This method of design follows a "factor of safety" methodology.

Anchor Bolt: A threaded rod, including hardware, used for holding a mechanism or structure in place.

Approach Slab: Rigid pavement that provides a transition element from the roadway to bridge, that abuts to the bridge at the bridge joint.

Armor: A metal fitting installed to protect the underlying joint material.

Backwall: The component of the abutment usually starting at the bearing seat elevation acting as a retaining structure and support for the approach pavement.

Bearings: A mechanical support system which transmits the vertical loads of the Superstructure to the Substructure. Bearings are composed of steel, rubber, Teflon, etc., and are separated into two general categories:

- Fixed: Permitting only rotational movements.
- Expansion: Permitting longitudinal as well as rotational movements.


Bent: A line of columns built as a structural unit, transverse to the bridge and supporting the load of the Superstructure.

Bridge: A structure consisting of single or multiple spans more than 20 feet in length that provides a means of transit for vehicles and/or pedestrians above the land, water surface, roadway, railroad or other obstruction.

Bridge Joint: Designated horizontal and vertical separation that forms a determined gap at the end of a bridge deck. Bridge joints include expansion joints and fixed joints of various systems and materials.

Camber: The upward curvature built into the longitudinal profile of a beam to accommodate the application of the load.

Culvert: A structure made of steel, concrete, aluminum, natural stone, High Density Polyethylene, or other material, covered by embankment material and allowing a creek, stream or roadway to pass under a roadway or fill. Culverts are typically box

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or arch in shape and may or may not have slabs under the creek or stream flowline. Culverts may be of any size up to 20 feet in span length.

Core Element: Commonly Recognized Bridge Structure Elements. A nationwide system developed by AASHTO to provide a uniform basis for data collection on bridge structure elements.

Cross Girders: Deep structural members in steel or concrete with an "I" or "Box" section that support stringers or girders over a roadway or railroad. Cross girders usually have only two supports, and have bearings that transmit vertical loads to columns. Cross girders may also be part of steel framing that has bearings at ground level.

Deck or Slab: The portion of a bridge that supports the highway, from the top of the major structural members to the Wearing Surface, and is designed to distribute loads evenly across the bridge.

Dolphin: Groups of piles driven close together in water and tied together so that the group is capable of protecting bridge elements by withstanding lateral forces from vessels and other floating objects.

Fender System: Piles and/or timbers used as guides along a bridge foundation face to absorb the shock of vessel impacts and to minimize damage to the structure and vessel.

Floor Beam: Transverse members which support the stringers and transmit the loads to the main load carrying members of a structure.

Fracture Critical: A tension member, reversal member or component (with a tension element) the failure of which will result in the collapse of the structure.

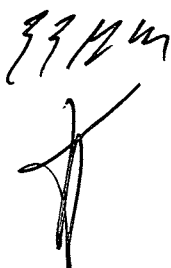
Girder: An "I" or "Box" section providing primary support for the bridge deck or floor beams. Girders are oriented in the direction of the roadway, with the exception of Cross-girders.

Grade Separation: Crossing of a highway over another highway, street, railroad, channel or other facility, at different elevations.

Grout: A fluid mixture of mortar composed of sand, cement and water that can be poured or pumped easily.

Gusset: A plate serving to connect the elements of a member(s) of a structure, and to hold them in the correct alignment and/or position at a joint.

Load Factor Design (LFD): A design methodology in which factors are applied to various loads on a structure and the resulting computed stress are compared to the ultimate strength of a material.



Load and Resistance Factor Design (LRFD): A probabilistic design methodology in which factors are applied to loads, and ultimate strength of materials. The factors applied are based on the degree to which the designer can predict both the loads and the ultimate strength of steel or concrete. These factors are established by AASHTO.

Load Rating: An analysis of a structure to compute the maximum allowable loads that can be carried across a bridge; the guidelines are set forth by AASHTO.

Overpass: The single or multi span bridge that crosses over the Toll Roads.

Parapet: A wall-like member integrally connected to the fascia edge of a bridge deck to serve as a protective barrier for vehicular or pedestrian traffic.

Piers: Substructure elements which support the Superstructure at intermediate points between the abutments.

PONTIS: An AASHTO ware product providing a comprehensive, rigorous, and flexible Bridge Management System.

Retaining Wall Structures: An engineered structure designed to resist horizontal earth pressures of a fill or cut, and/or a structure designed to prevent material from spilling onto another surface.

Roadway Arch Culvert: A concrete (cast in place or precast), or metal arch structure supporting fill or roadway with soil separation between the top surface and the underside of the arch. Arch culverts are considered either rigid or flexible and for the passage of roadways would span from 12 to 40 feet.

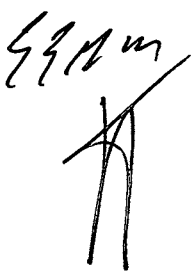
Scour: The lowering of the streambed by the erosive action of water as a result of a local obstruction or natural phenomena, typically occurring at piers and abutments in waterways.

Segmental Concrete Bridge: A concrete bridge typically with a "box" cross section that is either cast in place or precast and post tensioned together forming the span from pier to pier.

Spall: Circular or other shaped depression in a concrete surface resulting from the separation of a portion of the surface from its substrate.

Stringers: Longitudinal beams supporting the bridge deck, and in some bridges framed into or upon the floor beams.

Substructure: The pier and abutment elements required to support the Superstructure.




Superstructure: The entire bridge structure resting on the piers and abutments, consisting of stringers, girders, decks, floor beams, trusses, wearing surfaces, railings, etc.

Truss: A jointed bridge structure having open built web construction so arranged that the frame is divided into a series of triangular shaped figures.

Viaducts: All continuous multiple span bridges, usually consisting of more than 5 spans, and not defined as overpasses.

Wearing Surface: The portion of a bridge deck cross section which resists traffic wear.

Wingwall: A side wall to the abutment backwall or stem designed to assist in confining earth behind the abutment.

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## **G.2 References**

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA.
- Highway Design Manual, PRHTA.
- Standard Drawings, PRHTA.
- Standard Specifications for Road and Bridge Construction, PRHTA.
- Bridge Inspection Manual, PRHTA
- "LRFD Bridge Design Specifications," AASHTO.
- "Maintenance and Management of Roadways and Bridges", AASHTO.
- "Guide Specifications for Fatigue Evaluation of Existing Steel Bridges", AASHTO.
- "Guide Specifications and Commentary for Vessel Collision Design of Highway Bridges", AASHTO.
- Title 23, Code of Federal Regulation, Section 650, "National Bridge Inspection Standards (NBIS), FHWA
- "Bridge Inspector's Training Manual", FHWA.
- "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges", FHWA.
- "NCHRP Report 299: Fatigue Evaluation", NCHRP/FHWA.
- "SSPC Painting Manual", 2-Volume Set. SSPC.
- "Lead-Based Paint Removal for Steel Highway Bridges", SSPC.
- "SSPC-VIS1 – Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning", SSPC.
- "SSPC-VIS2 – Standard Method for Evaluating Degree of Rusting on Painted Steel Surfaces", SSPC.
- "SSPC-VIS3 – Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning", SSPC.
- "SSPC-VIS4 – Guide and Reference Photographs for Steel Cleaned by Water Jetting", SSPC.
- "SSPC-VIS5 – Guide and Reference Photographs for Steel Prepared by Wet Abrasive Blast Cleaning", SSPC.
- International Concrete Repair Institute Technical Guidelines, ICRI

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### G.3 Policy for Bridge & Structure Maintenance

#### G.3.1 Objective

The objective of Bridge and Structure Maintenance is to ensure that the stability, safety, durability, strength, and structural integrity of the Toll Roads are continually and properly maintained so as to maximize the functional life of the structures.

Structures require repairs due to wear, vehicular impacts, chloride infiltration, etc.; maintenance; inspections; and replacement in part and in whole.

Maintenance objectives for individual structure elements of a structure are further identified by the following:

- Bridge Decks and Wearing Surfaces: To provide a safe, uniform, smooth, stable and durable surface.
- Bridge Railings and Parapets: To provide a structurally sound and safe barrier for and between pedestrians, vehicles and hazards. This includes structure mounted fences.
- Bridge Joints: To provide a safe, smooth and stable condition across planned openings.
- Bridge Superstructure and Substructure Elements: To provide and maintain the structural integrity, durability and load carrying capacity of concrete and steel Superstructure and Substructure elements.
- Bridge Bearings: To ensure that Superstructure loads are properly transmitted and distributed to the Substructure, and that the Superstructure is free to undergo necessary movements without damage.
- Bridge Painting: To prevent corrosion in steel elements of bridge Superstructures and Substructures, and to present a neat and tidy appearance on both steel and concrete.
- Bridge and Structure Cleaning: To preserve the bridges and structures; and to remove dirt, debris, and deleterious materials.
- Bridge Waterway Protection: To ensure structural strength, to prevent scour and to maintain the impact resistance of the bridge fender system.
- Structure Accessories: To provide functionality and maintenance to ancillary bridge and structure items including, but not limited to, inspection walkways, sidewalks, slope walls, etc.
- Bridge Inspections: To provide current and accurate information on the condition and the structural adequacy of the bridge or structure in accordance with the applicable requirements of the Municipal, Commonwealth and Federal governments.

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### G.3.2 Responsibility of Concessionaire

In order to meet the requirements of this Chapter, the Concessionaire must engage in practices to ensure that all Bridges and Structures function properly as designed; to ensure that the stability, strength, durability and structural integrity of the Bridges and Structures are not compromised; and to provide a continuous safe and orderly movement of traffic. This requires that the Concessionaire carry out its obligations in accordance with this Chapter and all requirements of other Volume I chapters in a manner that minimizes the overall deterioration and/or improves the condition of the Bridges and Structures.

The Concessionaire is responsible for all management associated with the Bridge and Structures including; conducting Maintenance, Emergency and Mandatory inspections; filing inspection documents and reports with PRHTA; assisting in independent inspections; and replying to questions or comments that might arise. The Concessionaire is also responsible for determining repair needs; creating repair alternatives and procedures; scheduling work; and overseeing all work to ensure compliance with all of the Reference Documents listed in Section G.2 of this Chapter.

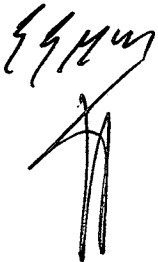
The Concessionaire is responsible for initiating, designing, determining, establishing and maintaining all required Traffic Control for the duration of the work as addressed by the requirements of Volume II, Chapter H, "Traffic & Travel Management Plan".

The Concessionaire must ensure that all repair drawings are prepared and sealed by a Professional Engineer Licensed in the Commonwealth of Puerto Rico. In addition, all repair work resulting in an alteration of a bridge or structural element must be recorded with an "As-Built" document, which must also be filed with PRHTA's Bridge Engineering Office.

All materials and construction for Bridge and Structure work performed by the Concessionaire must conform to the appropriate and applicable requirements of the Reference Documents listed in Section G.2 of this Chapter.

Once work on a Bridge or Structure has been started, the work must continue during consecutive working days until a thorough, complete, and structurally adequate product has been achieved. All work performed on Bridges and Structures must correct all safety deficiencies, preserve the Toll Roads as an asset, and restore a quality riding surface.

Structures include Bridges, Culverts, Retaining Walls and Noise Walls. Sign structures, which include truss and single tube bridges and cantilever structures, are also included. For clarity this Chapter mainly addresses bridges and bridge related structures. Refer to the following Volume I Chapters for other structure types:



Chapter D: Drainage Maintenance & Erosion Control

Chapter H: Noise Wall and Retaining Wall Maintenance

Chapter K: Signs and Signage Systems Maintenance

Refer to the corresponding Volume I "Maintenance Manual" Chapters for the following elements associated with Bridges:

- Bridge Approach Pavement Chapter B: Roadway Maintenance
- Bridge Approach Guide Rail Chapter J: Roadway Safety Features & System Maintenance
- Bridge Drainage Chapter D: Drainage Maintenance & Erosion Control
- Bridge Mounted Signs Chapter K: Signs and Signage Systems Maintenance
- Bridge Mounted Lights Chapter L: Lighting and Electrical Systems Maintenance

Work on Bridges and Structures within the Toll Roads that must be performed by the Concessionaire includes, but is not limited to, the following:

• Bridge Decks and Wearing Surfaces:

- Make repairs to deteriorated, delaminated and unsound portions of the Bridge Decks & Wearing Surfaces including but not limited to full and partial depth repairs; concrete crack sealing; and replacement of the Bridge Decks and Wearing Surfaces in part or in whole.
- When an entire span deck is replaced or overlayed, a moisture insensitive broadcast aggregate – low modulus epoxy shall be applied to the surface. Such product shall meet ASTM C-881 Type III Class B and C specifications.
- Ensure that Bridge Decks and Wearing Surfaces are securely attached to their support elements, so that a safe, durable, and structurally adequate condition is continually provided.
- Ensure that all Bridge Decks and Wearing Surfaces are structurally adequate to support vehicular and other design loads.
- Ensure that all repairs or replacement work provides the following:
  - A smooth and safe wearing and riding surface.
  - The repaired areas encompass all surrounding unsound and deficient areas.
  - Repairs are sound, durable, and well bonded to the substrate surface or support element.

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- The repaired area is finished in accordance to the requirements of the Reference Documents.
- Cracks are sealed and prevent the infiltration of water and chlorides.
- The repaired areas match the concrete color and the profile of the surrounding areas.
- Concrete used for repairs shall not have additives used with the purpose of modifying the natural color of concrete.

- Bridge Railings, Parapets and Fences:

- Maintain, repair or replace Bridge Railings and Parapets that are unsafe or have the potential to become unsafe to Toll Road users or users below the bridge.
- Install temporary barriers or railings where and when required, ensuring the continual safety of Toll Road users.
- Maintain, repair, and replace Bridge Railings, Parapets and Protective Fence to the original design, unless entire segments or lengths are replaced in which case the Concessionaire must conform to the most current requirements stated in the Reference Documents listed in Section G.2 of this Chapter.
- Repair or replace all rusted, bent, loose, missing, unsafe and/or damaged steel railings, parapets or fence supports.
- Repair or replace all cracked greater than 0.05 inches wide for reinforced concrete and 0.009 inches wide for prestressed concrete.
- Unsound, delaminated, missing, unsafe and/or damaged concrete railings or parapets.
- Modify or provide parapets and barriers in accordance with PRHTA Standard Drawings to prevent vehicular vaulting.

- Bridge Joints:

- Replace full or sectional lengths of Bridge Joints, seals and bridge joint armor that are unsafe or have the potential to become unsafe, or that would accelerate the deterioration of other bridge and structure elements, such as bearings.
- Replace all Bridge Joint seal material that becomes damaged, missing, worn, torn, leaky, misaligned, or no longer function as intended by the original design.
- Repair or replace all Bridge Joint armor and its components that become loose, bent, gouged, separated from its substrate, damaged, broken, cracked, experience section loss or missing.

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- Bridge Superstructure and Substructure Elements:
  - Ensure that all bolts are present, properly torqued, tight, and contain the proper nuts and washers.
  - 
  - Replace all loose, damaged, deteriorated, cracked, missing and non- functioning rivets with an appropriate high strength bolt of the same or larger diameter as the original rivet.
  - Repair or replace bent, corroded, cracked, fatigued, damaged or structurally deficient steel Superstructure and Substructure elements.
  - Repair or replace unsound, delaminated, spalled, cracked and structurally deficient concrete Superstructure and Substructure elements.
  - Inspect and investigate all truss elements as well as all Superstructure and Substructure elements that appear loose, damaged and/or resonate when load is applied.
  - Perform all steel repairs so that each individual element, as well as the structure, is structurally adequate to support vehicular and other design loads.
  - Perform all concrete repairs in a manner that removes all deficient concrete and ensures a sound, durable, well-bonded repair that is structurally adequate to support vehicular and other design loads.
  - Repair all concrete pedestals and bearing seat areas that become cracked, damaged, deteriorated, or unsound.
  
- Bridge Bearings:
  - Replace non-working or structurally unstable Bridge Bearings and associated components with replacement bearings that adequately support all the design loads and combinations that it might experience, in conformance with the requirements of the Reference Documents.
  - Employ a Licensed Professional Engineer in the Commonwealth of Puerto Rico to prepare jacking, removal and installation procedures and documents for all Bridge Bearing removal, replacement and resetting work.
  - Replace Bridge Bearings and associated components in part or in whole that are unsafe or have the potential to be unsafe or have deteriorated to the condition where maintenance and repair will not restore the intent of the original design function.
  - Clean, lubricate, realign, and repair Bridge Bearings in accordance with the manufacturer's specifications or the original design specifications.

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- Clean all bridge bearings and associated components that are rusted or become covered with abrasives, dirt, pigeon dung or debris.
  - Repair or replace all pads that are damaged, warped, distressed, bulging, crushed, cracked, split, torn, etc.
  - Repair or replace all anchor bolts, and associated components, that become damaged or are missing.
- 
- Bridge Painting:
    - Clean, prepare and coat all steel surfaces of bridge structures and railings in accordance with the requirements of the SSPC and the PRHTA Standard Specifications for Road and Bridge Construction, where the coating system is found to be deteriorated, broken, peeling, cracking, damaged, and/or the steel shows signs of corrosion or rust.
    - Test, remove and properly contain all existing paint that has or is thought to have lead present within its composition, in compliance with the requirements of the Reference Documents listed in Section G.2 of this Chapter.
    - Apply paint to all new steel bridge members or elements in accordance with the requirements of the SSPC and the requirements of the Reference Documents listed in Section G.2 of this Chapter.
- 
- Bridge and Structure Cleaning:
    - Ensure that the following surfaces and elements are cleaned of all dirt, debris and deleterious material, and washed to remove chemicals and abrasives at the frequency stated in Table G.3.3.2 of this Chapter:
      - Decks, shoulders, curbs, railings, bridge joints and parapets and gutter lines.
      - Truss members to a minimum height of 10 feet above the deck surface, including the bottom chord.
      - Bridge members that are located below the deck. Include members at deck joints, nesting locations for pigeons, members experiencing splash from bridge deck drain pipes or scuppers.
      - All drainage structures, including scuppers, deck drains, expansion joint troughs, abutment seat troughs, and drain piping.



- Approaches to the bridges and all associated bridge elements for a distance of not less than 30 foot-long, as measured from the abutment joints, including the wingwalls, parapets, guard rail, etc.
- Pier and abutment seats and caps, especially those beneath bridge deck expansion joints.
- Abutment stem walls and backwalls.
- Remove all fire hazards beneath bridges and structures.
- Ensure that all cleaning work is performed without damage to property, or injury to Toll Road users.
- Bridge Waterway Protection:
  - Ensure that the waterway and banks at all water crossings are free of all trees, logs or other debris that may impede vessel passage or water flow and/or reduce the functionality of the pier protection system.
  - Repair and/or replace Dolphins, Pilings, Fender Systems and their associated components that are unable to or have the potential to be unable to resist waterway vessel and debris impacts.
  - Employ a Licensed Professional Engineer in the Commonwealth of Puerto Rico to prepare designs and documents for the replacement of all Bridge Waterway Protection systems.
  - Maintain, repair or replace all Dolphins, Pilings, Fender Systems and their associated components that are loose, unattached, rotted, damaged and/or missing.

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Scour Protection:

- Establish internal procedures to monitor Scour Critical Bridges during or immediately after periods of high water. The Concessionaire must be pro- active relative to Scour potential for substructure elements within floodplains or floodways. Include the following elements as part of the procedures:
  - Maintain a list of scour critical bridges that are to be monitored during periods of high water. Include other bridges that are not classified as scour critical but that may have scoured previously or that may be susceptible to debris and aggradation.
  - Designate and train personnel to report and evaluate conditions after and during high water events.


