Federal Lands Highway

Road Inventory Program

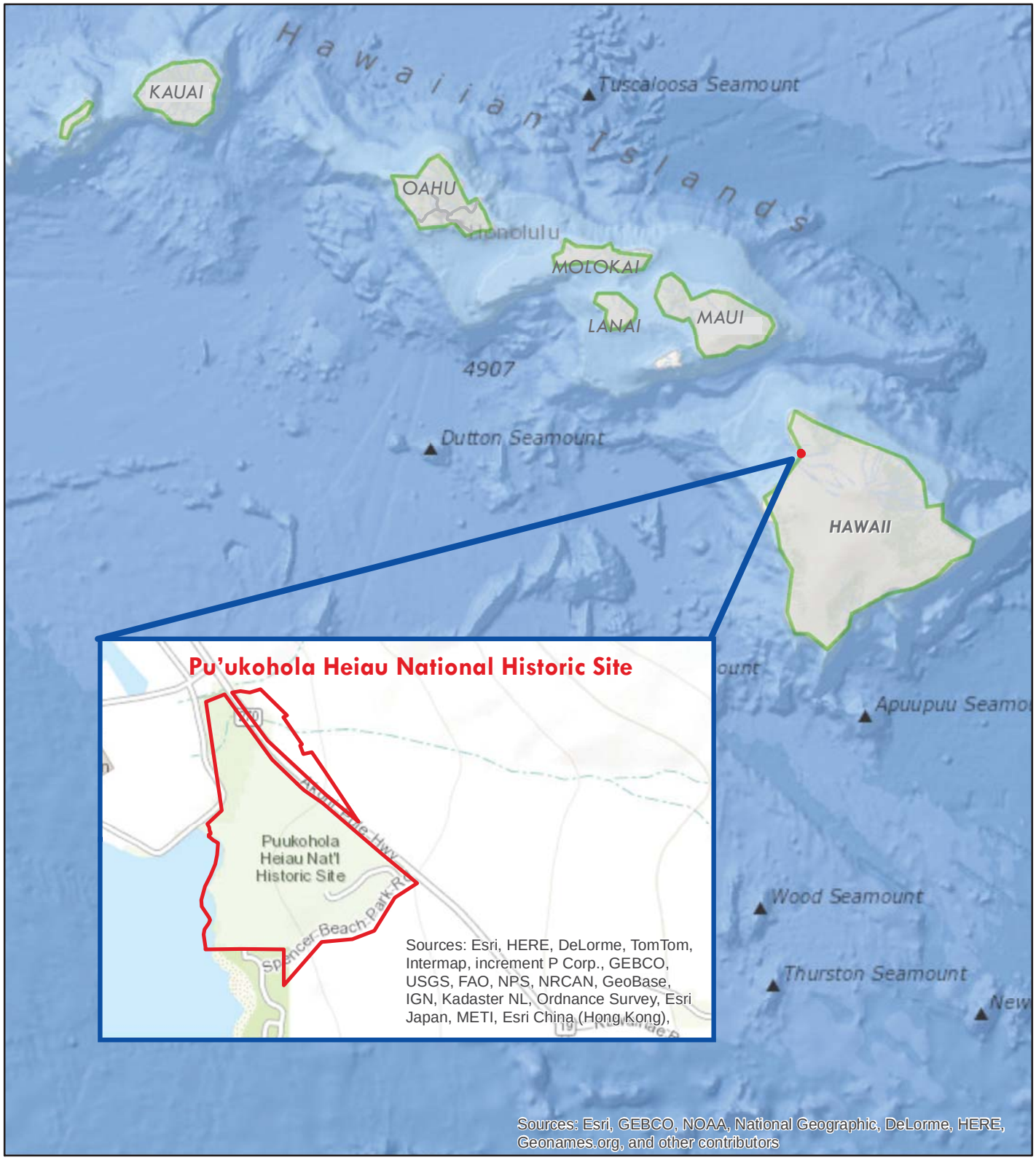
Road Inventory and Condition Assessment

Pu'ukohola Heiau National Historic Site
PUHE

Cycle 5 Report

Prepared By: Federal Highway Administration
Road Inventory Program (RIP)
Data Collected: 04/2014
Report Date: 11/2014