- Establish local benchmarks at Scour Critical Bridges to enable non-bridge inspectors to report the height of water. In the list of scour critical bridges indicate the location of the benchmarks and the water heights at which inspections are warranted. In addition, the benchmarks enable inspectors to quickly gauge the progress of scour at a substructure.
- Maintain a listing of substructure elements in flood areas supported by spread footings.
- Following flood events occur that produce high water velocities, inspect the substructure elements for scour, sounding adjacent areas underwater by means of poles, ultrasonic devices or radar. Determine if any potential exists for substructure tilt or subsidence.
- Repair and replace scoured and/or eroded materials at the bridge piers, shore, bank and watercourse with riprap or other materials that are appropriate and in full conformance with the requirements of the Reference Documents listed in Section G.2 of this Chapter.
- Obtain all necessary permits and Approvals prior to placing scour protection in the waterways.

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- Roadway Arch Culverts:

- Inspect these structures as one would inspect abutments on a bridge, and as one would inspect a stream culvert or tunnel. The Concessionaire must be especially mindful of crack patterns and depressions in overburden or the roadway indicating loss of soil or excessive deflection of the arch ring.
- Arch culverts may be rigid, made of concrete, or flexible, made of metal. Adjust record keeping, inspection and maintenance according to the arch culvert type and span.
- Rigid culverts rely on compression as a primary load path. The Concessionaire must be diligent in evaluating the condition of concrete. Cracks in the concrete that exceed 0.30 mm should be documented, monitored, and evaluated relative to cause.
- When a crack becomes 1.27 mm (0.05 inches) wide or greater it shall be pressure injected or repaired by some other method. Cracks in the range of 0.30 mm (0.012 inches) to 1.27 mm (0.05 inches) wide are considered "moderate cracking" and in fair condition state, hence perhaps not requiring pressure injection or other repair methods at 0.40 mm,

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- Flexible culverts rely on soil structure interaction and distortions in shape can significantly impede load carrying capacity. Flexible culverts should have key dimensions periodically checked to verify that the soil and structure is not shifting. Additionally, joints in flexible culverts are subject to corrosion and must be maintained adequately to transfer both axial and bending loads.
  - Flexible culverts are sensitive to impact damage. Following any crash event, the metal rings should be evaluated to determine if tears have occurred, shape has changed, or connections have been damaged. Accidents involving fire require an evaluation of the metal to determine that adequate ductility remains.
  - Foundations for arch culverts are critical to their load carrying capacity. Determinations should be made relative to settlement or shifting of foundations indicating loss of support. Care must be exercised in repaving operations or below grade utility installations so as not to undermine foundations.
  - Arch culverts can trap water which is detrimental to their load carrying ability and trapped water can cause excess corrosion or failure. Evaluate weep holes and joints to verify water can escape from the soil side of arch culverts.
  - Arch culverts for roadways are exposed to roadway salts during deicing operations. Protection, in the form of coatings in the splash zone, may be necessary to increase the longevity of such culverts.
  - Structure Accessories:
    - Repair or replace bent, corroded, cracked, fatigued, damaged or structurally deficient steel Inspection walkways and their components.
    - Repair and replace all damaged, settled, or deficient slope protection.
    - Repair and replace all unsound, deteriorated, or damaged bridge sidewalks, curbs, or safety walkways.
    - Repair and replace all damaged, non-functioning, or deficient Bridge underpass lighting, if that lighting is fed from an electrical source from the Toll Roads.
  - Bridge Mounted Utilities:
    - The Concessionaire must clean pipe, conduits or other appurtenances in accordance with regular Bridge cleaning requirements. Also, scheduled Bridge inspections must include condition assessment of utilities. Establish a system to report deficiencies or emergency conditions to the appropriate authority.

• Bridge Inspections:

- Ensure that all inspections required by Title 23 Code of Federal Regulations, as well as those required by PRHTA occur at the frequencies no greater than those stated in Table G.3.3.2, and the requirements of Volume II, Chapter L, "Annual State of the Toll Roads & Capital Improvement Program Reports".
- Employ qualified, experienced, and trained Professional Engineers Licensed in the Commonwealth of Puerto Rico to perform all of the required inspections, condition assessments, repair recommendations and required reports and filings with the appropriate Commonwealth and Federal entities.
- Ensure that all inspections methods and procedures are in conformance with the requirements of the NBIS.
- Develop, update, and maintain a Bridge management, inspection and condition database which shall include photographs, test results, field notes, etc., which will also identify and prioritize all required repairs.
- Perform bridge capacity and load analyses as required when deficient bridge members and elements are discovered.
- Ensure that all structures are properly inventoried with PRHTA, and that biannual updated Inventory Inspection Forms and Reports are correctly coded into the PRHTA inventory system.
- Ensure scheduling, organization, and compensation for all required inspections, including but not limited to, vehicle rental, testing equipment, outside testing services, lane closures, and securing rights-of-entry from property owners, and utilities.
- Ensure that all underwater inspections are performed by certified divers who have been trained to identify problems, and who are under the supervision of a certified bridge inspector.
- Notify PRHTA, the Commonwealth and Municipal Government immediately when inspections determine that the bridge or one of its major components is at the risk of a localized or large-scale structural failure.

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G.3.3 Performance Time Frames

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire), within which the Concessionaire must assess the condition and complete the required maintenance, repair or replacement work to Bridges and Structures, and their components (unless weather conditions limit material application):

TABLE G.3.3.1

<b>Bridge or Structure Feature</b>	<b>Maximum Time Duration</b>
<u>Bridge Decks &amp; Wearing Surfaces:</u> - Traveled Lanes - Remainder of Deck Area	24 Hours 1 month
<u>Bridge Railings and Parapets:</u> - Defect which compromises public safety - Other defects	24 Hours 1 Month
<u>Bridge Joints:</u> - Defect which compromises public safety - Other repairs	24 Hours 5 Days
<u>Bridge Superstructure and Substructure Elements:</u> - Defect critical to structure stability - Non-Structural Deterioration	24 Hours 2 Months
<u>Bridge Bearings:</u> - Defect critical to structure stability - Other defects	24 Hours 5 Days
<u>Bridge Painting:</u> - Directly Exposed to Weather - Protected from Direct Weather	3 Weeks 1 Month
<u>Bridge and Structure Cleaning:</u> - Typical Cleaning - Protected from Direct Weather	(See <u>Table G.3.3.2</u> ) (See Volume I, Chapter I)
<u>Bridge Waterway Protection:</u> - Floods causing stream shift - Stabilizations of footings	5 days 2 months
<u>Roadway Arch Culverts:</u> - Instability or Emergency Damages - Other defects	24 Hours 2 Months
<u>Structure Accessories:</u> - Defects which compromise public safety - Return to as designed condition	24 Hours 14 Days

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The following table establishes the minimum frequency that a particular maintenance operation is to be performed.

TABLE G.3.3.2

Activity to be Performed	Minimum Frequency of Occurrence
Bridge and Structure Cleaning	Annually
<u>Bridge Bearings:</u> Lubricate all required bearings in accordance with the original design and manufacturer's specifications.	Annually
<u>Inspections &amp; Reports:</u> <ul style="list-style-type: none"> <li>- All Bridge Structures</li> <li>- Filing of PRHTA Inventory / Appraisal Forms</li> <li>- Fracture Critical Structures &amp; Members</li> <li>- Underwater Inspection</li> <li>- Monitoring Inspection</li> </ul>	<ul style="list-style-type: none"> <li>As per NBIS</li> <li>As per NBIS</li> <li>As per NBIS</li> <li>Once every 5 years or after any major event</li> <li>After any flood, earthquake, fire or accidents events – Prepare Damage Inspection Report</li> </ul>

The Concessionaire must, from the time a deficiency is detected by discovery or report:

- Immediately dispatch a Licensed Professional Engineer in the Commonwealth of Puerto Rico to inspect, conduct testing, analyze, prepare condition reports and prepare repair/replacement recommendations.
- Notify PRHTA and the Commonwealth immediately when inspections by the Professional Engineer determine that the Bridge, structure or its components are at risk of a localized or large-scale structural failure.
- When such times occur that a Bridge, structure or its components are at risk of failure:
  - Commence repairs immediately as instructed by the Professional Engineer, except where the damage will require complete reconstruction.
  - Complete repairs within three (3) months or within a time frame that is appropriate to the nature and urgency of the repair as determined by the Professional Engineer.

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- Immediately establish and provide traffic control whenever a Bridge or Structure is unsafe or has the potential to become unsafe for Toll Road or local users.
- Ensure that all temporary work is properly disposed of and replaced with permanent work commencing no later than one (1) month after it was installed, or is no longer required.

G.3.4 Acceptance Criteria

Bridge and Structure maintenance work will be considered acceptable when the following criteria are met or exceeded:

• Performance Criteria:

Bridges within the Toll Roads are critical to the asset, safety of Toll Road users and overall performance of the Commonwealth transportation network and therefore cannot be compromised by the Concessionaire. For a Bridge to be deemed acceptable by PRHTA and the Commonwealth, the following criteria, in addition to all other criteria in the Operating Standards, must be met for each structure on an annual basis:

TABLE G.3.4

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Performance Item	Minimum Criteria
<u>Weight (Load) Restriction:</u> <ul style="list-style-type: none"> <li>• General</li> <li>• Structural Capacity</li> </ul>	<p>No Posted Bridges</p> <p>Rating Factor of 1.0 at the operating level for established legal loads</p>
<u>Bridge Rating:</u> <ul style="list-style-type: none"> <li>- Condition Ratings</li> </ul>	<p>Bridge shall not be classified Structurally Deficient*</p>

\* Structurally Deficient" includes bridges with condition ratings of "4" or less, among other criteria.

If a bridge is found during the annual inspections and reports required by this Chapter or by Volume II, Chapter L "Annual State of the Toll Roads and Capital Improvement Program Reports", as not conforming to the minimum criteria stated in Table G.3.4, that structure must be listed and included in the 5-year Capital Improvement Program for major improvement. In addition, during the 10-year timeframe, the Concessionaire must continually maintain all listed structures in a manner such that the conditions of the Major Bridge Elements (Deck, Superstructure, or Substructure), as well as other safety related elements, are always maintained at a rating of 5 or better at all times.

- Bridge Decks and Wearing Surfaces:

- The concrete finish of the decks and/or wearing surfaces provides a safe driving surface and is in accordance with the requirements of the Reference Documents listed in Section G.2 of this Chapter.
- Repair areas match the existing Deck profile, cross-slope, and finish.
- Repair areas and adjacent areas encompass all deterioration and are structurally sound, uniform in shape, durable and bonded to the supporting elements and substrate.
- Repair and replacement materials are compatible to the remaining materials, and new materials are in full compliance with the requirements of this Chapter and the Reference Documents listed in Section G.2 of this Chapter.
- Repair and replacement areas are structurally adequate and maintain the structural integrity of the deck.
- All cracks 0.0625 inch or larger are sealed to a minimum depth of 0.5inch.
- The decks and wearing surfaces are clean and free of all dirt, debris and foreign materials that may reduce the safety of Toll Road and Local users and impede drainage.
- The decks or wearing surfaces are replaced in whole when the existing combined areas with the required and proposed repair areas, account for more than 30% of the entire deck area.

- Bridge Railings, Parapets, and Fence:

- The railings and parapets are properly attached and meet all of the requirements of the Reference Documents so that the system provides a safe barrier for Toll Road and local users.
- The railings and parapets are properly aligned, and free of all damage, defects, and deterioration.
- Temporary barriers or railings have been installed only for the duration required to complete the permanent repair or replacement.

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- o Fence fabric is fully supported by pipe frames properly connected according to current standards.

- Bridge Joints:

- o The bridge joints have been properly installed and function as designed to withstand the movements of the bridge and structure.
- o The bridge joints are free of leaks and defects that can create damage or deterioration to the structure.
- o The bridge joints provide a smooth and safe transition for Toll Road and local users.
- o The bridge joint armor plates are securely attached to the substrate, are not misaligned, and are not damaged or deteriorated.

- Bridge Superstructure and Substructure Elements:

- o Existing and repaired or replaced elements are structurally adequate and maintain the structural integrity of the structure.
- o Repair areas match the adjacent surface color and finish.
- o All waste materials have been removed from the work site and the areas are left in a clean and tidy condition.
- o Repair areas and adjacent areas encompass all deterioration and are structurally sound, uniform in shape, durable and bonded to the supporting elements and substrate.
- o All structural cracks are filled and sealed with the appropriate materials and methods as determined by the Professional Engineer and in conformance with the Reference Documents listed in Section G.2 of this Chapter.
- o Backwalls at approach slabs should provide adequate vertical support without longitudinal movements. All joint materials must be adequately fastened and attached to the Backwalls and bridge deck.
- o The concrete pedestals and bearing seats are clean and free of all deterioration, damage and deficiencies that might compromise the bearings.

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- Bridge Bearings:

- o All bearings constructed with elastomeric or other pads are properly aligned and free of all bulging, warping, cracks, splits, tears, and distress.

- All bearings function as designed and are capable of supporting the applied loads in a manner that does not cause the bearing to compromise its structural integrity or that of the structure or bridge as a whole.
- All bearings are clean, properly aligned, and free of all damage, deterioration deficiencies, and missing components.
- Bearings that require lubrication are maintained as required by the original specifications and the manufacturer's recommendations.
  
- Bridge Painting:
  - All steel and metal surfaces of the bridge, structure, or its components that require paint (exposed to weather) are prepared and coated in accordance with the Reference Documents listed in Section G.2 of this Chapter.
  - All bridges, structures and their components are free from deficiencies in the paint surface that can cause corrosion or rust.
  - Existing paint that is thought or is known to contain lead is tested and handled in a manner that conforms to all Commonwealth and Federal laws and regulations.
  
- Bridge and Structure Cleaning:
  - All bridge and structure surfaces are free from vegetation, dirt, debris, foreign materials, and abrasives.
  - All fire hazards beneath or adjacent to bridges and structures have been removed, the area cleaned, and the site left in a neat and tidy manner.
  
- Bridge Waterway Protection:
  - Waterways, shores and banks are free from erosion, slumping and Scour.
  - Dolphins, Pilings and Fender Systems are functioning as designed and the systems are free of all defects, deficiencies, damage, and debris interferences.
  - Bridge piers within the waterway are supported by firm, solid and well compacted materials and no Scour or material loss has occurred.
  - Piers within a waterway are free of large accumulations of debris that can contribute to Scour or create unsafe boating conditions.
  - Loose, corroded, deteriorated, rotted, and missing components of the waterway protection system are repaired and replaced with materials that complement the environment and are in conformance with the requirements of the Reference Documents listed in Section G.2 of this Chapter.

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- Roadway Arch Culvert Structures:
  - Adequate clearance is provided both vertically and horizontally for the passage of vehicles on the road passing through the Culvert.
  - Drainage for the arch culvert is present and functioning as originally designed.
  - Vegetation that will or might exert stresses on the headwalls of the arch culvert has been removed.
  - The cross section of the arch is in conformance with the original design, is structurally stable, and does not indicate signs of distress or movements.
  - Repairs and replacement of portions or components of arch culvert walls are made utilizing materials and procedures in consultation and approval of the supplier of the arch culvert or in accordance with the original design.
  
- Structure Accessories:
  - The inspection or service walkways, access platforms, ladders and other similar accessories are free from damage, deficiencies, deterioration, and missing components.
  - The bridge slope walls are stable, free from damage, deterioration, settlement and other deficiencies.
  - All Bridge underpass lighting is functioning as designed, no burn-out lamps are present, and the lighting system illuminates at the original design level.
  
- Bridge Inspections:
  - Bridge and structure inspections have been performed in accordance with the requirements of Table G.3.3.2 of this Chapter, Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports", and all required documentation and reports have been filed with the appropriate agency.
  - The qualifications of the Engineers conducting the inspections conform to the requirements of this Chapter, Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports", and the Reference Documents, whichever is more stringent.

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## G.4 Additional Requirements

### G.4.1 Bridge and Structure Numbering Convention

#### G.4.1.1 Bridge Numbering

All of the bridge structures along the Toll Roads have been assigned an individual Structure Number by PRHTA. All communication to the PRHTA regarding these structures will use the assigned reference number. If any additional structure is going to be constructed along this facility, the Concessionaire will request a new number from the Bridge Engineering Office at PRHTA.

### G.4.2 Span Numbering

To determine the numbering system for spans of the bridge, first determine which direction is North or East. The following numbering rules are then applied:

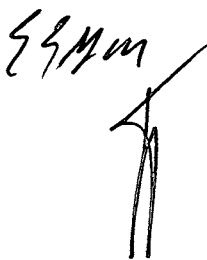
- If the Toll Road element travels North-South, or any direction in which the description contains "North", such as Northeast or Northwest: Stand at the end of the bridge with your back to the South looking along the length of the structure. Immediately in front of you is span one (1), with the higher number spans away from you. Count the spans in order beginning with one from near to far.
- If the Toll Road element travels East-West, or any direction in which the description contains "East". Stand at the end of the bridge with your back to the West looking along the length of the structure. Immediately in front of you is span one (1), with the higher number spans away from you. Count the spans in order beginning with one from near to far.
- The bridges over Toll Road segments have spans determined according to the direction of the roadway and Stationing associated with the Commonwealth or Local Road. Typically stationing is from west to east, or north to south. To determine span numbering, determine which is the Near or First abutment. Stand at such abutment and look ahead station. Immediately in front of you is span one (1), with the higher number spans away from you. Count the spans in order beginning with one from near to far.

#### G.4.2.1 Element/Component Numbering

Multiple elements and components of a bridge, within a particular span, are identified by a location.

To determine the location of an element or component, stand with your back to the lower numbered span and the following is then applied:

- Number elements and components left to right for elements and components parallel with the bridge.



- Number elements and components from the lower numbered span to the higher numbered span for elements and components transverse to the span.

### G.4.3 Clearance Requirements

#### G.4.3.1 Horizontal Clearance

The required horizontal clearances requirement which bridges and structures must meet is defined in the PRHTA Highway Design Manual, as well as the Reference Documents stated in Section G.2 of this Chapter, whichever is greater.

Roadway and shoulder widths must be maintained at the existing dimensions or may be increased as the result of construction. In no instance may a lane width be increased at the expense of a current shoulder width, nor may the median and parapet walls be increased in size to accommodate new features at the expense of existing lane or shoulder widths.

Local surface streets, railroads, navigable channels, and other traveled ways that pass beneath or over the Toll Roads must be maintained at the existing dimensions or may be increased as the result of construction. Existing horizontal clearance dimensions may be decreased only if the Concessionaire provides written documentation, and PRHTA and the Commonwealth or Local jurisdiction accepts and approves such proposals. In addition to any required approvals from PRHTA, the Concessionaire will be responsible for obtaining all required permits, exemptions, waivers, etc.

#### G.4.3.2. Vertical Clearance

The required vertical clearance which bridges and structures must meet is defined in the PRHTA Highway Design Manual, as well as the Reference Documents stated in Section G.2 of this Chapter, whichever is greater.

Vertical clearances at surface streets, railroads, the Navigable River channel, and all other traveled ways crossing under the Toll Road structures, should be maintained at the current clearance, or may be increased as the result of construction. In addition, vertical clearance between the paved Toll Road surface and all overhead features of the Toll Roads, respectively, must be maintained at the current clearance or increased, as required to meet current PRHTA criteria when the Bridge is subjected to a major rehabilitation or reconstruction.

When work on the Toll Roads occurs that may or will result in an increase in the current roadway surface elevations, the Concessionaire must evaluate and study the impact of the change on the existing vertical clearances to the overhead features so that the provided clearance is in full conformance to the requirements stated in the Reference Documents listed in Section G.2 of this Chapter. Existing vertical clearance dimensions may be decreased only if the clearance exceeds the requirements stated in the

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Reference Documents, and the Concessionaire provides written documentation, and PRHTA accepts and approves such proposals. In addition to any required approvals from PRHTA, the Concessionaire will be responsible for obtaining all required permits, exemptions, waivers, etc.