Pu'ukohola Heiau National Historic Site
in
Hawaii



DCV = Data Collection Vehicle

TABLE OF CONTENTS

Section 1
Introduction

Pu’ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

INTRODUCTION

The Federal Highway Administration, (FHWA), in the mid 1970s, was charged with the task of identifying surface condition deficiencies and corrective priorities on National Park Service (NPS) roads and parkways. Additionally, FHWA was tasked with establishing an integrated maintenance features inventory, locating features such as culverts, guardrails, and signs, among others, along NPS roads and parkways. As a result, in 1976 the NPS and FHWA entered into an MOA (Memorandum Of Agreement) which established the RIP (Road Inventory Program). This MOA was terminated and revised in 1980 to establish a new MOA aiming to update RIP data and develop a long-range program to improve and maintain NPS roads to designated condition standards and establish a maintenance management program.

The FHWA completed this initial phase of the RIP in the early 1980s. As a result of this effort, each NPS site included in the study received a RIP Report known as the "Brown Book" which included the information collected during this first RIP phase.

In the 1990s, the effort was again renewed to update and maintain the RIP data. By this time the computer age was upon us and a process was employed that relied heavily on electronic data collection and computer technology. A cyclical program was developed and the RIP completed two cycles of data collection from 1994 to 2001. Cycle 1, starting in 1994, was conducted in 44 "large parks" (parks containing 10 or more paved route miles). Cycle 2 began in 1997 and comprised 79 large parks and 5 small parks totaling 4,874 paved route miles. Each of these parks received a RIP Report known as the "Blue Book". Cycle 3, from 2001 to 2004, was conducted in all parks, large and small, that contained any paved routes, including parking areas and, again, each park received a RIP Report and associated electronic files.

Cycle 4 was initiated in the spring of 2006 covering 86 large parks and several associated small parks consisting of 5,553 paved route miles and 6,232 paved parking areas. Data collection has been completed for Cycle 4 and all data has been delivered to the NPS.

In 2005, the FHWA began implementing the use of a Pavement Management System (PMS) to assist the NPS in prioritizing Pavement Maintenance and Rehabilitation activities. The PMS used by FHWA is the Highway Pavement Management Application (HPMA) and this software has the ability to store inventory and condition data from RIP and forecast future performance using prediction models. Outputs include performance and condition reports at the National, Regional, Park, or Route level. A regional prioritized list and optimization have been produced for most regions and the Federal Highway Deferred Maintenance is calculated via the HPMA.

In an effort to improve the accuracy of treatment recommendations and pavement condition descriptions, an extensive study was completed throughout 2010 that has resulted in changes to the RIP condition reporting method, specifically the distresses and indexes that comprise the Pavement Condition Rating (PCR). It was determined that a better representation of PCR could

be achieved by modifying the relative impact certain distresses would have on the overall rating. The changes that were implemented were endorsed by management at both the FHWA and NPS in October 2010. These changes will allow greater use of RIP and HPMA data for not simply condition data reporting, but also as a reliable tool for project identification and selection. Because of these changes, the PCR Condition ratings reported in Cycle 5 do not directly relate to the condition ratings reported in previous cycle RIP Reports. For more detailed information about the changes, see Section 3 and Section 10 in this RIP Report.

Cycle 5 has launched in the summer of 2010 and will again comprise all parks, large and small, that are served by paved roads and/or parking areas. For Cycle 5, the decision was made to collect condition data in large parks on Functional Class 1, 2, and 7 paved routes only, as well as any new routes that were previously not collected. In small parks, all paved routes and parking areas will be collected. As a result, this will include 81 large parks with 4,459 paved route miles and 231 small parks with 529 paved route miles and associated paved parking areas.

Since 1984, the Road Inventory Program has been funded through the Federal Lands Highway Park Roads and Parkways (PRP) Program. Currently, coordination of the RIP with FLH is under the NPS Washington Headquarters Park Facility Management Division. The FLH Washington office coordinates policy and prepares national reports and needs assessment studies for Congress.

In 1998, the Transportation Equity Act for the 21st Century (TEA-21) amended Title 23 U.S.C., and inserted Section 204(a)(6) requiring the FHWA and NPS, to develop by rule, a Pavement Management System (PMS) applied to park roads and parkways serving the National Park System.

FLH is responsible for the accuracy of all data presented in this report. Any questions or comments concerning the contents of this report should be directed to the national RIP Coordinator located in Sterling, Virginia.

Respectfully,

FHWA RIP Team

FHWA/Eastern Federal Lands
21400 Ridgetop Circle
Sterling, VA 20166
(703) 404-6371

FHWA/Central Federal Lands
12300 West Dakota Ave
Lakewood, CO 80228
(720) 963-3556

Section 2
Park Route Inventory

Pu’ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

Cycle 5 NPS/RIP Route ID Report

Shading Color Key:
Red text denotes approx. mileage

White = Paved Routes, DCV Driven
Yellow = Unpaved Routes, DCV not Driven
Blue = All Paved Parking Areas
Green = All Unpaved Parking Areas
Grey = Paved Routes, DCV not Driven
Black = State, Local or Private non-NPS Routes
= Concession Route Flag ON

*Unpaved route data was obtained from NPS and was not inventoried by the Road Inventory Program (RIP).

** DCV - Data Collection Vehicle NC - Not Collected

PUHE

PU'UKOHOLA HEIAU NATIONAL HISTORIC SITE

Rte. No.	Cycle Collected	FMSS No.	Concess Route	Route Name	Route Description From	Route Description To	Maint. District	Paved Miles	Un-Paved Miles	Total Route Length	Func. Class	Manual Rated SQ/FT	Surf. Type	Area Maps
0010	5	104761		PARK HEADQUARTERS ENTRANCE ROAD	FROM ROUTE 0100 (SPENCER BEACH PARK ROAD)	TO ROUTE 0900 (PARK HEADQUARTERS PARKING LOT)	N/A	0.15	0.00	0.15	1		AS	1
0011	5	108665		VISITOR CENTER EXIT ROAD	FROM ROUTE 0901 (VISITOR CENTER PARKING LOT)	TO SPENCER BEACH COUNTY PARK PARKING LOT	N/A	0.08	0.00	0.08	1		AS	1
0100	5	104746		SPENCER BEACH PARK ROAD	FROM ROUTE 5270 (STATE ROUTE 270)	TO SPENCER BEACH COUNTY PARK ACCESS ROAD (STOP SIGN)	N/A	0.35	0.00	0.35	1		AS	1
0400	5	108666		MAINTENANCE FACILITY ACCESS ROAD	FROM ROUTE 5270 (STATE ROUTE 270)	TO ROUTE 0902 (MAINTENANCE FACILITY PARKING AREA)	N/A	0.00	0.00	0.00	3	10,301	AS	1
0900	5	104734		PARK HEADQUARTERS PARKING LOT	FROM END OF ROUTE 0010 (PARK HEADQUARTERS ENTRANCE ROAD)	TO PARKING	N/A	0.00	0.00	0.00		8,243	AS	1
0901	5	108664		VISITOR CENTER PARKING LOT	FROM ROUTE 0100 (SPENCER BEACH PARK ROAD)	TO ROUTE 0011 (VISITOR CENTER EXIT ROAD)	N/A	0.00	0.00	0.00		18,796	AS	1
0902	5	108667		MAINTENANCE FACILITY PARKING AREA	FROM ROUTE 0400 (MAINTENANCE FACILITY ACCESS ROAD)	TO PARKING	N/A	0.00	0.00	0.00		5,795	AS	1
5270	5			STATE ROUTE 270	FROM INTERSECTION WITH ROUTE 0100 (SPENCER BEACH PARK ROAD) AND STATE ROUTE 270	TO NORTH PARK BOUNDARY AT MAKAHUNA GULCH BRIDGE	N/A	0.51	0.00	0.51			AS	1

Cycle 5 NPS/RIP Route ID Report

Shading Color Key:
Red text denotes approx. mileage

White = Paved Routes, DCV Driven
Yellow = Unpaved Routes, DCV not Driven
Blue = All Paved Parking Areas
Green = All Unpaved Parking Areas
Grey = Paved Routes, DCV not Driven
Black = State, Local or Private non-NPS Routes
= Concession Route Flag ON

*Unpaved route data was obtained from NPS and was not inventoried by the Road Inventory Program (RIP).