#### G.4.4 Maintenance Inspections

The Concessionaire is responsible for establishing, scheduling and performing routine maintenance inspections of all Bridges and Structures within the Toll Roads. The Concessionaire's inspectors must be under the direct supervision of a qualified and experience Licensed Professional Engineer in the Commonwealth of Puerto Rico. The purpose of these inspections is to identify and note defects that may go unnoticed during daily patrols, to monitor known problems, and to monitor the performance of new construction and recent repairs.

#### G.4.5 Emergency Inspections

The Concessionaire is responsible for responding to all incidents along the Toll Roads that are known to have or are suspected to have caused damage and investigate the effects to the bridges, structures, and their components. These types of incidents include vehicle collisions, major storms, flooding, vandalism, and earthquakes; and are described in greater detail in Volume I, Chapter I, "Third Party Damages and Emergency Maintenance", and in Volume II, Chapter J, "Emergency Management and Operations Plan".

The Concessionaire must immediately inspect all known and suspected damage by employing qualified and experienced Professional Engineers Licensed in the Commonwealth of Puerto Rico. As required by the particular circumstances, the Concessionaire must also mobilize all required inspection and testing equipment to assist in the determination of the structural integrity and condition of the bridge, structure and its components. The Concessionaire will need to develop conclusions to make judgments on the required remedial actions such as whether to keep the bridge open, limit the use of one or more lanes, close the shoulder, impose a weight restriction, or take other measures to protect the public and Toll Road users.

The conclusions, decisions and judgments reached by the Concessionaire and its Professional Engineer must be implemented immediately. In addition, the Concessionaire is responsible for notifying all police, fire, governmental, utility, news and other organizations as appropriate.

When damage is discovered to a bridge or property owned by others, the Concessionaire must immediately notify PRHTA and the owner or agency.



#### G.4.6 Mandated Bridge Inspections & Reports

The inspections included in this section are intended to address required Federal, and Commonwealth inspections and reports. In addition to the inspections and reports required by this Chapter, the requirements of Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports", must also be fulfilled.

##### G.4.6.1 General Requirements

All inspections and reports must be performed by an independent Consulting Engineering firm registered in the Commonwealth of Puerto Rico, approved by PRHTA, and not associated or partnered with the Concessionaire.

The inspection type, filing requirements, and frequency of the work as stated in Table G.3.3.2 of this Chapter must be fulfilled.

All inspection procedures and inspectors' qualifications must be in accordance with NBIS from Title 23 CFR, as required by PRHTA, or as amended within this Chapter, whichever is more stringent.

The Concessionaire is responsible for testing, equipment, staff and supervision for all inspections.

##### G.4.6.2 Underwater Inspection Requirements

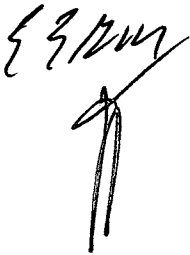
Bridges with underwater elements must have a separate and independent underwater inspection performed as per NBIS requirements (currently should be every two years). Elements determined to be susceptible to the effects of Scour and erosion must be inspected at a greater frequency as determined by the Concessionaire's Professional Engineer.

Underwater inspections that require diving must be performed by certified divers who have been trained to identify structural, Scour and instability defect characteristics, and must be under the direct supervision of a Licensed Professional Engineer in the Commonwealth of Puerto Rico.

##### G.4.6.3 Fracture Critical Inspection Requirements

In-depth bridge inspections must be performed on all bridges that are classified in part or in whole as containing members that are fracture critical. The continued inspection, function, and maintenance of these types of structures are critical to the stability and durability of the Toll Roads.

Bridges with fracture critical elements must have a separate and independent detailed inspection performed on them as per NBIS requirements (currently should be every two (2) years), in addition to being inspected annually at the fracture critical elements and connections per the requirements of Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports".



Elements that are considered to be in a condition of "poor", or that appear to have deteriorated from past inspections must be inspected at a greater frequency as determined by the Concessionaire's Professional Engineer.

Fracture critical inspections must be performed by personnel certified as bridge inspectors so that they are able to identify the specific structural defects and characteristics common to these types of structures. The leader of the Fracture Critical inspection team must be a Licensed Professional Engineer in the Commonwealth of Puerto Rico.

Refer to Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports" for further information and requirements.

#### G.4.6.4 In-Depth Inspection Requirements

An In-Depth Inspection is a close-up, hands-on inspection of one or more members above or below the water level to identify any deficiency not readily detectable using Routine Inspection procedures. In-Depth Inspections can be conducted alone or as part of a Routine or other type of inspection.

Schedule In-Depth Inspections, on a 5-year cycle (in addition to the annual inspections) for the following Bridge:

Table G.4.6.4

Bridge Name	PRHTA_ID	Route	Bridge No.
Aguas Claras Creek	2299	PR-53	2299

*It is important to note that currently one bridge is the one that is inspected, but the NBIS inspection requirements may require underwater inspection of any bridge that has elements submerged at least 3.5' of water. All bridges over bodies of water must meet the requirements of UW inspection of the NBIS. In-Depth Inspections do not reduce the level of intensity for Routine Inspections.*

#### G.4.6.5 Report and Inventory Filings

The Concessionaire's Professional Engineer is responsible for filing all required documentation with the Bridge Engineering Office at PRHTA.

As required by Title 23, Code of Federal Regulation, Section 650, "National Bridge Inspection Standards (NBIS) and the FHWA, an Inspection/Appraisal Record and an Inventory Turnaround Report must be filed once every 2 years for all Bridges greater than 20' in length.

The Concessionaire must obtain these forms from PRHTA and complete

them on an annual basis with the requirements of Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports" for each Structure. Fracture Critical inspection Forms, where required, must also be submitted at this time.

If in the sole judgment of PRHTA the information is deemed incomplete, does not show sound analysis of the conditions, or does not contain sufficient detail to track problems, the structure inventory and inspection information will be returned to the Concessionaire for revision.

The requirements and procedures for reports and findings due to PRHTA and the Commonwealth are stated in Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports".

#### G.4.6.6 Bridge Load Ratings

The two main indicators of a bridge's capacity are the Inventory and the Operating Ratings. When deficient members are identified during inspections or by reports, the Concessionaire's Licensed Puerto Rico Professional Engineer must perform a bridge rating on both the affected element and the structure as a whole, and update both the Operating and the Inventory Rating values. Load ratings and capacity must be calculated in accordance with the procedures and requirements stated in the "Manual for Condition Evaluation of Bridges", AASHTO.

When the load rating analysis shows that the structure cannot withstand the legal loads (Rating Factor at the operating level of less than 1.0 for the HS-30 design live load in LFR calculations or HL-93 design live load in LRFR calculations), the Concessionaire's Professional Engineer must prepare a Bridge Safety Analysis, which outlines the operating restrictions, maximum gross vehicle weights to be posted, the temporary support work that might be required, and a Action Plan that will restore the structure to its full capacity as soon as possible.

Whenever the rating values indicate a restriction of load, the Concessionaire must send PRHTA a separate written notification of the location, condition, rating analysis, posting limit, and Action Plan immediately.

Following permanent repairs, the Concessionaire's Professional Engineer must perform a new bridge load rating and capacity analysis to ensure that no further operating restrictions or maximum gross vehicle weight restrictions remain, to the complete satisfaction of PRHTA.

#### G.4.7 Weight Restrictions

The Concessionaire must be fully aware of the provisions set forth in Chapter XV of Act No. 22-2000, as amended, and the regulations promulgated thereunder, if any. Chapter XV indicates the allowable dimensions, weights and loads of all vehicles that circulate in Puerto Rico. No oversize vehicle or more than the

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allowable weight and/or loads will be allowed to circulate in the public space. Special Permits could be issued by the PRHTA to transport loads that exceed the regulatory dimensions and/or weights but must be authorized and approved by PRHTA prior to the moving of the load.

When damage or deterioration of a bridge, structure or its components is found, and the bridge rating and capacity analysis indicates that the structure is unable to meet requirements, as discussed in Section G.4.6.6, a weight restriction must be posted.

The Concessionaire must post the required signage on the structure approaches and must maintain such signage until repairs can be completed and a new rating analysis performed to ensure that the structure can support the required loadings.

The Concessionaire must complete all repairs and remove the posting within three (3) months of the posting of a weight restriction. The period of three (3) months is granted due to lead times for structural members, engineering design, ordering, fabrication, and scheduling. The Concessionaire must commence the replacement process immediately after first posting the weight restriction, to successfully meet these time requirements.

#### G.4.8 Bridge Decks and Wearing Surfaces

The Decks and Wearing Surfaces of the bridges and structures of the Toll Roads are of extreme importance since their condition impacts the safe passage of Toll Road users through the System.

All construction and design of Decks and Wearing Surfaces shall be in accordance with the requirements of the Reference Documents listed in Section G.2 of this Chapter, except as noted as follows:

- All new adjacent box beam bridges are to be constructed with composite decks.
- Concrete for the deck must be in accordance with the most current PRHTA Standard Specification for Road and Bridge Construction and Special Provision 934, Structural Concrete.
- When required, bridge deck overlays must be rigid (cement and concrete based materials).

Requirements for deck and wearing surface repairs must be in accordance with the requirements of the Reference Documents listed in Section G.2 of this Chapter, in addition to the following:

- When planning deck work, the entire area of the deck must be sounded to determine the extent of all unsound concrete, and to include it in the repair work.
- Repair areas must form square and rectangular shapes as much as possible.

- Saw cut the perimeter of the repair area to a depth so as to form a clean edge, to eliminate feathered edges, but to avoid cutting rebar. Perform repairs in accordance with PRHTA standards.
- The application of permanent bituminous overlays on bridge decks along the Toll Roads is prohibited.
- Additional overlays on Toll Road bridge decks without removing the existing overlays and additional overlays that would add dead load to the bridges are prohibited.
- Bituminous concrete patches are permitted as a temporary measure only and must be replaced with permanent repairs in no more than 90 days.
- Bituminous overlays are not permitted on local roads over the Toll Roads.
- When an entire span deck is replaced or overlaid, a moisture insensitive broadcast aggregate – low modulus epoxy shall be applied to the surface. Such product shall meet ASTM C-881 Type III Class B and C specifications.

#### G.4.9 Bridge Railings and Parapets

The Railings, Parapets and Fence of the bridges and structures of the Toll Roads are of extreme importance since their condition directly affects the safety of Toll Road users.

All construction and design of Bridge Railings and Parapets must be in accordance with the requirements of the Reference Documents listed in Section G.2 of this Chapter, except as noted as follows:

- Replace broken or damaged sections of the Bridge Parapets with a wall having the existing wall face shape and dimensions or having a face shape and dimensions that comply with the current PRHTA Bridge criteria. All transitions of wall face shape and dimensions must be made gradually so that no corners or projections will be present that impair the function of the barrier.
- When it is necessary to install a temporary railing or barrier, the Concessionaire must ensure that the temporary work is as effective a crash barrier as the original element.
- Maintain all fence and safety hardware to ensure projectiles do not fall on roadways below bridges.

#### G.4.10 Bridge Joints

Bridge Joint repairs must include all activities necessary to provide functional expansion joints that prevent water leakage onto the bearings, Superstructure and Substructure. This work will include, but is not limited to, rebuilding, or patching the joint edges, installing/replacing joint seals, installing drainage troughs, and

adjusting or re-securing the joint components.

All construction and design of Bridge Railings, Parapets and Joints must be in accordance with the requirements of the Reference Documents listed in Section G.2 of this Chapter. To the greatest extent possible, when performing Bridge Joint work, the Concessionaire must utilize the newest techniques implemented and approved by PRHTA for Commonwealth-wide major highway contracts so as to provide longer joint life.

Joint systems using steel angles, or any other steel component attached to the existing concrete shall not be used for repair.

#### G.4.11 Bridge Superstructure and Substructure Elements

Bridge Superstructure and Substructure elements within the Toll Roads have been constructed with both steel and concrete materials that create many different Bridge components. The timely repair of these components and elements is essential to the safety of Toll Road users.

The Concessionaire must coordinate all repairs, reinforcements, and replacements with a Puerto Rico Licensed Professional Engineer. This includes all actions to stringers, girders, beams, main truss members, etc. The Concessionaire must employ the

Professional Engineer when Plans and Construction Documents are required, and must prepare, review, and seal all plans, fabrication orders, and written field procedures.

To the greatest extent possible, when performing Superstructure and Substructure work, the Concessionaire must utilize the newest techniques implemented and approved State-wide for major highway contracts to provide longer life, maximize the capacity of materials, and to minimize motorist inconvenience.

All construction and design of Superstructure and Substructure elements and components must be in accordance with the requirements of the Reference Documents listed in Section G.2 of this Chapter, except as noted as follows:

- Concrete must be a High-Performance Mix in accordance with the most current PRHTA Standard Specifications for Road and Bridge Construction and Special Provision 934, Structural Concrete.
- All reinforcement must be epoxy coated and in accordance to the PRHTA Standard Specifications for Road and Bridge Construction.

Requirements for Superstructure and Substructure repairs must be in accordance with the requirements of the Reference Documents listed in Section G.2 of this Chapter, in addition to the following:

- Every attempt must be made to eliminate Fracture Critical and fatigue prone connections and situations.
- When planning work to the Superstructure or Substructure the entire element or component must be inspected and repaired as required.
- Deck repair areas must form square and rectangular shapes.

- Saw cut the perimeter of the repair area to a depth to form a clean edge, to eliminate feathered edges, but to avoid cutting rebar. Perform repairs in accordance with PRHTA Standards Specifications for Road and Bridge Construction.
- All emergency or temporary repair work must be planned to best meet the situation, protect the structure, and protect Toll Road users.
- The finish of the repair area must match the adjacent surfaces.
- High strength bolts of the same diameter as the rivets removed must be used to replace rivets in re-assembly.
- Heat straightening of members must not be used.

#### G.4.12 Minimum Design Life Requirements

Portions of the Toll Roads have been constructed or re-constructed according to PRHTA standards attempting to design structures to a minimum 50-year life. For any future re- construction of structures along the Toll Roads, the following requirements for usable life are to be attained. In general, the design life for new superstructures and substructures and arch culverts is 100 years with appropriate maintenance. New concrete decks should last 50 years.

#### G.4.13 Bridge Bearings

Bridge Bearings within the Toll Roads consist of numerous types and materials dependent upon their age, function, and location. Timely repair, inspection and maintenance to keep these components functioning are essential to the life and safety of structures.

The Concessionaire must coordinate all repairs and replacements with a Puerto Rico Licensed Professional Engineer. This includes all jacking plans, bearing designs and replacements procedures. The Concessionaire must employ the Professional Engineer when Plans and Construction Documents are required, and must prepare, review, and seal all plans, fabrication orders, and written field procedures.

All construction and design of Bridge Bearings must be in accordance with the requirements of the Reference Documents listed in Section G.2 of this Chapter. To the greatest extent possible, when performing Bridge Bearing work the Concessionaire must utilize the newest techniques implemented and approved by PRHTA and the Commonwealth for major highway contracts to provide longer life, maximize the capacity of bearing materials and to minimize motorist inconvenience.

#### G.4.14 Bridge Painting

Painting of bridges within the Toll Roads is essential to the life of structures, and

to prevent deterioration of structure components. In order to provide a long structure life, all steel and iron bridge components must be painted at a frequency so as to protect the metal from rust and corrosion.

All materials and procedures for the painting of bridges must be in accordance with the requirements of the Reference Documents listed in Section G.2 of this Chapter. When performing Bridge painting work the Concessionaire must utilize the newest materials implemented and approved by PRHTA and the Commonwealth for major highway contracts to maximize the life capacity of the materials.

All bridges that require the existing coatings to be stripped of existing paint layers must be inspected for the presence of lead, chromium, or cadmium containments. In conformance to the governing regulations, all paint so contaminated must be removed, contained, and disposed of in accordance with all EPA, DNER and OSHA guidelines and regulations. If the paint is in a condition that will permit an over-coating which will effectively contain the contaminate materials and protect the steel, this alternative should be implemented unless conditions demand otherwise. The Concessionaire is responsible for having the existing paint tested and sampled at sufficient locations to ensure that all prior painting applications have been tested.

#### G.4.15 Bridge and Structure Cleaning

Each structure must be given regular inspections for accumulations of dirt, debris and animal droppings including on the deck; in the drainage openings; on the Substructure seats; and on the Superstructure members. Checks must be conducted to eliminate all potential fire hazards such as debris accumulating under the bridge.

All bridge and structure components and elements including, but not limited to, decks, pier caps, abutment seats, bearings, expansion joints, drainage openings, headwalls, wingwalls, Superstructure members, Substructure faces, etc. must receive a thorough water flush at the frequency stated in Table G.3.3.2.

#### G.4.16 Bridge Waterway Protection

Protection of Bridge and structure components that reside in or adjacent to streams and rivers is essential to the safety of the Toll Roads and must be maintained continually.

The following waterway conditions must be included in patrols and maintenance scheduling, at a minimum:

- Waterways should be checked for evidence of erosion and Scour conditions.
- Logs or other debris that could become jammed or lodged against Piers, the Fender System, and Dolphins, must be removed.
- Deterioration and/or damage to the Fender System and other protection systems must be monitored and repaired.

#### G.4.17 Structure Accessories

Activities performed under this category include all repairs and modifications to inspection catwalks, lighting platforms and ladders, sidewalks, slope paving, fill material, fill stabilization systems and all other similar items.

This activity must be addressed on a case-by-case basis dependent upon the system, damage, deterioration, function of the system, and usage of the system. The Concessionaire must repair these systems as the need requires and must not eliminate them to reduce maintenance and repair work.

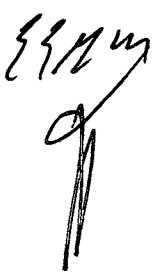
In addition, if specialized features such as cathodic protection devices and specialized geotextile systems are introduced to the Toll Roads in later years they must be maintained and repaired as with every other element of the Toll Roads.

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## H.1 Definitions

Absorptive Noise Panels: Noise wall panels that absorb a significant portion of incident sound rather than reflecting all incident sound.

Abutment: Earth retaining structures which support the superstructure at the beginning and end of a bridge.

Anchor Bolt: A threaded rod, including hardware, used for holding a mechanism or structure in place.

Bridge: A structure consisting of single or multiple spans more than 20 feet in length that provides a means of transit for vehicles and/or pedestrians above the land, water surface, roadway, railroad or other obstruction. The roadway is directly supported by the structure.

Insertion Loss: The actual acoustical benefit derived from the presence of a noise barrier.

Mechanically Stabilized Earth (MSE): A self-supporting reinforced earth retaining wall system comprised of metallic (strip or bar mat) or geosynthetic (geogrid or geotextile) reinforcement strip or panel connected to a segmental precast concrete or prefabricated metal facing panel to create a reinforced soil mass.

Noise Walls: A solid wall and/or earthen berm located between the roadway and the receptor location that reduces the overall net noise levels to the receptor; also commonly referred to as Noise Barriers.

Overpass: The single or multi span bridge that crosses over the Toll Roads.

Parapet: A wall-like member integrally connected to the fascia edge of a bridge deck to serve as a protective barrier for vehicular or pedestrian traffic.

Reflective Noise Panels: A Noise Wall panel that reflects incident sound rather than absorbing a significant portion of the incident sound.

Retaining Wall Structures: An engineered structure designed to resist horizontal earth pressures of a fill or cut, and/or a structure designed to prevent material from spilling onto another surface.

Substructure: The pier and abutment elements required to support the Superstructure.

Superstructure: The entire bridge structure resting on the piers and abutments, consisting of stringers, girders, decks, floor beams, trusses, wearing surfaces, railings, etc.