** DCV - Data Collection Vehicle NC - Not Collected

CYCLE 5 SUMMARY TOTALS FOR PU'UKOHOLA HEIAU NATIONAL HISTORIC SITE

CYCLE 5 ROUTE TOTALS

DCV Driven Route Miles	0.58
Manually Rated Route Miles	0.00
TOTAL PARK ROUTE MILES COLLECTED IN CYCLE 5	0.58
Manually Rated Routes (SQFT)	10,301
TOTAL UNPAVED PARK ROUTE MILES	0.00

CYCLE 5 CONCESSION TOTALS

Concession Paved Route Miles	0.00
Concession Unpaved Route Miles	0.00
TOTAL CONCESSION ROUTE MILES	0.00
Concession Paved Parking Area SQFT	0
Concession Unpaved Parking Area SQFT	0
TOTAL CONCESSION PARKING AREA SQFT	0
Concession Manually Rated Routes SQFT	0

* CYCLE 5 PARKING AREA TOTALS

Paved Parking (SQFT)	32,834
Unpaved Parking (SQFT)	0
TOTAL PARKING (SQFT)	32,834

CYCLE 5 WEIGHTED AVERAGE PARK VALUES

DCV Driven PCR	96
**Manually Rated Routes PCR	90
**Parking PCR	90
***Total Equivalent Lane Miles	2.05

* - The Parking Area Totals SQFT value represents **all** parking areas collected in Cycle 5, both park and concessionaire.

** - Parking and Manually Rated Routes are assigned the following PCR values based on their observed condition: Construction=-1, Excellent=97, Good=90, Fair=73, and Poor=45.

*** - Equivalent Lane Miles are calculated by route using the following equations : DCV and Manually Rated Lines Routes=(PAVE_WIDTHxPAVED_MI)/11 foot lane. Parking Areas=SQ_FEET/5280/11. Manually Rated Polygons=SQ_FEET/5280/11.

Cycle 5 NPS/RIP Route ID Report

Shading Color Key:
Red text denotes approx. mileage

White = Paved Routes, DCV Driven	Yellow = Unpaved Routes, DCV not Driven	Blue = All Paved Parking Areas	Green = All Unpaved Parking Areas
Grey = Paved Routes, DCV not Driven	Black = State, Local or Private non-NPS Routes	= Concession Route Flag ON	

*Unpaved route data was obtained from NPS and was not inventoried by the Road Inventory Program (RIP).

** DCV - Data Collection Vehicle NC - Not Collected

General Park Road Functional Classification Table

Class 1 Principal Park Road/Rural Parkway (Public Roads) Roads which constitute the main access route, circulatory tour, or thoroughfare for park visitors. Route Numbers 1 - 99. Note: Rural parkways (e.g. Natchez Trace) are numbered 1 - 9. State Routes Inventoried for Park. Route Numbers 5000-5999

Class 2 Connector Park Road (Public Roads) - Roads which provide access within a park to areas of scenic, scientific, recreational or cultural interest, such as overlooks, campgrounds, etc. Route Numbers 100-199.

Class 3 Special Purpose Park Road (Public Roads) - Roads which provide circulation within public areas, such as campgrounds, picnic areas, visitor center complexes, concessionaire facilities, etc. These roads generally serve low-speed traffic and are often designed for one-way circulation. Route Numbers 200-299.

Class 4 Primitive Park Roads (Public Roads) - Roads which provide circulation through remote areas and/or access to primitive campgrounds and undeveloped areas. These roads frequently have no minimum design standards and their use may be limited to specially equipped vehicles. Route Numbers 200-299.
Note: Functional Classes 3 and 4 have the same route numbers because, historically, they were numbered similarly.

Class 5 Administrative Access Road (Administrative Roads) - All public roads intended for access to administrative developments or structures such as park offices, employee quarters, or utility areas. Route Numbers 400-499.

Class 6 Restricted Road (Administrative Roads) - All roads normally closed to the public, including patrol roads, truck trails, and other similar roads. Route Numbers 400-499.
Note: Functional Classes 5 and 6 have the same route numbers because historically they were numbered similarly and often there is little distinction between these routes. For example, because utility areas and employee housing are often closed to the public, this restriction would result in classification of FC 6 rather than FC 5.

Class 7 Urban Parkway (Urban Parkways and City Streets) - These facilities serve high volumes of park and non-park related traffic and are restricted, limited-access facilities in an urban area. This category of roads primarily encompasses the major parkways which serve as gateways to our nation's capital. Other major park roads or portions thereof, however, may be included in this category. Route Numbers 1-9.

Class 8 City Streets (Urban Parkways and City Streets) - City streets are usually extensions of the adjoining street system that are owned and maintained by the National Park Service. The construction and/or reconstruction should conform with accepted local engineering practice and local conditions. Route Numbers 600-699.