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## H.2 References

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA
- Highway Design Manual, PRHTA
- Standard Drawings, PRHTA
- Standard Specifications for Road and Bridge Construction, PRHTA
- "LRFD Bridge Design Specifications," AASHTO.
- "Maintenance and Management of Roadways and Bridges", AASHTO.
- Publication GTN-3: "Guide on Evaluation and Abatement of Traffic Noise", AASHTO.
- Publication R020-99: "Standard Recommended Practice for Procedures for Measuring Highway Noise", AASHTO.
- Publication TNA-1: "Policy on Land Use and Source Control Aspects of Traffic Noise Attenuation", AASHTO.
- "Highway Traffic Noise Analysis and Abatement: Policy and Guidance Manual", FHWA.
- Publication FHWA-EP-00-005: "FHWA Highway Noise Barrier Design Handbook", FHWA.
- Publication FHWA HEP-06-015: "FHWA Highway Construction Noise Handbook", FHWA.
- Publication FHWA-HEP-05-054: "FHWA Roadway Construction Noise Model (FHWA RCNM) User's Guide", FHWA. "Highway Traffic Noise Analysis and Abatement: Policy and Guidance Manual", FHWA.
- Title 23 - Code of Federal Regulations, Part 772 (23 CFR 772), FHWA.

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### **H.3 Policy for Maintenance of Noise Walls & Retaining Walls**

#### H.3.1 Objective

The objective of Noise Wall and Retaining Wall maintenance is to ensure that the stability, safety, durability, strength, and structural integrity of these features within the Toll Roads are continually and properly maintained so as to maximize their functional life.

Noise Walls and Retaining Walls require routine and preventative inspections and the associated maintenance due to wear, impacts, and natural occurrences, etc.

##### H.3.1.1 Noise Walls

Noise Walls typically consist of steel or precast concrete posts with concrete precast panels or timber planks that bridge between the support posts. These walls can be Ground Mounted, Bridge Mounted, or Retaining Wall Mounted. Ground Mounted walls are founded on caissons or concrete spread footings; Bridge Mounted walls have the noise panels bolted to the outside face or top of the bridge barrier or parapets; while Retaining Mounted walls have the noise panels bolted to the outside face of the retaining wall barrier, or the posts anchored to the top of the retaining wall.

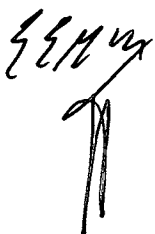
##### H.3.1.2 Retaining Walls

Retaining Walls typically consist of Reinforced Concrete, Mechanically Stabilized Earth (MSE), Soldier Piles with Concrete Lagging, Crib Wall structures with rubble fill, Soil Nail, Masonry, etc., that support or retain earth.

#### H.3.2 Responsibility of Concessionaire

In order to meet the requirements of this Chapter, the Concessionaire must engage in practices to ensure that all Noise Walls and Retaining Walls function properly as designed and to ensure that the stability, strength, durability, and structural integrity are never compromised, so that these elements function as design and not impede the continuous safe and orderly movement of traffic. The Concessionaire will carry out its obligations in accordance with the Operating Standards in a manner that minimizes the overall deterioration and/or improves the condition of the Noise Walls and Retaining Walls.

The Concessionaire is responsible for all management associated with the Noise Walls and Retaining Walls including conducting Maintenance, Emergency and Mandatory inspections; filing inspection documents and reports with required agencies and PRHTA; assisting in requested inspections; and replying to questions or comments that might arise.



The Concessionaire is also responsible for determining repair needs; creating repair alternatives and procedures; scheduling work; and overseeing all work to ensure compliance with all of the Reference Documents listed in Section H.2 of this Chapter. Also, the Concessionaire must maintain, repair, monitor and utilize all existing and/or future instrumentation that would or might be employed to monitor the effectiveness of the Wall System.

The Concessionaire is responsible for initiating, designing, determining, establishing, and maintaining all required Traffic Control for the duration of the work as addressed by the requirements of Volume II, Chapter H, "Traffic & Travel Management Plan".

The Concessionaire must ensure that all repair drawings are prepared, signed and sealed by a Professional Engineer Licensed in the Commonwealth of Puerto Rico. In addition, all repair work resulting in an alteration of a structural element must be recorded with an "As-Built" document, which must also be filed with PRHTA.

All materials and construction requirements for work performed by the Concessionaire must conform to the appropriate and applicable requirements of the Reference Documents listed in Section H.2 of this Chapter.

Once work on a Noise Wall or Retaining Wall has been started, the work must continue during consecutive working days until a thorough, complete, and structurally adequate product has been achieved. The stockpiling of materials, open excavations, etc., is not permitted. All work performed must be made to correct all safety deficiencies and preserve the Toll Roads as an asset.

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The work that must be performed includes, but is not limited to, the following:

- Clean out and remove accumulations of debris behind and around the walls so that debris does not prevent the drainage system from functioning properly. Dispose of debris in an acceptable and legal manner.
- Repair erosion that affects or has the potential to affect the structural stability of the wall.
- Replace walls or their components where maintenance and repair will not restore the original function of the structure.
- Repair, reinforce and replace all portions of walls that indicate evidence of movement, deflection, or settlement. The Concessionaire must employ a Licensed Geotechnical Engineer in the Commonwealth of Puerto Rico to determine the extent of the situation and to prepare the appropriate work details and documents to remedy the problem.
- Consult with the original design company for all MSE Walls damaged, deficient or not properly functioning, and replace all portions and components of the wall system with parts and materials as recommended by the manufacturer, this Chapter and the Reference Documents listed in Section H.2 of this Chapter.

- Ensure that all bolts and fasteners are present, properly torqued, tight and contain the proper nuts and washers.
- Repair unsound, delaminated, spalled, cracked and structurally deficient concrete. In addition, the repaired concrete work must match the finish and color of the adjacent concrete surfaces.
- Seal concrete cracks greater than 1/8" to prevent the infiltration of water and chlorides.
- Clean, prepare and coat all steel surfaces in accordance with the requirements Volume I, Chapter G, "Bridge & Structure Maintenance", and the Reference Documents listed in Section H.2 of this Chapter, where the coating system is found to be deteriorated, broken, peeling, cracking, damaged, and/or the steel shows signs of corrosion or rust.
- Ensure that all work is performed without damage to property, or injury or delay to Toll Road users, and adjacent property owners.
- Repair or replace all wall attachments such as fences, guiderail, barriers, or signs in accordance with applicable chapters of this Volume.
- Repair or replace architectural treatments or coatings such that a uniform and neat appearance is maintained.

The work also includes routine inspections of the walls:

- Ensure that all inspections required by Title 23 Code of Federal Regulations, as well as those required by PRHTA occur at the frequencies not in excess of those stated in Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports".
- Employ qualified, experienced and trained Professional Engineers Licensed in the Commonwealth of Puerto Rico to perform all of the required inspections, condition assessments, repair recommendations and required reports and filings with the appropriate Commonwealth and Federal entities.
- Ensure that all inspections methods and procedures are in conformance with the requirements of the National Bridge Inspection Standards and PRHTA.
- Develop, update and maintain a Wall Structure management, inspection and condition inventory and database which shall include photographs, test results, field notes, and condition observations. Identify and prioritize all required repairs.
- Perform load analyses as required when deficient elements are discovered.
- Ensure that all structures are properly inventoried with PRHTA, and that updated Inventory Inspection Forms and Reports are correctly coded into the Commonwealth's Inventory System.


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- Secure proper, orderly and required rights-of-entry from adjacent property owners and utilities when the work may involve their notification and permission.
- Notify the Commonwealth and the Municipal Government immediately when inspections determine that the Wall System creates the possibility of a localized or large-scale structural failure.

### H3.3 Performance Time Frames

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire), within which the Concessionaire must assess the condition, provide temporary protection measures to ensure public safety, and/or initiate the repair or replacement work required to the feature (unless weather conditions limit material application):

Wall System Type	Maximum Time Duration
<u>Noise Walls:</u>	
○ Instability or Structural Damage	24 Hours
○ Non- Structural Damage	2 Months
<u>Retaining Walls:</u>	
- Instability or Structural Damage	24 Hours
- Non- Structural Damage	1 Month

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### H.3.4 Acceptance Criteria

Noise Wall and Retaining Wall maintenance work will be considered acceptable when the following criteria are met or exceeded:

- Noise Walls
  - Vegetation that will or might exert stresses on the structure has been removed.
  - All elements of the structure are plumb, structurally stable, and do not indicate signs of distress or movements.
  - Posts and panels are securely fastened to other structural elements.
  - Architectural treatments and coatings are uniform, free of spalling, peeling, or other defects.
  - The wall is structurally sound and free of defects that compromise the structural integrity.
  - The wall and its panels provide insertion loss to the levels and amounts prescribed by the design.

- Retaining Walls
  - The earth retained by the structure is present without deformations, cracks, erosion, or slumps, and is in a stable state.
  - Drainage for the retaining structure is present and functioning as originally designed.
  - Vegetation that will or might exert stresses on the retaining structure has been removed.
  - All vertical faces of the retaining structure are plumb, structurally stable, and do not indicate signs of distress or movements.
  - Repairs and replacement of portions or components of MSE walls are made with materials and procedures in consultation and approval of the original wall design company.
  - Concrete cracks greater than 1/8" are sealed.
  - Architectural treatments and coatings are uniform, free of spalling, peeling, graffiti, or other defects.
  - Elements attached to the wall are securely attached and functioning as designed.
  - The wall is structurally sound and free of defects that compromise the structural integrity.

## H.4 Additional Requirements

### H.4.1 Inventory and History Record

The Concessionaire must develop, maintain, and keep current an inventory and history record of all Noise Walls and Retaining Walls along the Toll Roads. The inventory and history record must consist of the type, size, location, age, and length of each Wall System. Information that must be contained in the inventory and history record includes:

- Wall location referencing the Kilometer Post along the Toll Roads.
- Assigning and maintaining an Identification Number.
- Length of the Wall, along with its average height, and exposed face area.
- The wall type, material composition and features.
- The adjacent property owner's information.
- The age of the wall, including the year constructed.
- The general condition of the wall.
- Chronological history of all repairs/replacements including a brief note of what the change was.

#### H.4.2 Geotechnical Engineering

Because the Noise Walls and Retaining Walls are present at various locations along the Toll Roads, affect the functionality and operation of the Toll Roads, and are founded on variable and unique soil characteristics, the Concessionaire must employ a qualified, experienced and Licensed Geotechnical Engineer when considering and performing maintenance work.

#### H.4.3 Wall Technology

To the greatest extent possible, when performing work the Concessionaire must utilize the newest techniques, technologies, and implement the most current and Commonwealth-approved wall systems so as to provide the maximum life, maximize the capacity of the wall system, minimize motorist inconvenience, and ensure the safety and operation of the Toll Roads.

#### H.4.4 Inspection Requirements

All of the Wall Systems must be inspected by a qualified engineering firm that meet the requirements stated in Volume II, Chapter L, "Annual State of the Toll Roads and Capital Improvement Program Reports", at the frequencies stated.

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## **I.1 Definitions**

Animal Control Work: The efforts by the Concessionaire to remove animal pests from the Toll Roads, and prevent additional damage by pests, including trapping, baiting, poisoning, fencing, or deterring animals.

Animal Damage: Damage done to any part of the Toll Roads by the actions of animal pests including squirrels, skunks, mice, rats, etc., as well as incidental damage resulting from vehicle interactions or collisions with animals.

Animal Removal Work: The work performed by the Concessionaire to remove animals, including wildlife and stray pets, from the Toll Roads, as well as the removal of animal carcasses.

Atmospheric Damage: Damage done to any part of the Toll Roads by the action of the atmosphere or climate, including rain, wind, storms, lightning strikes, chemical or pollutant degradation, etc.

Collision: An incident involving the impact of a vehicle with another vehicle or with some component of the Toll Roads. Vehicles that can cause collision damage include highway traffic, aircraft, off-road vehicles, railroad cars and locomotives, utility or railroad service vehicles, construction equipment, and vessels within the channel of navigable rivers.

Earthquake: A seismological event or earth tremor described, reported or classified by the USGS as an earthquake.

Emergency Maintenance: Time-critical repair work performed on an unplanned basis and intended to restore operations and mitigate damage done to the Toll Roads by collision, vandalism, earthquake, an atmospheric event, etc. Emergency maintenance and repairs may be a temporary measure, using the staff and materials available immediately following the incident.

Graffiti: Painted vandalism of buildings, walls, signs, etc. that has been placed on a surface without the property owner's consent.

Hurricane: A severe weather event with winds over 75 mph described, reported or classified by the National Weather Service as a Hurricane.

NOAA Weather Radio: Local broadcast radio which issues bulletins and alerts regarding severe weather conditions or forecasts. The Concessionaire must subscribe to NOAA Weather Radio and monitor this station on a 24 hour-a-day basis.

Responsible Public Agencies: Government agencies that are empowered to take responsible charge of the operational and safety aspects of an emergency,



including the Puerto Rico Police, Local and State Fire Departments, the FBI, FEMA, the Department of Homeland Security, etc.

Soda Machine or Soda Truck: A truck or truck-mounted tank, pump and hose assembly that uses baking soda delivered under high water pressure to remove painted graffiti from mineral surfaces such as masonry, brick, and Portland cement concrete. Soda machine devices have been shown to cause no damage to viaduct surfaces, while being faster and more environmentally safe than sandblasters or chemical solvents.

Third Party Damage Repair: The repair work to restore any damaged feature located within the Toll Roads to undo or mitigate the effects of an intentional destructive human act (vandalism or graffiti marking), vehicle collision, animal pests, atmospheric event, etc.

Tornado: A severe weather event or wind gale described, reported, or classified by the National Weather Service as a tornado or funnel cloud.

Vandalism: An intentional, destructive human act that damages or weakens any part of the Toll Roads or causes harm, peril, or inconvenience to Toll Road users. Acts of vandalism include arson, graffiti, breakage, theft, placing obstructions in the traveled way, fence cutting, etc.

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## 1.2 References

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA
- Highway Design Manual, PRHTA
- Signage Guide, PRHTA
- Standard Drawings, PRHTA
- Standard Specifications for Road and Bridge Construction, PRHTA
- Traffic Sign Manual, PRHTA
- "Manual on Uniform Traffic Control Devices" (MUTCD), FHWA
- "NOAA Weather Radio (NWR) Brochure", NOAA
- "A Guide to Standardized Highway Barrier Hardware", AASHTO
- "A Policy on Geometric Design of Highways and Streets", AASHTO
- "Guide Design Specifications for Bridge Temporary Works", AASHTO

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### **I.3 Policy for Performing Third Party Damage and Emergency Maintenance**

#### *I.3.1 Objective*

The objective of Third-Party Damage and Emergency Maintenance is to restore the elements of the Toll Roads that are damaged by unforeseen accidents, events or incidents to a safe, operable, useful condition and to maintain orderly traffic flows.

Any element of the Toll Roads is liable to suffer damage from storms, climate variations, animal pests, pollution, vandalism, or other causes as discussed in this Chapter. Damaged portions of the Toll Roads will require maintenance; temporary repairs; permanent repairs or replacement.

An effective response to incidents of third parties' damages to the Toll Roads requires:

- Immediately attending to incidents that is potentially life threatening or poses a threat to Toll Road users.
- Cooperating with all responsible police, fire, emergency or, Commonwealth and Federal officials.
- Performing damage assessments using qualified personnel and taking all necessary steps to safeguard life and property.

Information regarding the Concessionaire's required response to emergency incidents is addressed by the requirements of Volume II, Chapter J, "Emergency Management and Operation Plan".

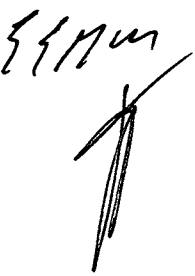
#### *I.3.2 Responsibility of the Concessionaire*

##### *I.3.2.1 Maintenance and Repair Requirements*

Maintenance and repair of damage done by third parties to the Toll Roads, as well as maintenance and damage repair following severe weather, animal or emergency events are the responsibility of the Concessionaire.

The Concessionaire is responsible for assessing the damage to the Toll Roads by the incidents and for ranking the priority for repair of such damage in order to assure safe, continuous use by Toll Road users.

The Concessionaire is responsible for completing all the necessary repair/replacement work within the Time Frames established in other Chapters for the particular elements damaged.



### 1.3.2.2 Incident Response Requirements

The Concessionaire is responsible for responding to notifications of vehicle collision, vandalism, animal damages, natural disaster, severe weather, earthquake, etc. as addressed by the requirements of Volume II, Chapter J, "Emergency Management and Operation Plan", and must fully restore the damaged elements of the Toll Roads to their condition as they existed before the event.

The Concessionaire's responsibilities will encompass many roles during an event and include, but are limited to, the following:

- Dispatching qualified staff and emergency response equipment to sites where a collision, natural disaster, fatality, personal injury, or property damage has been reported.
- Communicating and cooperating with the Puerto Rico Police, PRHTA, Local and State Fire and Police agencies, Local emergency medical personnel, utilities, adjunct Commonwealth Agencies, and other local Agencies, etc., both with their offices and with their on-site crews.
- Facilitating access to the crash site by fire, police and emergency medical personnel and equipment, and assisting in moving involved vehicles from the traveled way.
- Establishing, maintaining, and providing all required Traffic Control such as lane use restrictions, lane closures, ramp closures, plaza closures, or bridge closures as appropriate given the apparent blockage of the roadway, visible structural damage, or similar hazards.
- Conducting immediate inspections, repair/replacement work and integrity assurances of any damaged structural members using qualified Professional Engineers Licensed in the Commonwealth of Puerto Rico and mobilizing any inspection and testing equipment required for thorough inspections as quickly as possible.
- Maintaining and policing on-going lane use restrictions, lane or ramp closures, weight restrictions, bridge closures, etc. based on the inspection findings.
- Responding to notifications by responsible authorities that Toll Road traffic needs to be temporarily halted or redirected whenever an emergency incident occurs within or adjacent to the Toll Roads which might pose a hazard to Toll Road users.

### 1.3.2.3 Management and Coordination Requirements

The Concessionaire is responsible for all management and coordination associated with the required to repair damage caused by the incidents discussed in this Chapter. The Concessionaire must conduct all required inspections, file documents with PRHTA and the Commonwealth as required, and assist any independent inspections conducted on behalf of



PRHTA and the Commonwealth. The Concessionaire is not required to block traffic, arrange special inspections, or otherwise hamper Toll Road operations in order to accommodate third party insurance claims adjusters.

The Concessionaire is responsible for all determinations of repair needs, performing maintenance and/or repairs on elements within the Toll Roads, as specified elsewhere in Volume I – “Maintenance Manual”, for those specific elements, and generally ensuring that the specified acceptance criteria are achieved.

The Concessionaire is responsible for monitoring the local NOAA Weather Radio Station 24 hours a day, and acting upon all bulletins and alerts regarding severe weather conditions that are forecast.

The Concessionaire must also communicate with PRHTA, as well as the Puerto Rico State Agency for Emergency Management and Disaster Administration and to coordinate all communications and coordination with those agencies.

#### I.3.2.4 Incident Report Documentation

The Concessionaire must document, record, and file a report in a separate log whenever third-party damages occur within the Toll Roads. The reports must include the following minimum information, so that an accurate evaluation of the situation may be made whenever required:

##### Outline of a Third-Party Damage Report:

###### I General Discussion

- a. Toll Road on which the incident occurred.
- b. Date of occurrence
- c. Discussion of occurrence
- d. Impact on travel
- e. Estimated cost of repairs

###### II Supporting Information

- a. Damaged element(s) or segment(s) of the Toll Road
- b. Nature of damage
- c. Condition of remaining element(s)
- d. Weather Conditions
- e. Highway conditions
- f. Start and end locations of incident.

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g. Witness interviews

h. Photographs

III Third Party Information (As Available)

a. Names and addresses

b. Insurance information

c. Copies of any reports filed.