****

A park road system contains those roads within or giving access to a park or other unit of the NPS which are administered by the NPS, or by the Service in cooperation with other agencies. The assignment of a functional classification (FC) to a park road is not based on traffic volumes or design speed, but on the intended use or function of that road or route.

The historic route numbering system also included a 300 number series for interpretive roads, and a 500 series for one-way roads. There are approximately 250 roads nationwide which are designated by the 300 and 500 series. The numbers for these roads will be maintained for reporting consistency. However, since these interpretive and one-way routes are not as clearly tied to a specific functional class, the 300 and 500 series will be discontinued for future use.

5000 route numbers are assigned to Non-NPS Routes that are State, County or City owned which border, traverse, or provide access to Park Facilities or Locations. 5000 Routes are driven for GPS and Video Log only.

Surface Type Abbreviations:

AS - Asphaltic Concrete Pavement

CO - Portland Cement Concrete Pavement

BR - Brick or Pavers Road Bed

CB - Cobble Stone Road Bed

GR - Gravel Road Bed

SA - Sand Road Bed

NV - Native or Dirt Material Road Bed

OT - Other Materials Road Bed

ROUTE IDENTIFICATION CHANGES TO PAVED ROUTES FROM PREVIOUS CYCLE - PUHE

ROUTES ADDED FROM PREVIOUS INVENTORY:			
Route #	**Route Name**	**Reason for Addition**	**Comments**
5270	STATE ROUTE 270	OTHER	NON-NPS ROAD ADDED TO THE INVENTORY IN CYCLE 5 PER THE PARK'S REQUEST.

OTHER CHANGES FROM PREVIOUS INVENTORY:			
Route #	**Route Name**	**Type of Change**	**Comments**
0011	VISITOR CENTER EXIT ROAD	ROUTE SPLIT	ROUTE 0901 WAS SPLIT INTO ROUTE 0011 (VISITOR CENTER EXIT ROAD) AND 0901 (VISITOR CENTER PARKING LOT) DURING THE 2012 INVENTORY UPDATE AND COLLECTION.
0400	MAINTENANCE FACILITY ACCESS ROAD	ROUTE SPLIT	ROUTE 0902 WAS SPLIT INTO ROUTE 0400 (MAINTENANCE FACILITY ACCESS ROAD) AND 0902 (MAINTENANCE FACILITY PARKING AREA) DURING THE 2012 INVENTORY UPDATE AND COLLECTION. FUNCTIONAL CLASS CHANGED FROM 6 IN 2012 TO 3 IN 2014 BECAUSE VISITORS MAY PARK HERE TO ACCESS THE JOHN YOUNG HOMESTEAD SITE.
0901	VISITOR CENTER PARKING LOT	ROUTE SPLIT	ROUTE 0901 WAS SPLIT INTO ROUTE 0011 (VISITOR CENTER EXIT ROAD) AND 0901 (VISITOR CENTER PARKING LOT) DURING THE 2012 INVENTORY UPDATE AND COLLECTION.
0902	MAINTENANCE FACILITY PARKING AREA	ROUTE SPLIT	ROUTE 0902 WAS SPLIT INTO ROUTE 0400 (MAINTENANCE FACILITY ACCESS ROAD) AND 0902 (MAINTENANCE FACILITY PARKING AREA) DURING THE 2012 INVENTORY UPDATE AND COLLECTION.

Section 3
Park Summary Information

Pu’ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

PUHE: PAVED ROUTE MILES AND PERCENTAGES BY FUNCTIONAL CLASS AND PCR

F.C.	Pavement Condition Rating (PCR)								TOTAL MILES
	Poor (0-60)		Fair (61-84)		Good (85-94)		Excellent (95-100)		
	MILES	%	MILES	%	MILES	%	MILES	%	
1	0.02	3.45%	0.05	8.62%	0.06	10.34%	0.45	77.59%	**0.58**
2									
3									
4									
5									
6									
7									
8									
Totals	**0.02**	**3.45%**	**0.05**	**8.62%**	**0.06**	**10.34%**	**0.45**	**77.59%**	**0.58**

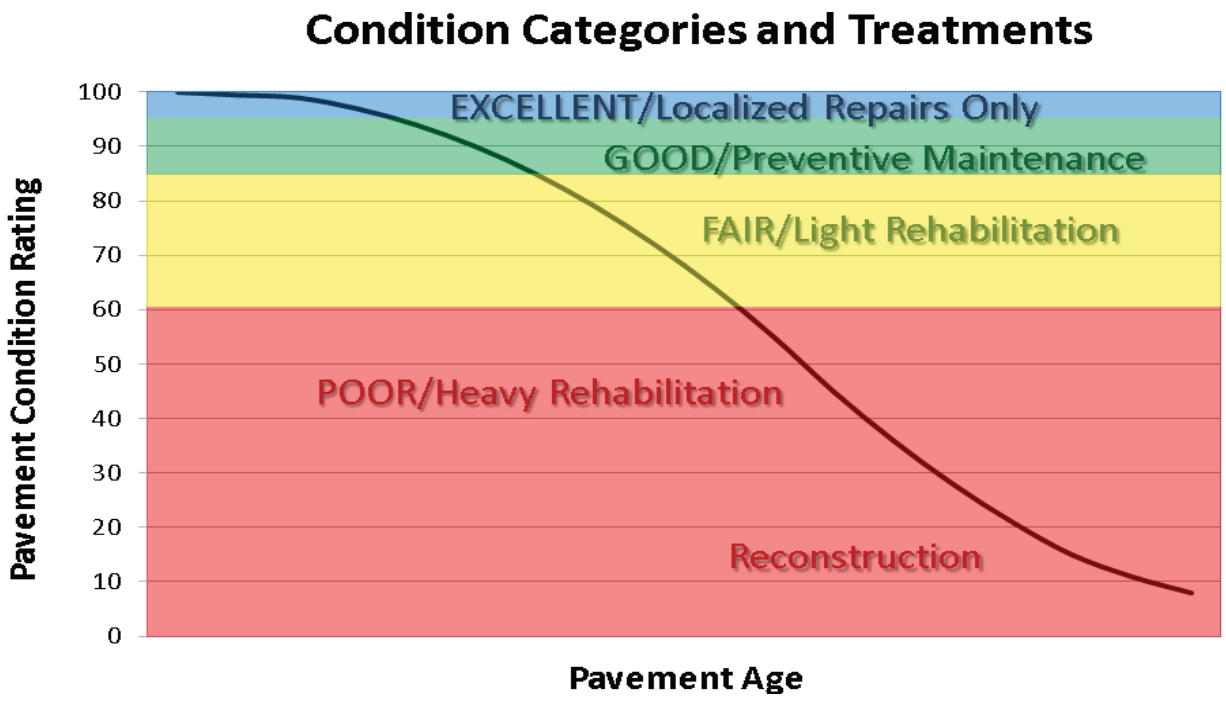
Note: **The information in this table is derived from the PMS_20 table in the Park database, which only contains processed data from routes collected with the Data Collection Vehicle (DCV). Information for Manually Rated Routes (MRR) and Parking Areas is not reported in this table. Only Functional Class 1, 2, & 7 routes, and any new routes not previously collected by RIP, are collected in Large Parks.**

Explanation of the Excellent, Good, Fair and Poor Condition Descriptions

In addition to the RIP Index changes that have been implemented in Cycle 5, we will also aim to provide greater assistance in translating excellent/good/fair/poor categories into pavement needs categories. The PCR can be used to indicate the place in the Pavement Life Cycle and the types of treatments that should be considered now and into the future.

- Excellent/New: PCR of 95-100. Pavements in this range will require only spot repairs
- Good: PCR of 85-94. Pavements in this range will likely be candidates for Preventive Maintenance. Examples include Chip and Slurry Seals, Micro Surfacing and Thin Overlays.
- Fair: PCR of 61-84. Pavements in this range will likely be candidates of Light Rehabilitation (L3R). Examples include single-lift overlays up to 2.5 inches in total thickness, milling and overlays.
- Poor: PCR of 0-60. Pavements in this range will likely be candidates of Heavy Rehabilitation or Reconstruction (H3R or 4R). Examples include Pulverization, Multiple Lift Overlays, and Reconstruction.