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1.3.3 Performance Time Frames

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire), within which the Concessionaire must respond to and commence the required repair or replacement to restore the damaged Toll Road component to its original condition or to a better condition:

Table I.3.3

Event	Maximum Time Duration
<p>Roadway Clearance Time (crashes, breakdowns, etc.) - Time between first recordable awareness of incident by a responsible agency and first confirmation that all lanes are available for traffic flow.</p>	<p>30 minutes (minor incident – blocking one lane (no injury/fatality and no spills)).</p> <p>1 hour 15 minutes (major incident – blocking two or more lanes or blocking one lane (with injury/fatality or spills))</p>
<p>Incident Clearance Time (crashes, breakdowns, etc.) - Time between first record able awareness of incident by a responsible agency and time at which the last responder has left the scene.</p>	<p>40 minutes (minor incidents – blocking one lane (no injury/fatality and no spills))</p> <p>1 hour 30 minutes (major incident – blocking two or more lanes or blocking one lane (with injury/fatality or spills))</p>
<p><u>Material Spills:</u></p> <p>-Non-Hazardous (aggregate material loads (sand gravel, etc.), and other general cargo loads).</p> <p>-Hazardous (Any hazardous material identified in the Emergency Response Guidebook)</p>	<p>15 minutes (Arrival on Scene)</p> <p>10 minutes (Arrival on Scene)</p>
<p><u>Vandalism Incidents:</u></p> <p>- Graffiti Removal</p> <p>- All other incidents which affect the highway operations</p>	<p>24 Hours</p> <p>24 Hours</p>

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Atmospheric Damage	1 Hour or as the situation dictates (Response)  (Repair/Replacement work per requirements of the applicable Chapter)
<u>Animal Incidents:</u>  - Damage  - Removal of carcasses	  24 Hours  8 Hours

The Concessionaire's response time and the scale of mobilization in reaction to each detected or reported incident must be appropriate to the seriousness of the event and must be addressed and coordinated with the requirements of Volume II, Chapter J, "Emergency Management and Operation Plan".

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### 1.3.4 Acceptance Criteria

Third party damage repairs and emergency maintenance work will be considered acceptable when the following criteria are met or exceeded:

- The Concessionaire is responsive to reported incidents along the Toll Roads in conformance within the Time Frames specified in Table 1.3.3.
- The Concessionaire performs all necessary inspections and evaluations following an event, and makes all repairs required to restore all affected components to a safe and functioning condition in conformance to the relevant Chapters of Volume I, "Maintenance Manual".
- The Concessionaire protects traffic and the event site as deemed necessary, and maintains Traffic Control as appropriate during any incident site cleanup, inspection, repair, testing, shoring, etc.
- The Concessionaire manages each incident as outlined herein and maintains contact in order to coordinate forces and consult on work tasks with the Puerto Rico Police, PRHTA, the Commonwealth, and all other concerned Government Agencies and authorities as appropriate or required.
- The Concessionaire manages incidents of minor vandalism, graffiti, animal and pest control, and similar nuisances in the manner and within the Time Frames specified in Table 1.3.3.

### 1.4 Additional Requirements

#### 1.4.1 Vehicle Incidents

##### 1.4.1.1 Initial Response and Towing

The Concessionaire must respond to any notification that an inoperable vehicle has been located within the Toll Roads and must remove the vehicle. If the vehicle owner is present, the Concessionaire must first move the vehicle out of the traveled way and must offer to help the owner arrange for a commercial tow operator to remove the vehicle from the Toll Road. If the vehicle owner is not present, cannot assist in arranging the commercial tow, has abandoned the vehicle, or is present but refuses to arrange for a commercial tow, the Concessionaire must tow the vehicle to a pre-designated site. The pre-designated tow site selected by the Concessionaire should be conveyed to the Puerto Rico Police and PRHTA so that it remains on file.

The Concessionaire must promptly notify the Puerto Rico Police concerning all vehicles that have been towed and that are stored in the pre-designated site so that the owner can be informed.

When the Concessionaire has good cause to believe that a wrecked or abandoned vehicle has been used in the commission of a crime, or if the incident involves a fatality or serious injury, the Concessionaire should not move, tow or handle the vehicle until permitted by the Puerto Rico Police. The Concessionaire must cooperate with the Puerto Rico Police and comply with requests to assist with emergency traffic control until such time as the vehicle is removed.

#### 1.4.1.2 Incidental Repairs and Cleanup

The Concessionaire is responsible for clearing the traveled way including roadside shoulders and drainage gutters from debris, glass, firefighting foam, abandoned equipment, and any substances spilled from damaged vehicles such as liquids, chemicals, bulk (solid) material, or hazardous materials. All such cleanup work must be performed under emergency traffic control before the Concessionaire allows normal traffic to resume on or along the damage site. All such removed material must be properly handled and disposed of by the Concessionaire.

Requirements for the containment, removal, transportation and disposal of hazardous material spills, flammable liquid spills, livestock, or potentially hazardous bulk materials must be done in accordance with all Municipal, State and Federal requirements and as addressed by the requirements of Volume II, Chapter J, "Emergency Management and Operation Plan".

#### 1.4.1.3 Repair of Damage caused by Vehicles.

The Concessionaire is responsible for repairing all damage to the Toll Roads caused by vehicle incidents with any element or device of the Toll Roads, regardless of the cause of the incident. Damage repair must be sufficiently thorough, complete, and competent to restore the affected elements of the Toll Roads to their condition as existed before the damage event.

The Concessionaire must refer to the specific Chapters of Volume I "Maintenance Manual" pertaining to the damaged element for information and requirements concerning the repair of that element.

### 1.4.2 *Vandalism Incidents*

#### 1.4.2.1 General Requirements

The Concessionaire must maintain the Toll Roads by repairing any damage caused by vandalism and must respond to any notification that intentional damage has been done to any element within the Toll Roads by a third party.

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Third-party damage to any element within the Toll Roads that involves fire, explosion, obvious structural damage, or visible damage to the traveled roadway must be immediately inspected by the Concessionaire and reported to the Puerto Rico Police. Foreign materials or debris that are thrown upon or deposited in the traveled way that is likely to jeopardize safety must be immediately removed by the Concessionaire.

#### 1.4.2.2 Repair of Vandalism Damage

The Concessionaire must act to restore all elements within the Toll Roads affected by vandalism to a safe and functioning condition, and must prioritize its repairs based on the severity of the act, as the situation demands, and according to the scale of the damage. The Concessionaire must make repairs within the Time Frames stated in the appropriate Chapter of Volume I – Maintenance Manual.

Whenever the Concessionaire is forced to postpone the permanent repair work, or is compelled to do so in order to schedule the necessary forces and receive replacement parts, the Concessionaire must continually monitor the temporary repairs and the incident site to ensure that the damaged system or element does not continue to weaken or deteriorate, and endanger the public.

#### 1.4.2.3 Removal of Graffiti & Postings

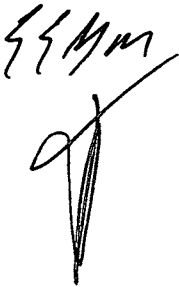
The Concessionaire is responsible for removing graffiti within the Toll Road System, and must recognize graffiti as an issue that affects Toll Road users' perception of the Toll Roads, PRHTA, the Concessionaire's operations, and the Commonwealth of Puerto Rico as a whole. The Concessionaire must engage in its own efforts to remove graffiti and maintain the aesthetics and value of the Toll Roads.

The Concessionaire is responsible for immediately removing graffiti upon detection if the marks obscure lamps, sign information, traffic devices, or are otherwise a safety concern. Also, graffiti of an obscene or offensive nature must also be removed or covered immediately.

The Concessionaire is required to contact the Puerto Rico Police to report vandalism and graffiti-painting acts in progress, so that the offenders can be pursued and apprehended.

The Concessionaire must use graffiti removal techniques wherever feasible, and may only use paint to cover graffiti on wood, traffic signal equipment, various painted surfaces or other areas unsuitable for the soda machines removal techniques.

Signs or posters that are placed within the Toll Roads without the knowledge or approval of the Concessionaire, or in violation of Municipal or Commonwealth Law or Ordinance, such as house and garage sale advertisements, political ads, protest signs, and similar materials must be promptly removed upon discovery.



### I.4.3 Atmospheric Damage Repairs (Rain/Wind/Hurricanes/Tropical Storms)


#### I.4.3.1 General Requirements

The Concessionaire must maintain the Toll Roads by repairing any and all damage caused by high winds, gales, hailstorms, lightning strikes and similar typical atmospheric disturbances. The Concessionaire is required to respond to reports of damage caused by unusually severe weather such as hurricanes, or seismological incidents such as earthquakes, as addressed by the requirements of Volume II, Chapter J, "Emergency Management and Operation Plan".

The Concessionaire must respond to all notifications that severe weather has caused damage to an element within the Toll Roads and must perform an immediate site inspection. Should the Concessionaire's inspectors determine that the damage poses a hazardous situation, the Concessionaire must act immediately to safeguard the public by taking steps such as temporarily closing the traveled roadway, making emergency repairs, etc., so as to restore safe operations along the Toll Roads.

#### I.4.3.2 Repair of Atmospheric/Weather Damage

The Concessionaire must restore all elements within the Toll Roads damaged by severe weather to a safe and functioning condition, and must prioritize and schedule repairs based on the damage. The Concessionaire must refer to the specific Chapters of Volume I - Maintenance Manual that pertain to the damaged element for information and requirements concerning the repair for that element. If the Concessionaire is forced to postpone the permanent repair work, all temporary repairs must be continually monitored.

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#### I.4.4 *Animal Removal and Damages*

##### I.4.3.1 General Requirements

The Concessionaire must repair the Toll Roads by correcting any damage caused by the actions of animal life. The Concessionaire is also responsible for removing and properly disposing dead animals (carcasses) from the Toll Roads in accordance with all applicable Municipal and Commonwealth Laws.

Removal of an animal carcass should be performed within the Time Frames stated in Table I.3.3 of this Chapter. Whenever possible, the Concessionaire should recover license tags, name badges, or other pet identification and the Concessionaire should notify the pet owner prior to disposal.

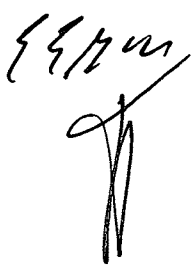
##### I.4.3.2 Treatment of Live Animals

Live animals, including wildlife, must either be removed by the Concessionaire, or be tolerated and protected by the Concessionaire as part of the natural habitat. In the case of domesticated animals or pets that stray into the Toll Roads the Concessionaire must not attempt to trap or remove the animal, but must call the Municipal or the appropriate Commonwealth Animal Control Officers for removal.

When there is evidence at a specific location that an animal is causing damage to the Toll Roads, the Concessionaire is then authorized to use humane means to target and eradicate the specific pests. Traps or poison may be set by qualified personnel only for the specific pests at the specific location, and only until such time as the damage is stopped. Once the pest is removed, the Concessionaire must remove and dispose of all traps and/or poison bait.

##### I.4.3.3 Maintenance Activities


The Concessionaire must inspect and repair all damage done by animals to the Toll Roads. The Concessionaire must evaluate the severity of all such damage and its effect on safety, and prioritize the repairs accordingly. Damage to electrical wiring, plumbing, signage, lighting and other similar elements that affects safety systems and which poses a hazard to the public must be repaired as a higher priority.



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## **J.1 Definitions**

Barrier Walls: All concrete wall elements used as a protective barrier for vehicular or pedestrian traffic. Examples include median barrier walls, permanent or temporary roadside concrete barrier (single for double faced), ground mounted barrier walls, and parapets and barriers attached to retaining walls and mechanically stabilized earth (MSE) retaining walls.

Guard Rail Systems: All plate-like beam rails, including all associated terminal sections and hardware, used to protect traffic from slopes or obstacles near the traveled way or to protect elements from traffic.

Impact Attenuators: Protective systems that prevent errant vehicles from impacting hazards by either decelerating the vehicle to a stop after a frontal impact or by redirecting it away from the hazard after a side impact, accomplished using either energy absorbing or energy transferring devices.


Median: The portion of the highway forming the separation of the traveled ways for traffic in opposing directions.

Moveable Barrier Wall System: An articulated and segmental concrete barrier wall that can be moved by re-positioning such that additional directional traffic capacity is achieved. The Moveable Barrier Wall is moved via the use of a specialty vehicle created solely for that purpose.

Parapet: A wall-like element of reinforced concrete integrally and structurally connected to the deck portion of a bridge to serve as a protective barrier for vehicular or pedestrian traffic.

Toll Plaza Crash Protection Systems: Crash protection devices located at each of the Toll Plaza collection lanes that are intended to protect the toll attendant, the toll booth, and plaza hardware from the effects of vehicular impact.


Toll Point Crash Protection Systems: Crash protection devices located at each of the Toll Zone and Toll Point that are intended to protect the maintenance team, the toll gantries, and Toll Zone hardware from the effects of vehicular impact.

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## J.2 References

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA
- Highway Design Manual, PRHTA
- Standard Drawings, PRHTA
- Standard Specifications for Road and Bridge Construction, PRHTA
- "Roadside Design Guide", AASHTO.
- "A Guide to Standardized Highway Barrier Hardware", AASHTO.
- "A Policy on Geometric Design of Highways and Streets," AASHTO.
- "Manual on Uniform Traffic Control Devices", AASHTO.

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### **J.3 Policy for Performing Roadway Safety Systems Maintenance**

#### J.3.1 Objective

The objective of Roadway Safety Features and Systems is to preserve in working order or restore to working condition all features and systems installed to enhance the safety of motorists, pedestrians and or workers, should a vehicle leave the traveled way; and to protect the integrity of the Toll Roads from damage by vehicle collisions. These features and systems include guard rail systems; impact attenuators; fixed Barrier Walls; Moveable Barrier Wall Systems; the Toll Plaza Crash Protection System; and the Toll Point Crash Protection System.

#### J.3.2 *Responsibilities of Concessionaire*

In order to meet the requirements of this Chapter, the Concessionaire must engage in practices to ensure that all Roadway Safety Features and Systems function properly to ensure the safety of the Toll Road users, traffic, pedestrians and workers while protecting the structural integrity of the Toll Roads from vehicle collision; and meet other safety, aesthetic and economic benefits. The Concessionaire must perform its obligations in accordance with this Chapter in a manner that maintains and/or improves the condition and functionality of the Roadway Safety Features and Systems.

Roadway Safety Features and Systems maintenance, inspection, and work activities must be performed at a frequency that ensures uniform and consistent compliance with PRHTA, Commonwealth and Federal regulations, and the requirements specified within this Chapter.

All materials and construction requirements for Roadway Safety Features and Systems work performed by the Concessionaire must conform to the appropriate and applicable requirements and the Reference Documents listed in Section J.2 of this Chapter.

Once a particular maintenance repair has been started the work must continue during consecutive working days, as weather permits, until a thorough, complete, and workmanlike repair has been achieved. The Concessionaire must establish and maintain traffic control and protection during this time.

Parapets, railings, and other systems attached to the bridge structures are addressed in Volume I, Chapter G, "Bridge and Structure Maintenance".

Work on Roadway Safety Features and Systems within the Toll Roads that must be performed by the Concessionaire includes the following:

- Repair or replace all damaged, deteriorated, or deficient portions of the guard rail systems, impact attenuators, fixed Barrier Wall, Moveable Barrier Wall, the Toll Plaza Crash Protection System and the Toll Point Crash Protection System that constitute or have the potential to create an unsafe condition for Toll Road users, personnel and the public.

- Ensure that all of the Roadway Safety Features and Systems are: functioning as intended and designed; are free from debris; securely fastened to their foundations; are structurally sound; and are clearly and highly visible.
- Ensure that all of the Roadway Safety Features and Systems are properly aligned and positioned as safety devices.
- Maintain all posts and vertical components in a plumb, aligned and straight position.
- Apply preservatives to all timber elements as required to maintain rot-free and structurally sound components.
- Replace all timber and steel components if elements are rotted, broken, settled, excessively corroded, or damaged.
- Repair or replace guard rail sections that are bent, broken, cracked, rusted or damaged with materials and finishes that meet or exceed the components that they replaced.
- Ensure that damaged, compromised, ineffective or non-functioning impact attenuators are repaired with parts and components in consultation with the original manufacturer, or successor.
- Alleviate any and all impediments to the drainage flow caused or created by the presence of the Roadside Safety Features and Systems, including cleaning drainage holes in the bases of the barrier walls.
- During repairs, construction, replacement of all Roadway Safety Features Systems, traffic control and protection as addressed in Volume II, Chapter H "Traffic and Travel Management Plan" must be implemented.

### J.3.3 Performance Time Frames

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire), within which the Concessionaire must complete the required repair or replacement work to the Roadway Safety Feature & Systems and their components (unless weather conditions limit material application):

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Table J.3.3

Roadway Safety Feature or System	Maximum Time Duration
<u>Guard Rail System:</u> - Damage to Structural Integrity - Non-Structural Damage or Deterioration	24 Hours 15 Days
<u>Barrier Wall (fixed or moveable):</u> - Damage to Structural Integrity or Stability - Non-Structural Damage or Deterioration	24 Hours 45 Days
Impact Attenuators	24 Hours
<u>Toll Plaza and Toll Point Crash Protection Devices:</u> - Damage to Structural Integrity - Non-Structural Damage or Deterioration	12 Hours 30 Days
<u>DTL Lane Access Gates and Emergency Gates:</u> - <u>Damage to Structural Integrity</u> - <u>Non-Structural Damage or Deterioration</u>	24 Hours 30 Days

The Concessionaire must also:

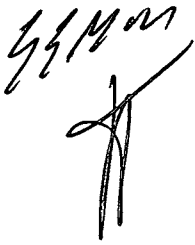
- Clean all drainage holes in the barrier wall bases and inlets adjacent to the barrier walls at least two (2) times annually.
- Immediately establish and provide temporary barricades and traffic control whenever a Roadway Safety Feature or System is unsafe or has the potential to become unsafe for Toll Road users.
- Remove all litter and debris in and around the impact attenuators at least six (6) times annually, or at a greater frequency as conditions and locations dictate.

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### J.3.4 *Acceptance Criteria*

Roadway Safety Features and Systems will be considered acceptable when the following criteria are met or exceeded.

- Guard Rail Systems:
  - The guard rail has been installed in full compliance with the Reference Documents listed in Section J.2 of this Chapter, and the system is within
    - ¾-inch of plumb and grade.
  - The surface materials are smooth, undamaged, and free of defects.
  - The rails and terminal elements are not warped or otherwise deformed.
  - The posts are installed square to the rail.
  - The work site is left in a clean condition.
  
- Impact Attenuators:
  - The system is free of obstructions and is fully capable of functioning as designed and intended.
  - The system components are free of damage which impairs the ability of the attenuator to serve its function or have been repaired with equal or comparable parts in consultation with the original manufacturer or its successor.
  -
  
- Barrier Walls (fixed and moveable):
  - Barrier walls are properly aligned horizontally and vertically to conform to the roadway profiles, alignment and geometry.
  - The barrier wall is free from defects and damage which impair its ability to perform its function.
  - Moveable Barrier Wall components, elements and machinery perform in accordance with the intention and with the manufacture's requirements.
  -
  
- Toll Plaza and Toll Point Crash Protection Systems:
  - Protection System is free from all damage and deficiencies, which affect the function of the System, and on which all cosmetic defects have been removed or repaired.
  - The protection system is structurally sound and is capable of functioning as designed.



- DTL lane access gates and emergency gates:
  - DTL lane access gates are emergency gates are free from all damage and deficiencies, which affect the function of the System, and on which all cosmetic defects have been removed or repaired.
  - The protection system is structurally sound and is capable of functioning as designed.

## **J.4 Additional Requirements**

### *J.4.1 Guard Rail Systems*

#### J.4.1.1 General Requirements

The Concessionaire required inspections must include a visual examination of the roadside guard rail to evaluate its functional integrity, height, and alignment.

#### J.4.1.2 Applicability of PRHTA Standard Plans

Guard rail must be repaired and/or replaced in accordance with the most current PRHTA Plans Standards and Reference Documents, whichever is more stringent. Damaged guard rail sections, posts, block-outs and hardware must be replaced in kind or with superior shapes or materials. If replacement cannot be made in kind, an analysis by a Licensed Professional Engineer in the Commonwealth of Puerto Rico must be made to ensure that all protective devices, hardware, and breakaway terminals are replaced with acceptable current standard devices.

#### J.4.1.3 Upgrading to Current Standards

The Concessionaire must upgrade or retrofit older segments of the guard rail system to current standards when such segments of the system are damaged or in need of replacement. When a substantial portion (25% or greater) of a run of guard rail (defined as the length between the guard rail origin and end) is damaged the Concessionaire must bring the entire run up to current standards or replace the guard rail with an equal or better safety feature. Mixtures of old and new types of guard rail within a run of guard rail are not permitted.



#### J.4.1.4 Construction Requirements

The Concessionaire must perform all guard rail work in such a manner that motorists are always protected from an opening in the rail. The Concessionaire must make every effort to fully restore the system by the end of the working day once repairs have started. An unprotected gap in the guard rail must never be left overnight. Barricades or drums will not be considered sufficient protection.

Adjustments to line and grade of guard rail should be done in conjunction with other repair work whenever possible.

Surface irregularities such as berms or windrows must not be allowed on the traffic side of guard rail.

All work areas are to be left in a clean and neat condition after repair, replacement, or routine maintenance.

#### J.4.2 *Impact Attenuator Systems*

##### J.4.2.1 General Requirements

The Concessionaire is responsible for repairing and/or replacing impact damage to energy attenuation devices. An ample supply of replacement parts should be ordered in advance and kept on hand.

Impact attenuator replacement must be performed during a single working day, and the work site and the hazard itself must be properly shielded from traffic by temporary crash cushions, lane closures and similar approved methods.

Additionally, litter and debris that accumulates at the base of attenuators or between, in front of or around the cells must be removed. Debris must not be allowed to accumulate since such debris could hinder and impair the operation of the impact attenuator. Impact attenuator inspections must include checking for debris under or around the attenuators.

##### J.4.2.2 Requirements for Replacement Parts & Assemblies

Replacement of broken, missing or damaged elements of the impact attenuator systems must be exactly in kind and should be supplied by the manufacturer of the original device to ensure that the device's physical properties and impact responses continue to function as designed.

The entire replacement of damaged impact attenuator assemblies, unless otherwise designed and approved by a Licensed Professional Engineer in the Commonwealth of Puerto Rico, must be of the same type as the existing impact attenuator assemblies in terms of the module's length, width of



protection, re- directive properties, debris retention features, support legs and ground pad, transition panels or struts to concrete barrier wall or guard rail and all other parameters pertaining to the module's performance at a particular location. If a different manufacturer's product is considered for use as a replacement, that product must meet the current requirements for impact attenuators.

#### J.4.2.3 Upgrading to Current Standards

The requirements of this Chapter are not intended to prevent the Concessionaire from upgrading or retrofitting existing impact attenuators to higher performance standards or modifying existing Roadway Safety Features and Systems that possess little or no energy absorbing properties. Any time impact attenuators are replaced, they must be replaced with devices meeting the current highway standards established by PRHTA and the Commonwealth.

#### J.4.2.4 Assurance by Concessionaire

The Concessionaire inspections, maintenance and work must be conducted with sufficient thoroughness so that the Concessionaire can warrant that all attenuators components are in satisfactory and operable condition and that all necessary repairs and replacements have been completed.

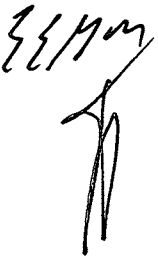
#### J.4.3 Barrier Wall (Fixed and Moveable)

##### J.4.3.1 General Requirements

It is the Concessionaire's responsibility to maintain all barrier walls types and kinds in a crashworthy, fully functional condition. Missing or damaged sections must be repaired or replaced.

The inspection and repair work for barrier walls mounted on bridge structures (parapets) is specified in Volume I, Chapter G, "Bridge and Structure Maintenance".

The Concessionaire must replace broken or damaged sections of the barrier wall with a wall having the existing wall face shape, or having a face shape that complies with current Reference Documents or in the case of the Moveable Barrier Wall the manufacture's recommendations. All transitions of wall face shape must be made gradually so that no corners or projections will be present that impair the function of the barrier.



#### J.4.3.2 Requirements for Median Wall

Median walls, fixed or moveable, must not be retrofitted or replaced in such a manner that the clear zone available to motorists is reduced, or any inappropriate projections are created in the wall face.

The Concessionaire is prohibited from cut openings in the median wall to facilitate movement around the Toll Roads, nor disconnect the articulated sections of the Moveable Barrier Wall System.

The Concessionaire must not erect cantilever sign supports, overhead sign truss supports, light fixtures, or any other appurtenance in the median wall that would rely on the barrier wall for a portion or all of its foundation support unless the Concessionaire retrofits the median wall at that location to resist all of the applied loads it must withstand. In addition, the Concessionaire must not retrofit or replace the barrier wall in such a manner that the clear zone available to motorists is reduced, or any dangerous projections are created in the wall face.

#### J.4.3.3 Requirements for Impact Events

When a vehicle impact creates a gap in the wall that could permit a vehicle to cross the median, expose a drop-off greater than two (2) feet, or expose a fixed object hazard to traffic, and permanent repairs cannot be made immediately, the Concessionaire must protect the opening with temporary barrier to completely protect the hazard. Barricades, barrels, and the like must never be used as temporary means for a fully functional barrier wall.

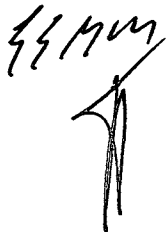
All permanent repairs must be made of the same type as the existing barrier wall, and in accordance with the manufacture's recommendations. Precast concrete units may not be considered a permanent repair for existing cast-in-place barrier wall. All precast units and all replacement construction must be done in accordance with current PRHTA Standard Plans for Barrier Wall.

#### J.4.3.4 Requirements for Reversible Lane Barrier Transfer Machine

The PRHTA will lend to the Concessionaire two current Reversible Lane Barrier Transfer Machines for a period of two years after the Closing Date. It will be responsibility of the Concessionaire to maintain both of them and return them to the PRHTA at the same level of condition.

The Concessionaire must acquire two new Reversible Lane Barrier Transfer Machines, one of them capable of performing two-lane transfers simultaneously for the PR-18 reversible lane segment.

It is the Concessionaire's responsibility to maintain all Reversible Lane



Barrier Transfer Machines in a crashworthy, and fully functional condition during the Term.

#### J.4.4 Toll Plaza Crash Protection System

##### J.4.4.1 General Requirements

The Concessionaire is responsible for maintaining all Toll Plaza Crash Protection Systems in sound, operable condition. The specific characteristics and features at each Plaza may vary greatly due to the age, traffic, location, function and other elements that affected the design. It is important that the Concessionaire is aware that the purpose of the Toll Plaza Crash Protection System is to protect the toll attendant and the toll collection booth from vehicular impact.

The inspection requirements for other toll plaza elements such as booths, the overhead canopy, lighting, and all related hardware are specified in Volume I, Chapter M, "Toll Booth and Plaza Maintenance".

##### J.4.4.2 Requirements for Impact Damage Events

If the Toll Plaza Crash Protection System is damaged by vehicular impact, the Concessionaire must conduct an inspection of the structural integrity of all toll plaza appurtenances involved. Plaza lanes must not be opened to traffic until a complete repair has been made of all damaged devices and systems.


During all repairs, the Concessionaire must establish and maintain traffic control and protection as to be addressed in Volume II, Chapter H, "Traffic and Travel Management Plan".

Replacement of damaged portions of the Toll Plaza Crash Protection System must be of the same type as the existing Toll Plaza Crash Protection System. In order to properly replace severely damaged portions of the Toll Plaza Crash Protection System, the As-Built Contract Drawings for the Plaza are to be researched. Construction drawings must be prepared, signed and sealed by a Professional Engineer Licensed in the Commonwealth of Puerto Rico to guard the repair work and to serve as a reference for future replacements of this nature.

#### J.4.5 Toll Point Crash Protection System

##### J.4.5.1 General Requirements

The Concessionaire is responsible for maintaining all Toll Point Crash Protection Systems in sound, operable condition. The specific characteristics and features at each Toll Point may vary greatly due to the age, traffic, location, function, and other elements that affected the design.

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It is important that the Concessionaire is aware that the purpose of the Toll Point Crash Protection System is to protect the workers and the Open Road

Tolling structure, equipment and systems from vehicular impact.

The inspection requirements for other Toll Point elements such as equipment, systems, lighting, and all related hardware are specified in Volume I, Chapter O, "Open Road Tolling Systems Maintenance".

#### J.4.5.2 Requirements for Impact Damage Events

If the Toll Point Crash Protection System is damaged by vehicular impact, the Concessionaire must conduct an inspection of the structural integrity of all Toll Point appurtenances involved.

During all repairs, the Concessionaire must establish and maintain traffic control and protection as to be addressed in Volume II, Chapter H, "Traffic and Travel Management Plan".

Replacement of damaged portions of the Toll Point Crash Protection System must be of the same type as the existing Toll Point Crash Protection System. To properly replace severely damaged portions of the Toll Point Crash Protection System, the As-Built Contract Drawings for the Toll Point are to be researched. Construction drawings must be prepared, signed, and sealed by a Professional Engineer Licensed in the Commonwealth of Puerto Rico to guard the repair work and to serve as a reference for future replacements of this nature.



#### J.4.6 Equipment outside Toll Road limits

The Concessionaire must maintain the DTL access gates and auxiliary components (controllers, communication devices, etc.) located at PR-1, and PR-21 that fall outside of the limits of the Toll Roads and needed for the Dynamic Toll Lane operation. These assets are at the PR-1 and PR-21 DTL entrance/exit ramps.

The Concessionaire must maintain the reversible lane barrier transfer machine and modules located at PR-18 that fall outside of the limits of the Toll Roads and needed for the DTL operation. The operation of the reversible lane barrier transfer machine is needed to perform the opening of the DTL towards the southbound direction during the PM hours. The reversible lane barrier transfer machine operation must be performed in PR-18 from km 0.1 up to the Dynamic Toll Lane fixed median barriers located near Américo Miranda Avenue.

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## **K.1 Definitions**

Clear Zone: The unobstructed, relatively flat, total roadside border area beyond the edge of the traveled way available for a driver to stop safely or regain control of a vehicle that leaves the traveled way.

### Damaged Sign:

- a. A sign that is not flat (planar) and properly oriented to the traveling public or other intended audience.
- b. A sign that has either 4 square inches or 1% (whichever is greater) of the sign panel face area containing deficiencies.  
A sign that, in the opinion of PRHTA or the Commonwealth, is damaged or contains a message to the traveling public or other audience that is unclear, improper or confusing.

Dynamic Message Signs (DMS): Overhead sign structure capable of displaying a visual message by means of light bulbs, plastic tabs, liquid crystal displays etc. (Referred to as Variable Message Signs – VMS or Changeable Message Signs – CMS in some publications)

Emergency Maintenance: Time-critical repair work performed on an unplanned basis and intended to restore operations and mitigate damage done to the Sign System by Collision, Vandalism, Earthquake or an atmospheric event. Emergency maintenance and repairs may be a temporary measure, using the staff and materials available immediately following the incident.

Flashing Light (or Flashing Lamp): A device on a sign or Signage System that consists of a lamp or series of lamps which are turned on and off repetitively.

Guide Sign: A sign that does not contain regulatory information, traffic laws, or warnings. Examples include signs that show route designations, destinations, distance to exits, services, or other geographical, recreational, or cultural information.

Portable Changeable Message Signs (PCMS): A portable, dynamic message sign usually mounted on a trailer or truck bed that can be deployed quickly for meeting temporary requirements found in work zones or accident areas.

Overhead Sign Structure: An overhead sign support structure, with the horizontal member either supported at both ends or cantilevered over the Traveled Lanes.

Regulatory Sign: A sign that gives notice to road users of traffic laws or regulations. Examples include STOP, SPEED LIMIT 45 MPH and LOAD LIMIT signs.

Retro-reflectivity: A property of a sign panel surface which causes a specified portion of the light coming from a point source to be returned directly back to the origin.

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Right-Of-Way Assignment: The process which uses a sign to give preference to vehicles to proceed in a lawful manner before other vehicles. An example is a YIELD sign.

Sign: A lettered board, message or other display which includes all regulatory, warning, guide or informational, advisory, construction and maintenance, route markers and all special or other messages/displays.

Sign Lighting: An engineered lighting system that makes a sign uniformly visible to road users, whether by day or night. Signs along the Toll Roads have external illumination, in which a light pattern is cast upon the sign panel by lamps.

Sign Panel: The layer of the sign panel which contains the message, and which is applied to the aluminum, wood or steel sign.

Sign System: All Signs and Signage Systems components including regulatory, warning, guide or informational, advisory, construction and maintenance, overhead and bridge mounted signs.

Structure Mounted Sign: All Signs that are attached directly to bridge structure by frame work without foundation.

Warning Sign: A sign that gives notice to road users of a potentially hazardous situation that might not be readily apparent. Examples include STOP AHEAD and LOW CLEARANCE signs.

Work Zone Sign: A sign that gives notice to road users of construction and maintenance activities. Work zone signs are required in advance of the site and must be erected through the work zone. Examples include CONSTRUCTION SPEED LIMIT 30 MPH and FLAGGER signs.

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## **K.2 References**

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA
- "Guidelines for the Selection and Installation of Orientation Signs", PRHTA
- Highway Design Manual, PRHTA
- Signage Guide, PRHTA
- Standard Drawings, PRHTA
- Standard Specifications for Road and Bridge Construction, PRHTA
- Traffic Sign Manual, PRHTA
- "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals", AASHTO.
- "Manual for Condition Evaluation of Bridges", AASHTO.
- "A Policy on Geometric Design of Highways and Streets", AASHTO.
- "Bridge Inspector's Training Manual", FHWA.
- "Manual on Uniform Traffic Control Devices (MUTCD)", FHWA.
- "Inspection for Fracture Critical Bridge Members, Report No. FHWA-IP-86-26", FHWA.
- National Bridge Inspection Standards (NBIS), FHWA.
- "Portable Changeable Message Sign Handbook (PCMS)", FHWA.
- "Method for Maintaining Traffic Sign Retro reflectivity", Report No. FHWA-HRT-08-026, FHWA.

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### **K.3 Policy for Performing Systems Maintenance**

#### **K.3.1 Objective**

The objective of Sign and Signage System Maintenance is to ensure that all regulatory, warning, guide, informational, advisory and work zone (construction and maintenance) signage and their components are properly maintained so as to regulate and facilitate the safe and orderly movement of traffic.

Signs and Signage Systems require: repairs due to wind damage, loss of retro-reflectivity, vehicular impact, etc.; maintenance; relocation; and replacement in part and in whole.

Highway signs are grouped into four general classifications: Regulatory, Warning, Guide, and Work Zone (Maintenance and Construction). Designated shapes and colors are used to differentiate between the different sign classifications. All signs must be reflectorized and/or illuminated to show the same shape and color by day and night.

Effective Signs and Signage Systems require:

- Selection of the correct Signage System for a particular situation.
- Correct location of the Signage System.
- Ongoing maintenance to ensure that the sign and its supports are in good condition.

#### **K.3.2 Responsibilities of Concessionaire**

In order to meet the requirements of this Chapter, the Concessionaire must engage in practices and inspection survey intervals to ensure that all Signs and Signage Systems are clearly displaying the necessary messages to ensure the safe and orderly movement of traffic, and meet other safety, aesthetic and economic benefits. This requires that the Concessionaire carry out its obligations in a manner that maintains and/or improves the condition and purpose of Signs and Signage Systems.

All materials and construction requirements for Sign and Signage System work performed by the Concessionaire must conform to the appropriate and applicable requirements of the Reference Documents listed in Section K.2 of this Chapter.

Each sign face must be kept visible and legible under both day and nighttime conditions. It should be noted that all signs will gradually deteriorate to a point where the signs must be refurbished or replaced. The retro-reflective sheeting of signs deteriorates from the effects of sunlight, weather, airborne particles, and air pollution. Dirt from road spray and air pollution may collect on the sign sheeting, and, if unchecked, will severely affect the nighttime visibility of the sign.

The Concessionaire must make routine sign inspections part of its daily activities, and all Concessionaire staff who travel the Toll Roads for any reason must be instructed to report any damaged or obscured signs to the Concessionaire.

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Work on Signage Systems along the Toll Roads that must be performed by the Concessionaire includes the following:

- Repairing Signs and Signage Systems and their components.
- Maintaining a stock of sign panels, supports and other sign system components for use when damage occurs.
- Clearing obstructed signs.
- Cleaning Sign Systems and their components.
- Inspecting the Sign Systems.
- Resetting/repairing Signs and Signage Systems that are accidentally knocked or blown down.
- Relocating Signs and Signage Systems that need to be removed and/or reinstalled due to changing needs or conditions.
- Replacing or installing new Signs and Signage Systems and their components.
- Replacing or relocating Signs and Signage Systems as required by Local, Commonwealth or Federal regulations.
- Retrofit signs that have a retro reflectivity level below the minimum standards established by the MUTCD
- Ensuring that all Signs and Signage Systems are legible, adequately reflectorized, erect, and correctly located in accordance with the Reference Documents listed in Section K.2 of this Chapter.
- Obtaining approval from the Commonwealth for all re-ordering and design of guide and information signs.
- Removing all illegal or unauthorized signs within the Toll Roads, as discovered by the Concessionaire, PRHTA or the Commonwealth.


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### K.3.3 Performance Time Frames

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire), within which the Concessionaire must complete the required cleaning, resetting, replacement of missing, repair, or relocation work to the Signs and Signage System and its components:

Table L.3.3.1

<b>Sign &amp; Signage System Classification/Type</b>	<b>Maximum Time Duration</b>
Regulatory	2 Days
Warning	2 Days
Guide	3 Days
<u>Work Zone:</u>	
Construction	4 Hours
Maintenance	2 Hours
Dynamic Message Signs (DMS) or Portable Changeable Message Signs (PCMS)	4 Hours
All Other Signs	3 Days

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The frequency of Sign Structure inspections shall conform to:

Table L.3.3.2


<b>Sign Structure Type</b>	<b>Inspection Type</b>	
	<b>Routine</b>	<b>In-Depth</b>
Aluminum Overheads	---	2 Years
Galvanized Steel Overheads	2 Years	2 Years
Condition < 6	2 Years	2 Years
Mounted on Bridges	2 Years	2 Years
Galvanized Steel Cantilevers		
Ground Mounted	3 Years	6 Years
Mounted on Bridges	---	2 Years
Structure Mounted	2 Years	2 Years

The Concessionaire must, from the time a deficiency is detected by discovery or report:

- Make temporary repairs to all regulatory or warning signs determined to be a "damaged sign" (see Definitions), or to replace missing signs; and to immediately initiate installation of temporary signage.
- Touch-up or re-paint all painted Sign System components when the surface is discolored or damaged within seven (7) days; and re-paint all components once every five (5) years.
- Relocate Signs and Signage Systems required to be removed and reinstalled due to changing needs or conditions within seven (7) days.
- Make all replacements and/or repairs to Signs and Signage System lighting, including burnt-out bulbs, within twelve (12) hours.

The Concessionaire must also:


- Commence the replacement or installation of new regulatory or warning signs within forty-eight (48) hours from receiving direction from the PRHTA.
- Perform detailed inspections on all overhead, cantilever and bridge mounted sign structures, in accordance to the requirements of PRHTA, at an interval no greater than the frequencies stated and submit a written report to PRHTA and the Commonwealth. The inspection procedures shall be in conformance with the requirements of the National Bridge Inspection Standards (NBIS).
- Upon receipt of notification or when local, state, or federal regulations mandate; the Concessionaire must order, replace or install new Sign Systems as follows:
  1. Order within 48 hours.
  2. Install within 24 hours of delivery.