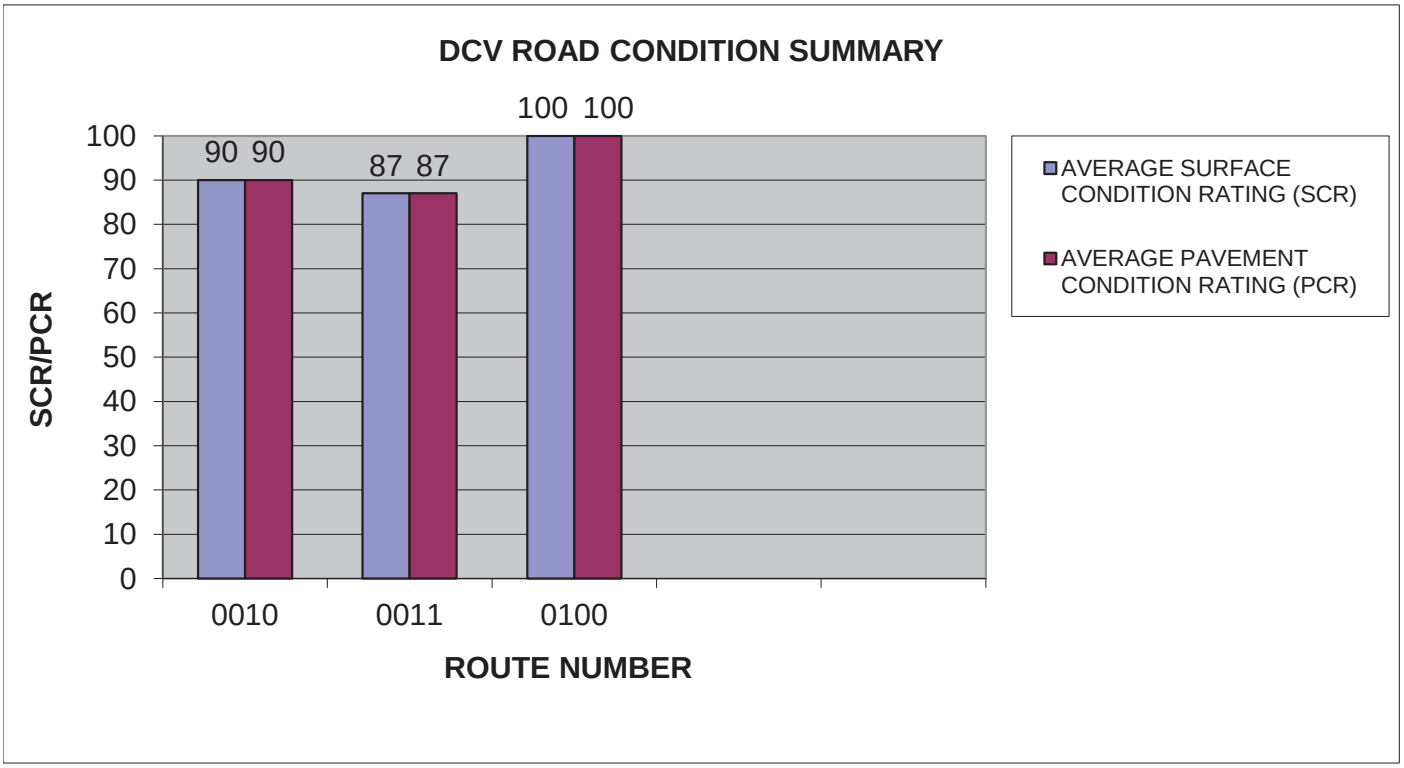
At this time, specific Maintenance and Rehabilitation activities should be evaluated and recommended at the project level. Site-specific conditions that influence treatment type should be determined based on performing a subsurface investigation and/or pavement condition survey, and not be based solely on RIP data. Additionally, RIP produces a snapshot of conditions the year in which the data was collected. For further information or to obtain additional Pavement Management System's data from our Highway Pavement Management Application (HPMA) please contact the Eastern Federal Lands pavement team.