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#### K.3.4 Acceptance Criteria

Signs and Signage Systems will be considered acceptable when the following criteria are met or exceeded:

- Supports are plumb and level.
- Design, type classification and installation are in accordance with the requirements of the applicable Reference Documents listed in Section K.2 of this Chapter.
- Concrete bases and foundations are the proper and correct distance out of the ground.
- Signs maintain a retro-reflectivity level above or equal to the minimum levels established by the MUTCD.
- Steel supports are properly coated and protected by the galvanizing process, when required, as described in the PRHTA and the AASHTO Specifications, whichever is more stringent.
- The site and area adjacent to the Signs and Sign System is left clean and tidy after all work is completed.
- Sign Panels contain the correct color, spelling or symbols required for its classification and application.
- Supports have a complete coverage of paint that is free of cracking, peeling and flaking, when the support requires paint to be present.
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- **Sheeting Material:**
  - Lettering and symbols are of the correct size, clear and legible, and of the required retro-reflectivity in accordance with Municipal, Commonwealth and Federal guidelines.
  - Sheeting has been applied free of blistering, delamination, peeling or chipping, with no discoloration or fading.
- **Sign Panel Backing:**
  - Wood Panels are straight and smooth with no warping, bending, twisting, or splitting, and are properly sealed to prevent swelling.
  - Aluminum Panels are straight with no warping, bending, or twisting, and are not torn or deformed at connections.

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## **K.4 Additional Requirements**

### **K.4.1 Inventory and History Record**

The Concessionaire must develop, maintain, and keep current an inventory and history record of all Signs and Sign Systems within the Toll Roads. The inventory and history record must consist of the type, size, location, and age of each Sign and Signage System. Information that must be contained in the inventory and history record includes:

- Sign location: including highway, kilometer post, and the traffic direction it faces.
- Measured distance from edge of traveled way to nearest point of sign.
- Separation of signpost(s) from traveled way by: guiderail, barrier wall, or none.
- Sign type or name (e.g. STOP, NO PASSING, etc.).
- Sign panel color, size and/or shape (e.g. 18" x 18", 30" x 30").
- Sign and Signage System support material and type characteristics.
- Chronological history of all repairs/replacements including a brief note of what the change was (i.e. raised it 2 feet, pipe post to 4" x 4" wood post, etc.).

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### **K.4.2 Sign Materials**

The Concessionaire must ensure the following:

- All Signs and Signage System materials must conform to the current requirements of the Reference Documents listed in Section K.2 of this Chapter.
- Sign panel base material must be a flat sheet aluminum to which a chemical conversion has been applied.
- Sign panels have a minimum thickness of 0.125 inch.
- Sign panels must be a flat continuous section of the length, width and shape as specified in the Standard Sign Design Criteria of the MUTCD with specific mounting holes and corner radii.
- Sign panels must conform to dimensions and colors specified in the MUTCD.
- Before reflective sheeting or paint is applied to the sign panel, the application surface must be cleaned and prepared according to the sheeting or paint manufacturer's recommendations. The sheeting must form a durable bond to resist corrosion, provide a weather-resistant surface, and adhere securely at temperatures ranging from -34°C to 71°C (-93°F to 160°F).
- Signs and Signage System posts must be straight and have a uniform finish.

- All holes must be free from burrs and ends must be cut square. Steel posts must be hot-dipped galvanized according to AASHTO requirements. If a weld process is performed after galvanizing, the weld must be zinc-coated after the scarifying operation.

#### K.4.3 Storage and Handling of Signage System Components

Improper storage or handling can damage Signage System materials. It is important that signs and sign supports be protected in storage and transporting, as well as during installation.

Certain types of signs support, panels and components may require special storage techniques. An example of this is panel signs, which have small weep holes in the channel at the bottom edge. These holes allow moisture that enters the panel to drain. Therefore, these types of panels must be stored upright to help drain accumulated moisture.

The Concessionaire must ensure that wood sign supports are properly stored in maintenance yards. Wooden signposts must not be stored on the ground, as they can become warped.

The Concessionaire must ensure that signs are stored properly in the vehicles during transportation. Any sign panels that have sustained damage to their surface or reflectivity during transportation must be replaced with new panels free of damage.

#### K.4.4 Installation Requirements

Prior to digging, the Concessionaire must notify the Puerto Rico Center for Excavation about the intended work through the Toll Roads and must furnish sufficient time for the Puerto Rico Center for Excavations to locate all existing lines.

The Concessionaire must install all Signs and Signage Systems and their components in accordance with the applicable Reference Documents listed in Section K.2 in this Chapter, as well as the manufacturer's recommendations.

Sign panels must be thoroughly inspected both before application to sign supports as well as after installation is complete. The Concessionaire must clean all installed sign panels prior to the final field inspection.

#### K.4.5 Inspection Requirements

The Concessionaire must incorporate the requirements outlined below into its sign inspection procedures, to ensure that a consistent method of inspecting the daytime and nighttime performance of Sign and Sign Systems is upheld. The daytime inspection must evaluate the condition, state of repair, security of sign attachment hardware, repair needs of support systems and local earth grading, etc. for all signs. The effects of age, weathering, vandalism, and visibility must be assessed during the night inspection. In addition, a nighttime inspection must be made immediately following a nearby fire, as heat can cause loss of reflectivity.

The Concessionaire must remember that the signs are to be clearly legible to the traveling public and present a neat and balanced appearance free from defects. Signs not adequately visible because they are dirty, hidden by vegetation, or otherwise obscured must be noted as deficient.

#### K.4.5.1 Daylight Visual Inspection


Under daylight conditions the Concessionaire must inspect the sign panels to detect non-uniform color, streaks, spots, abrasions, or other defects in the panel surface. The inspection must include reviewing slight imperfections that may be visible only during daylight and would not be visible during the nighttime inspection. The Concessionaire must conduct these inspections as required, but at a frequency no less than four (4) times annually.

#### • K.4.5.2 Nighttime Visual Inspection

The Concessionaire must conduct nighttime inspections as required, but at a frequency no less than four (4) times annually.

The following requirements and guidelines pertain to performing Sign and Signage System inspections at night:

- The inspection must be performed with a vehicle driven in the furthest lane from the median with the headlamps in the dimmed position. The lane location places the inspection team in a position where signs hidden by vegetation will be noted. It is important that the inspection vehicle headlamps be properly adjusted prior to the start of inspection.
- Signs must be observed at the "distance of driver need". This distance is subjective but must include factors such as average speed and roadway alignment. For the average highway, observations should be made 250foot –long to 500 foot-long in advance of the sign.
- The inspection team must include one member who is considered a qualified sign maintenance employee.
- One team member must have good color vision for evaluating sign colors.
- Median mounted signs may be observed from the lane adjacent to the median if it is safe to do so.
- It may be necessary to make individual passes for sections where both median and shoulder mounted signs are to be inspected.
- Spotlights must not be used to evaluate night sign reflectively since they are several times brighter than vehicle headlamps and can cause false observations of sign brightness.

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- The Concessionaire's nighttime sign inspection team must also inspect all sign panels with an inspection light. The inspection light shall be a 120-watt, 120-volt reflector flood lamp with an average rating of 1600 lumens. The inspection shall be performed while holding the light at eye level and looking directly over the top of the light.
- A sign face is considered to have lost its retro-reflectivity for nighttime display when the area of limited retro-reflectivity or blotchy reflectiveness exceeds 25% of the sign face area. A sign face is also considered to have lost its retro-reflectivity when the reduced retro-reflectivity overrides the ability of the sign text, color, or legend to be effectively presented to the traveling public or other intended audience.

#### K.4.6 Obstructed Signs

Because landscape plantings grow along the Toll Roads continually, untrimmed plants, trees and vegetation may obscure signs. Signs and Signage Systems that are hidden by planted or natural vegetation must be cleared so that the sign is visible.

#### K.4.7 Obsolete Signs

Whenever the design requirements for new signs are changed by the Commonwealth, or when PRHTA adopts changes instituted by the FHWA, new requirements must be considered to immediately affect the Concessionaire's operations, and any obsolete signs in inventory that have not yet been installed must not be installed within the Toll Roads.

Existing signs that have been rendered obsolete must be replaced in a timely manner acceptable to the PRHTA, regardless of actual condition or estimated remaining service life.

#### K.4.8 Temporary Signs

Temporary signs must be continually maintained for as long as they are required and must be replaced with permanent signs as soon as possible.

Temporary signs for nighttime use must have a reflectorized background and/or legend and border depending on the standards for that sign type. Temporary signs must conform to the color, size, material, and other requirements which apply to permanent signs of that type.

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#### K.4.9 Portable Changeable Message Signs (PCMS)

Portable Changeable Message Signs (PCMS) must be mounted on a trailer designed to adequately support the message board in a level position. The PCMS must be aligned and positioned to provide optimal driver visibility. The Concessionaire must program and adjust the message display cycle so that a minimum of two complete message cycles can be legibly displayed to a driver while approaching the sign at the posted speed.

Repairs due to failure, malfunction, or damage to a PCMS shall be completed within the requirements stated in Section K.3.3 of this Chapter. During the process of repair, the Concessionaire must furnish another PCMS.

The Concessionaire must relocate the PCMS for the various stages of maintenance and construction work as needed to adequately inform the motorists. The Concessionaire must provide an experienced operator for the PCMS during periods of operation to ensure that the messages displayed are correct and legible. In addition, the Concessionaire must ensure that the message sign is illuminated properly to meet the current light conditions, and that all adjustments for operation of the sign are made as needed to properly guide motorists.

The Concessionaire must perform all maintenance operations recommended by the manufacturer of the sign, including periodic cleaning of the sign face, and if present, the associated solar panels.

#### K.4.10 Sign Lights and Lighting

The Concessionaire must inspect all Signs and Signage Systems lights, lighting units, fixtures and services, as required by the requirements of the Operating Standards, and must pay particular attention to the following deficiencies:

- Burned out, broken, missing or damaged light fixtures or any elements thereof.
- Broken or missing cover plates on hand-holes or other access points.
- Broken latches on access hatches, hinged lens, etc.
- Defects in the electrical service, such as exposed wiring, open splice or junction boxes, loose or detached boxes, and loose, broken or missing sections of conduit or conduit hangars.

All electrical work must be performed by a duly certified and licensed Electrician who possesses adequate previous experience.

#### K.4.11 Work Zone Signage

##### K.4.11.1 General Requirements

The requirements for the Concessionaire to provide movement of traffic through work zones for maintenance, construction, inspections, emergency.



repairs, etc. is to be addressed in Volume II, Chapter H, "Traffic & Travel Management Plan". As it pertains to work zone signage, the responsibility of the Concessionaire is to erect, maintain, adjust, modify, repair and remove as required, all temporary traffic control signage in compliance with all relevant PRHTA Criteria, and/or the detailed traffic control drawings for a particular project.

During the construction and maintenance work zone traffic restrictions, the Concessionaire must continuously review and maintain all work zone signage to ensure the safety of Toll Road users, the workers, and the general public. The Concessionaire must repair or replace all work zone signage in accordance with the requirements stated in Section K.3.3 of this Chapter.

Specific work zone signage maintenance responsibilities of the Concessionaire include, but are not limited to the following:

- Sign replacement due to loss of retro-reflectivity.
- Repair of defaced sign sheeting and legends.
- Replacement of broken supports.
- Repositioning of leaning signs.
- Cleaning of dirty devices.
- Replacement of stolen or vandalized devices or signs.

#### K.4.11.2 Stationary Signs

Work zone stationary signs must stand plumb in all directions, under all conditions. The signs must be securely anchored in a manner such that they resist all loadings like the requirements associated with permanent signs.

When required, the Concessionaire must cover work zone signs with an opaque material that does not damage the sign panels, and that can prevent reading of the sign at night by a driver using high beam headlights.

#### K.4.11.3 Portable Signs

Portable work zone signs must stand plumb in all directions, under all conditions. The signs must be securely anchored in a manner such that they resist all loadings like the requirements associated with permanent signs.

When not in use for periods longer than 30 minutes, the Concessionaire must lay the portable work zone sign flat on the ground and collapse the sign stand so it also lays flat on the ground. Prior to erecting the sign again, the Concessionaire must thoroughly clean the sign face.

If the distance from the ground to the lowest point creates a sight problem to Toll Road users, the Concessionaire must install adjustable sign stands so as to provide the best possible view of the portable signs.

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#### K.4.11.4 Arrow Panels

The Concessionaire must furnish, install, place, operate, maintain, relocate, and remove flashing arrow panels as needed based on maintenance or construction work. Only Arrow Panels that meet or exceed the requirements of the MUTCD, and that are also the PRHTA Approved Construction Materials listing shall be used.

The Concessionaire must use arrow panels that have the capability to display mode selections, but do not use the straight-line caution display. Flashing arrow panels must be securely mounted on trucks, trailers, or other mobile units.

#### K.4.12 Overhead and Bridge Mounted Signs

##### K.4.12.1 General

New types of overhead sign structures introduced by the Concessionaire along the Toll Roads must be approved by the PRHTA and must be warranted. In addition, calculations and drawings prepared by and sealed by a Professional Engineer Licensed in the Commonwealth of Puerto Rico must accompany all requests for Approval.

##### K.4.12.2 Inspector Requirements

It is the responsibility of the Concessionaire to employ a qualified sign structure inspector to perform the inspection described above, and to prepare the report. The sign inspector must meet the following minimum requirements:

- The inspector must be a Certified Inspector who has successfully completed a comprehensive training course based on the FHWA "Bridge Inspector's Training Manual", and who has 5 years of bridge and/or sign structure inspection experience.
- The inspector must be a Puerto Rico Licensed Professional Engineer.
- All inspectors must be properly trained in the use of all required inspection equipment.

##### K.4.12.3 Inspection Requirements

The Concessionaire must conduct a detailed inspection and provide a written report to PRHTA for all cantilever, overhead, and bridge mounted sign structures as described in Table K.3.3.2 of this Chapter.

The inspection and report must include all components and elements of the sign structures, including mechanical and electrical equipment.

The Concessionaire's inspection of all overhead and bridge mounted sign structures shall pay special attention to the following:



- Condition and attachment of sign panels and assemblies.
- Bolted connections to ensure all bolts are tight, free from cracks or deformity, and performing as designed.
- Fracture critical details where the welds and weld material have a greater potential to fail.


#### K.4.13 Sign System Supports

##### K.4.13.1 General

When conditions dictate the replacement or repair of Signs and Signage System supports, the types and sizes of the supports must be evaluated and selected based on the Reference Documents listed in Section K.2 of this Chapter, and in consideration of the following:

- Breakaway properties increase safety in the event of a vehicle collision.
- The ability of the support to withstand wind and other loads.
- Conformance to the existing Toll Road Signage System's aesthetics and other such features.

New types of signs support introduced by the Concessionaire along the Toll Roads must gain the Approval of PRHTA and must be warranted. In addition, calculations and drawings prepared by and sealed by a Professional Engineer Licensed in the Commonwealth of Puerto Rico must accompany all requests for Approval.

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##### K.4.12.2 Inspection Requirements for Sign Supports

Inspection of Signs and Signage System supports must include inspection for cracks, rust or corrosion, and any distress in the members. Welds at the member joints must be carefully examined for any signs of cracking or separation of the weld from the adjoining members. All nuts, bolts and washers on the structures must be checked for tightness. Of particular importance, the anchor bolts must be inspected to determine if any of the bolts have corroded, suffered section loss or are loose.

The Concessionaire must inspect the paint system on all the sign supports and identify locations where the paint is peeling, cracking or curling.

The Concessionaire must inspect the galvanization system on all the sign supports and identify locations where the galvanization has wear, chipping, or damage.

Inspection of the sign support foundations must note the presence of any surface cracks, missing grout, exposed reinforcing steel, spalls, etc. If safety of the foundation is found to be compromised, the sign structure foundation must be replaced immediately.

Due to their exposure to repetitive wind loads, metal sign supports are

susceptible to fatigue, and inspections must include this factor. Fatigue distress, if found or suspected, must be tested to quantify deflection, crack propagation, etc., and the appropriate and expeditious repairs must be immediately scheduled to restore the Signage System to full serviceability. The Concessionaire must perform non-destructive testing as required.

#### K.4.13.3 Bent and Damaged Sign Supports

Whenever sign panels have been damaged or bent, the Concessionaire must determine if the signs and supports are to be repaired or replaced. In deciding, the Concessionaire must consider the physical condition of the panels and supporting members. All repairs or replacements must conform to the requirements of the Reference Documents listed in Section K.2 of this Chapter.

#### K.4.13.4 Break-Away Wide Flange and Tubular Metal Sign Supports

Existing and new break-away metal sign supports must meet all current FHWA and PRHTA requirements for supports that break-away. Break-away sign supports must reduce the change in momentum that occurs during vehicular impact to tolerable levels as defined by the FHWA and PRHTA, and must also conform to the applicable sections of the Reference Documents listed in Section K.2 of this Chapter. Correct alignment of post sections and placement of bolts in the slip base is critical to the proper functioning of the break-away feature.

When conditions necessitate the replacement of an existing support, the Concessionaire must investigate the merits of installing break-away type metal sign supports within the Clear Zone as a replacement, subject to the following:

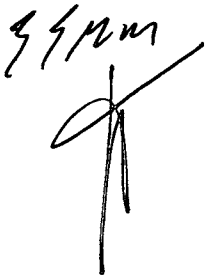
- The new sign support type meets all of the requirements of the Reference Documents.
- The history of vehicle impacts at the sign location.

#### K.4.13.5 Wood Posts

Wood posts may be utilized by the Concessionaire if they conform to the requirements stated in the Reference Documents listed in Section K.2 of this Chapter. Typically, most applications of installing wood posts are limited to locations where they are protected from traffic (e.g., behind guide rail).

The Concessionaire must never replace current sign supports that have break-away characteristics, with wood posts, timbers or other lumber.

Where directed by the requirements of the stated Reference Documents, holes must be drilled in larger-diameter wood posts to provide a weakened plane for breakage if the post should be impacted by a vehicle. It is important in this case to make sure the holes are drilled at the specified height above the ground. The holes are designed for the specified height to



ensure that the broken end protruding above the ground will not snag the bottom of a car.

Combinations of timber poles with alternate sign support types will not be permitted in the same multi-post installation.

Wood signposts must not be painted.

#### K.4.13.6 Laminated Wood Posts

Whenever conditions and requirements permit, existing signposts can be replaced using laminated wood posts. The Concessionaire must design the laminated posts to meet or exceed all applicable PRHTA requirements for such break-away devices as noted in the Reference Documents listed in Section K.2 of this Chapter.

To ensure that laminated wood signposts will break-away properly when hit and still not be damaged by high winds, posts must be designed and installed in conformance with the requirements of the stated Reference Documents.

Laminated posts must be stored and handled carefully.

#### K.4.14 Sign System Foundations

Sign System concrete foundations must be designed to conform to the requirements of the Reference Documents listed in Section K.2 of this Chapter, and must be inspected for the following types of deterioration:

- Cracking, Scaling, and spalling of the concrete.
- Delamination, or hollow sounds when the surface of the concrete is impacted with a hammer.
- Exposed and/or corroded reinforcing steel.
- Collision impact damage.
- Foundation movement; including sliding with a shifting or eroding slope, rotation out of plumb due to soil movement or collision.
- Missing or severely cracked grout under base plates.
- Anchor bolts that are missing, loose or bent.

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## **L.1. Definitions**

Conduit or Duct: An enclosed tubular way for protecting wires and cables.

Electrical Systems: Systems, elements and components that are contained in facilities, and which supply, distribute and function using electricity. These systems include, but are not limited to substations, meters, wiring, service panels, individual circuits, generators, transformers, lighting, motor control units, back-up generators and systems, and emergency lighting.

Luminaire: A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

Permanent Repair Time: Amount of time from initial discovery or report to the Concessionaire until the time permanent repairs are made.

Service Response Time: Amount of time from initial discovery or report to the Concessionaire until personnel are present at the required location.

Service Restoration Time: Amount of time from initial discovery or report to the Concessionaire until the time the system is fully operational again.

Uninterruptible Power Supplies (UPS): Power supplies that operate in parallel with the electric utility sources and supply their load without interruption when and if the utility source fails. Used to meet the operating needs of the computers and critical elements of the Toll Collection System (TCS).

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## **L.2. References**

All stated references must be the most current version, or the document known to have succeeded or replaced the original stated herein:

- Design Directives, PRHTA
- Highway Design Manual, PRHTA
- Standard Drawings, PRHTA
- Standard Specifications for Road and Bridge Construction, PRHTA
- "An Informational Guide to Roadway Lighting", AASHTO.
- "Roadside Design Guide", AASHTO.
- "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals", AASHTO.
- "Roadway Lighting Handbook – Implementation Package 78-15", FHWA.
- "ANSI Catalog of American National Standards", ANSI.
- DG – 4 – 03 "Design Guide for Roadway Lighting Maintenance", Illuminating Engineering Society of North America (IESNA).
- "Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems", IEEE.
- "National Electrical Code", NFPA.
- "Title 33 Code of Federal Regulations – Part 118", U.S. Government Printing Office.

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### **L.3. Policy for Maintenance of Lighting and Electrical Systems**

#### L.3.1. Objective

The objective of Lighting and Electrical Systems maintenance is to ensure that all elements and components of Lighting and Electrical Systems including, but not limited to, roadway luminaries, underpass lighting, sign lighting, navigation and aircraft warning beacons, toll plaza lighting, Toll Zones lighting, site, grounds, illumination, etc.; as well as all highway electrical systems including power, communication, signaling wiring, surveillance cameras and wiring, and ITS and wiring, etc., are properly maintained and serviced so as to continuously function at superior reliability, and to reduce potential hazards to the safe and orderly movement of traffic. For purposes of clarification, underpass lighting attached to and underneath any structural elements pertaining to any overhead bridge structure carrying the Toll Roads, are included in this requirement.

Lighting and Electrical Systems require maintenance, repairs due to age, lamp burnout, weather effects, corrosion, traffic impact, failure of soil support, etc.; cleaning of lenses and other elements; and replacement.

Effective and reliable lighting and electrical systems require:

- Frequent maintenance patrols to identify outages and damage.
- Timely repairs to ensure uniform and acceptable illumination in nighttime and low light level conditions.
- Seasonal maintenance and cleaning of lenses and fixtures

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#### L.3.2. Responsibility of Concessionaire

In order to meet the requirements of this Chapter, the Concessionaire must engage in practices that ensure that all roadway, bridge and underpass lighting, warning lights, toll plaza lighting, Toll Zones lighting, and other critical illumination systems remain fully operational during low ambient light conditions, and all cameras, communications, power cabling, related electrical panels and wiring, and other critical highway electrical devices remain functional at all times in order to ensure the safe and orderly movement of traffic, and meet other safety, aesthetic and economic benefits.

The Concessionaire is responsible for conducting nighttime patrols of all Lighting and Electrical Systems within the Toll Roads and must repair all defects or deficiencies. The patrols must evaluate all locations in the lighting system, including underpass fixtures that are the Concessionaire's maintenance responsibility, temporary lighting installations, etc. The patrols must be arranged so that all locations are inspected in compliance with the required Performance Time Frames.

The Concessionaire is responsible for maintaining a stock of replacement lamps, lenses, fixture heads, light standards, cameras, electrical conduit and cabling, and other lighting and electrical systems parts for ready use in case of damage.

The Concessionaire must implement a cleaning and maintenance schedule for the luminaries and fixtures. In this schedule the luminaire lenses and housings shall be cleaned of dust and grime build-up as recommended by the IESNA, manufacturer's specifications, and as required by the conditions.

Temporary or permanent repairs performed on high voltage or high current systems, highly sensitive equipment, cameras, monitors, and other similar devices must only be done by trained, certified technicians and Licensed Electricians as appropriate. The Concessionaire is responsible for determining staffing needs to service broken or defective components within the time frames specified below.

General work on Lighting and Electrical Systems within the Toll Roads that must be performed by the Concessionaire includes the following:

- Coordinating with all electrical utilities and equipment vendors to ensure prompt response and repair of electrical service, connections, outages, or other difficulties with lighting and electrical systems.
- Create and maintain an inventory and history record of all Lighting and Electrical Systems.

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- Roadway Lighting and Sign Illumination:
  - Perform nighttime patrols and inspections for each lighting system to detect deficiencies or defects.
  - Inspect, maintain, and repair or replace defective, malfunctioning, or deficient lighting controllers.
  - Ensure that all light pole units, mast arms and foundations are inspected and all damage or deficiencies repaired or replaced.
  - Ensure that all luminaries are inspected, and all damage or deficiencies are repaired or replaced.
  - Establish and conduct a re-lamping and cleaning program to maintain the efficiency and continual operation of the lighting systems.
  - Replace and/or repair all lighting systems components that are excessively corroded, repairing foundation cracks or spalls, replacing missing hardware and hand-hole covers, etc.
  - Rewire or relocate Lighting and Electrical Systems and components as required by changing needs, altered conditions, or as required by PRHTA or Federal regulations.

- Aircraft Obstruction Lights / Warning Beacons:
  - Ensure that the Obstruction Lights and Aircraft Warning Beacons are inspected, and all damage or deficiencies repaired or replaced.
  - Ensure that all outages and repair work are coordinated with the Federal Aviation Administration (FAA).
  - Ensure that all outages of the Aircraft Warning Beacons System are completely restored within the Performance Time Frames stated in Table L3.3.1 of this Chapter.
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- Navigational Warning Lights:
  - Ensure that the Navigational Warning Lights are inspected, and all damage or deficiencies repaired or replaced.
  - Ensure that all outages and repair work are coordinated with the Army Corp of Engineers and the United States Coast Guard.
  - Ensure that all outages of the Navigational Warning Light System are completely restored within the Performance Time Frames stated in Table L3.3.1 of this Chapter.
  -
- Cables, Conduits, and Unit Ducts:
  - Ensure that all cables, conduits and unit ducts remain free of all defects and damage; that all breaks of these lines are repaired or replaced within the stated Performance Time Frames stated in Table L3.3.1 of this Chapter; and that the lines remain operational and functional at all times.
  - Ensure all temporary cabling only be used to temporarily restore service until a permanent repair to the defects and deficiencies can be completed. Temporary aerial cabling must be installed and maintained at a minimum height of twenty-five (25) feet above ground level.
  - Ensure that all re-cabling and conduit or duct repairs be performed for all permanent repairs of defects or deficiencies. Cables should be replaced with new copper cable meeting all applicable codes and requirements.
  - Ensure that all direct bury cable repairs be performed in accordance with all applicable codes and requirements.


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L.3.3. Performance Time Frames

The following table establishes the maximum duration (measured from the time a deficiency is or reasonably should be detected by or reported to the Concessionaire) within which the Concessionaire must complete the required maintenance, replacement or repair work to restore the functionality or operation of a deficient Lighting and Electrical Systems or component (unless weather conditions limit material application):

TABLE L.3.3.1

Lighting and Electrical System	Maximum Time Duration
Roadway Lighting & Sign Illumination: <ul style="list-style-type: none"> <li>- Lighting Controller</li> <li>- Light Pole Units, Mast Arms, and Foundations</li> <li>- Luminaires</li> <li>- Sign Illumination</li> </ul>	8 Hours 7 Days 5 Days 24 Hours
Obstruction Lights / Aircraft Warning Beacons: <ul style="list-style-type: none"> <li>- Service Response</li> <li>- Service Restoration</li> <li>- Permanent Repair</li> </ul>	1 Hour 4 Hours 7 Days
Navigational Warning Lights: <ul style="list-style-type: none"> <li>- Service Response</li> <li>- Service Restoration</li> <li>- Permanent Repair</li> </ul>	1 Hour 4 Hours 7 Days
Cables, Conduits and Unit Ducts: <ul style="list-style-type: none"> <li>- Temporary Cabling</li> <li>- Re-cabling and Conduit or Duct Repair</li> <li>- Direct Bury Cable Repair</li> </ul>	8 Hours 15 Days 15 Days

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The following table establishes the minimum frequency that a particular operation is to be performed:

TABLE L.3.3.2

<b>Operation to be Performed</b>	<b>Minimum Frequency of Occurrence</b>
Inventory of Lighting and Electrical Systems	Yearly
Roadway Lighting and Sign Illumination Nighttime Patrol	Monthly
Obstruction Lights / Aircraft Warning Beacon Nighttime Inspection	Monthly
Navigational Warning Lights Nighttime Inspection	Monthly
Re-lamping (Group)	See Section L.4.2.5

The Concessionaire must, from the time a deficiency is detected by discovery or report:

- Immediately initiate temporary repairs to all damaged or deficient lighting and electrical components in order to provide continual service.
- Immediately initiate temporary repairs to all damaged or deficient navigation or aircraft warning beacons to restore service in compliance with applicable regulations of PRHTA, the U.S. Coast Guard, Federal Aviation Administration, and all other governing authorities.
- Complete a permanent repair of deficient lighting, electrical or communication cabling mounted on or within bridge parapets, or beam fascia's within twenty-one (21) days.
- Notify the electrical supply utility company of an outage or low-voltage complaint within thirty (30) minutes of discovery and re-contact the utility company every one (1) hour if service has not been restored.
- Provide and maintain back-up power supply for all essential electrical systems. All essential electrical systems must include, but not be limited, to aircraft warning beacons, navigational warning beacons, toll booth and plaza warning and lighting systems, and computers and critical elements of the Toll Collection System (TCS), Open Road Tolling System, ITS Systems and DTL Systems.

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#### L.3.4. Acceptance Criteria

Lighting and Electrical Systems within the Toll Roads will be considered acceptable when the following criteria are met or exceeded:

- Inventory databases are maintained including performance history records for all Lighting and Electrical Systems.
- The work conforms to all Municipal, Commonwealth and Federal requirements and the work is performed by certified and/or licensed professionals.
- Light standards, camera mounts and other supports are plumb and level.
- Design and installation of replacement components conform to the requirements of the applicable Reference Documents listed in Section L.2 of this Chapter.
- Work sites are left clean and tidy after all repairs are completed.
- Roadway Lighting and Sign Illumination:
  - Nighttime Patrols and inspections for each lighting system and its controllers are completed within the Performance Time Frames stated in Table L3.3.1 of this Chapter.
  - Light pole unit, mast arm, fixture mount and foundation maintenance, repair work and replacement work has been completed within the Performance Time Frames stated in Table L3.3.1 of this Chapter; and the components are free of defects and deficiencies.
  - Replacement lamps are the correct type and wattage for the installation.
  - All luminaries are free of burnt-out bulbs, defects, damage and deficiencies; and all components are operating and functioning as intended.
  - A re-lamping and cleaning program has been established and implemented to maintain the efficiency and continual operation of the lighting systems.
  - Lighting systems and their components are free of foundation problems, missing hand-hole covers and all other deficiencies that are unsafe or have the potential to become unsafe.
  - Sites adjacent to outdoor controllers are maintained free of obstructions.
- Obstruction Lights and Aircraft Warning Beacons:
  - Obstruction Lights and Aircraft Warning Beacons are operational, functioning as intended, and all maintenance, and repairs are completed.

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- Outages and repairs have been coordinated with the Federal Aviation Administration (FAA) as specified.
- Obstruction Lights and Aircraft Warning Beacons service has been restored within the Performance Time Frames stated in Table L3.3.1 of this Chapter.
- Navigational Warning Lights:
  - Navigational Warning Lights are operational, functioning as intended, and all maintenance, and repairs are completed.
  - Outages and repairs have been coordinated with the Army Corps of Engineers and the United States Coast Guard as specified.
  - Navigational Warning Lights service has been restored within the Performance Time Frames stated in Table L3.3.1 of this Chapter.
- Cables, Conduits, and Unit Ducts:
  - Temporary overhead cabling has been installed maintaining a minimum height of twenty-five (25) feet above ground level, and promptly removed as permanent repairs to cabling are complete.
  - All cables, conduits and unit ducts are free from all defects, damage, and breaks; and service has been continually provided.
  - Permanent re-cabling and conduit or duct repairs have been completed and all work meets the requirements stated in the Reference Documents listed in Section L.2 of this Chapter.
  - Direct bury cable repairs have been performed in accordance with all applicable codes and requirements, and the site has been restored and left clean.
  - Electrical conduit, signal cabling, unit duct, and other wiring systems are properly buried, secured to supports and bridge fascia's, etc. as appropriate for the installation.

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## **L.4. Additional Requirements**

### **L.4.1. Inventory and History Record**

The Concessionaire must develop, maintain, and keep current a complete and detailed inventory and history record of all Lighting and Electrical Systems within the Toll Roads. The inventory and history record must include the following at a minimum:

- Type, make, model, age, installation date and location of every Lighting and Electrical System and its components and appurtenance referenced to Kilometer Post.
- Measured distance from edge of traveled way to nearest point of appurtenance.
- Chronological history of all repairs/replacements including a brief note of what the change was (i.e., re-lamped, replaced ballast, painted standard, etc.).

### **L.4.2. Roadway Lighting and Sign Illumination**

The Concessionaire must incorporate the following requirements into its roadway lighting and sign installation work procedures in order to ensure that the highest reliability and most consistent performance are upheld.

The following must be included and performed for work with the roadway lighting sign illumination, or electrical service components:

#### **L.4.2.1 Nighttime Patrol**

The Concessionaire must patrol all roadway lighting, toll plaza lighting, Toll Zone lighting, underpass lighting, and sign illumination system to assure consistently safe, functional, and operational conditions of equipment and materials; and to assure that all installations are performing at the level of service for which they were designed. Each lighting system must be inspected at the frequency stated in Table L.3.3.2.

The nighttime patrol must record and document all lighting systems inspected, and the deficiencies and repair needs.

#### **L.4.2.2 Lighting Controllers**

The Concessionaire must adhere to all procedures and special training in order to understand, operate, and repair the lighting controllers and their components. Repair and service logs must be recorded and maintained for any inspection, service or repair to the controller or components of the controller. If more than one service is required to a component of the controller within a one-month period, that component should be considered defective, and the component replaced.



Additional controller requirements apply as follows:

- Clock – If the controller is equipped with a time clock, and if repeated controller malfunctions are required due to time clock malfunctions, the clock component of the controller must be replaced.
- Photoelectric Controls – If so equipped, photoelectric controls must be checked during routine lighting inspection, serviced periodically, or replaced, as required.
- Attention must be given to coordinating controls to ensure that all highway lighting units turn off or on at approximately the same time within a given segment of the Toll Roads, regardless of the number of circuits in use. Circuits designed for early turn on of illuminated signs should have the early turn on type of photocells. When these photocells fail, it is important that they are replaced with the correct unit.
- Cabinet – The Concessionaire must maintain the controller cabinet including all doors, hinges, hatches, and locks to keep the cabinet functioning as originally intended.
- Warning Sign – The Concessionaire must assure all lighting controller cabinets have a voltage warning label affixed and clearly legible.
- Foundation – The lighting controller foundations must be maintained to minimize any problems with the controller due to poor foundation conditions.
- Service Voltage – If there is a notification of low voltage or utility problems, the Concessionaire must verify this within one (1) hour. If voltage is not restored by sunset, the Concessionaire must provide generator power for the lighting system.
- Vegetation – The Concessionaire must clear all vegetation from within ten (10) feet of the controller.

#### L.4.2.3 Light Pole Units, Mast Arms, and Foundations

The Concessionaire must inspect all light pole units, mast arms, and foundations to ensure safe, operational condition of equipment and materials; to ensure that all installations are performing at the level of service for which they were designed; and to ensure that all unsafe conditions have been addressed.

Standard light poles and mast arms must be replaced with galvanized steel equipment or aluminum equipment meeting the same strength, height, and mast arm length requirements of the existing equipment. All replacement lighting equipment must meet or exceed all loading requirements.

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Additional light pole unit, mast arm, and foundation requirements apply as follows:


- Ground Lugs – If existing ground lugs are damaged or non/functional, the pole must be drilled, and the ground wire lugged onto the pole.
- Foundations – It is the Concessionaire's responsibility to be knowledgeable of safety requirements for light pole foundations. Foundations must be maintained in a safe and functioning manner.
- Identification Labels - All lighting units shall be marked with identification labels. The identification labels must be maintained.
- Hardware – All hardware must be rust free and tightened according to original requirements. Any loose, defective, or missing hardware should be replaced immediately.
- Shrouds or Skirts – Base shrouds or skirts must be in place and rust free. Any missing or defective shrouds must be replaced.
- Hand-Hole Doors – All hand-hole doors or access covers must be in place and securely fastened. Any missing or defective doors or covers must be replaced or repaired immediately.
- Poles or Standards – Poles or Standards must be plumb to within 10-degrees and in good condition free of corrosion. Any misaligned or defective poles or standards must be repaired or replaced.
- Base Coupling – It is the Concessionaire's responsibility to be knowledgeable of safety requirements for light pole mounting and coupling. All reset or new installations must conform to the current requirements for base couplings.
- Slip Bases – Slip bases or slip base inserts must be inspected annually to ensure the slip bases or slip base inserts will function properly under the impact of collision.

#### L.4.2.4 Luminaries

The Concessionaire must inspect all luminaries to ensure proper operational condition of equipment and materials, and to ensure that all installations are performing at the level of service for which they were designed. Inspection and service logs must be recorded and maintained for any inspection, service, repair, or replacement to the luminaries.

Luminaries must be thoroughly inspected at the time of lamp replacement. During inspections the following components must be checked:

- Gaskets – Inspect for loose or missing gaskets. Repair or replace as required.

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- Glassware – Clean and inspect for cracked or broken lenses. Replace if necessary.
- Hardware – Inspect for loose or missing hardware and replace or tighten as required.
- Terminal Block – Inspect for cracked or broken barriers on the block.  
Replace if necessary.
- Mounting – Inspect mounting to determine if luminaries are rigidly held in proper position. Make all adjustments necessary.
- Wiring – Inspect wiring for abrasions and loose connections, and repair as required.
- Reflectors – Clean and inspect for tarnish or oxidization. Replace if necessary.
- Ballasts – Replacement luminaries must be installed with a new lamp and new ballast of the same type and wattage. Where primary lines of multiple ballasts are provided with fused splice connectors, fuse ratings must be maintained at the current values.
- Sign Lighting Fixtures - Sign lighting fixtures may be replaced with metal halide sign lighting fixtures and must meet the current specifications and requirements of PRHTA.

#### L.4.2.5 Re-lamping

In addition to burn-out replacement of lamps discussed above, all roadway, bridge, toll plaza, signage and underpass luminaire lamps must be group replaced on a planned schedule based on the average rated lamp life, which must not exceed the following:

• High Pressure Sodium	Group re-lamp every 4 years
• Low Pressure Sodium	Group re-lamp every 3 years
• Fluorescent	Group re-lamp every 2 years
• LED	Group re-lamp every 4 years
• Other	Per Approval of PRHTA

#### L.4.3. Obstruction Lights/ Aircraft Warning Beacons

The Concessionaire must inspect the obstruction lights and beacons during the night at the frequency stated in Table L.3.3.2, or more often if persistent problems continue with a particular beacon. Upon discovery or notification of a broken, damaged, or malfunctioning item, the Concessionaire shall repair or replace the beacon within the Performance Time Frames stated in Table L.3.3.1 above.