PUHE: DCV ROAD CONDITION SUMMARY

DCV - Data Collection Vehicle

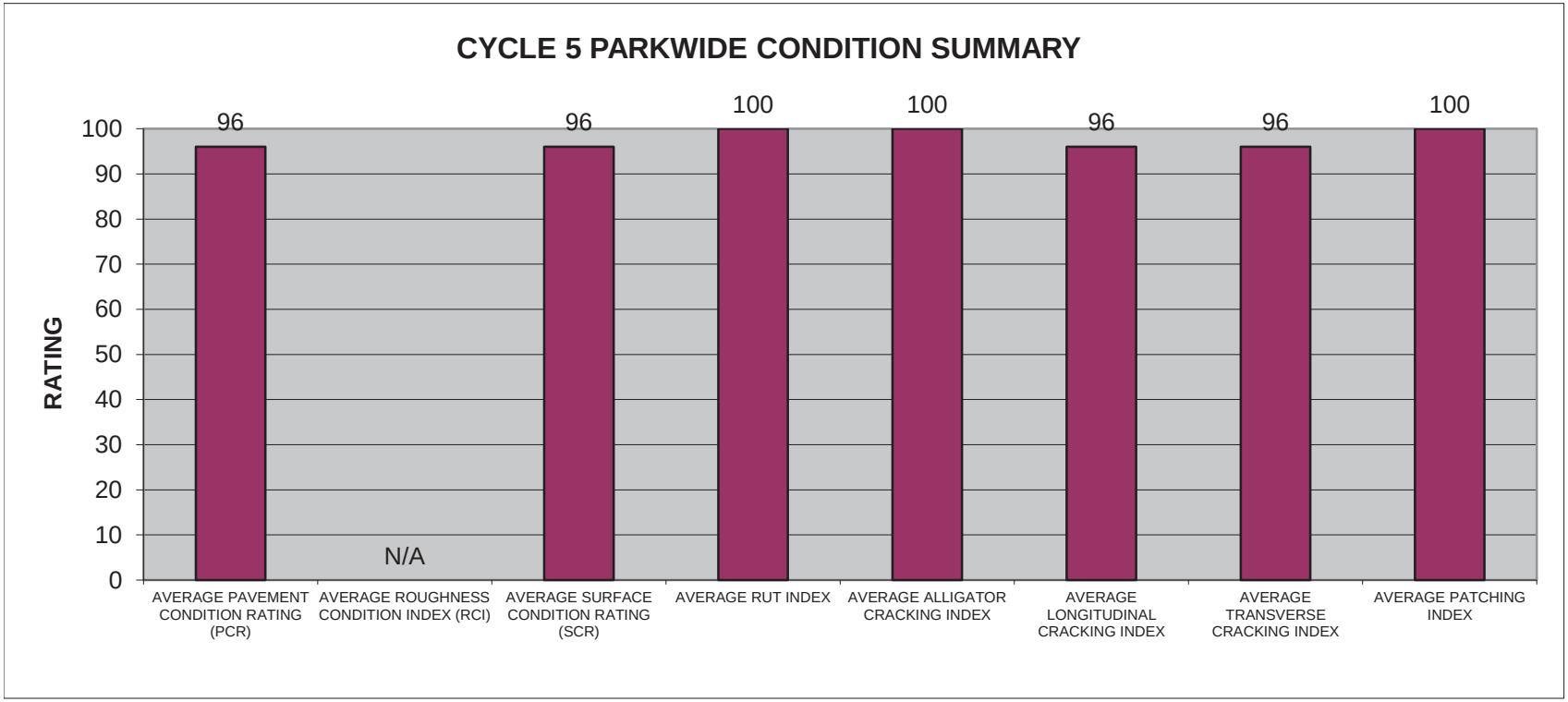
ROUTE NUMBER	ROUTE NAME	FUNCT CLASS	PAVED LENGTH	SURFACE TYPE	AVERAGE SURFACE CONDITION RATING (SCR)	AVERAGE PAVEMENT CONDITION RATING (PCR)
0010	PARK HEADQUARTERS ENTRANCE ROAD	1	0.15	ASPHALT	90	90
0011	VISITOR CENTER EXIT ROAD	1	0.08	ASPHALT	87	87
0100	SPENCER BEACH PARK ROAD	1	0.35	ASPHALT	100	100



PUHE: PARKWIDE DCV CONDITION SUMMARY

AVERAGE PAVEMENT CONDITION RATING (PCR)	AVERAGE ROUGHNESS CONDITION INDEX (RCI)	AVERAGE SURFACE CONDITION RATING (SCR)	AVERAGE RUT INDEX	AVERAGE ALLIGATOR CRACKING INDEX	AVERAGE LONGITUDINAL CRACKING INDEX	AVERAGE TRANSVERSE CRACKING INDEX	AVERAGE PATCHING INDEX
96	N/A	96	100	100	96	96	100

All Index values are based on Data Collection Vehicle (DCV) driven roads that were collected in Cycle-5.
Roughness data is only collected on routes with lengths greater than 0.5 miles and a posted speed limit of 25 MPH or greater.

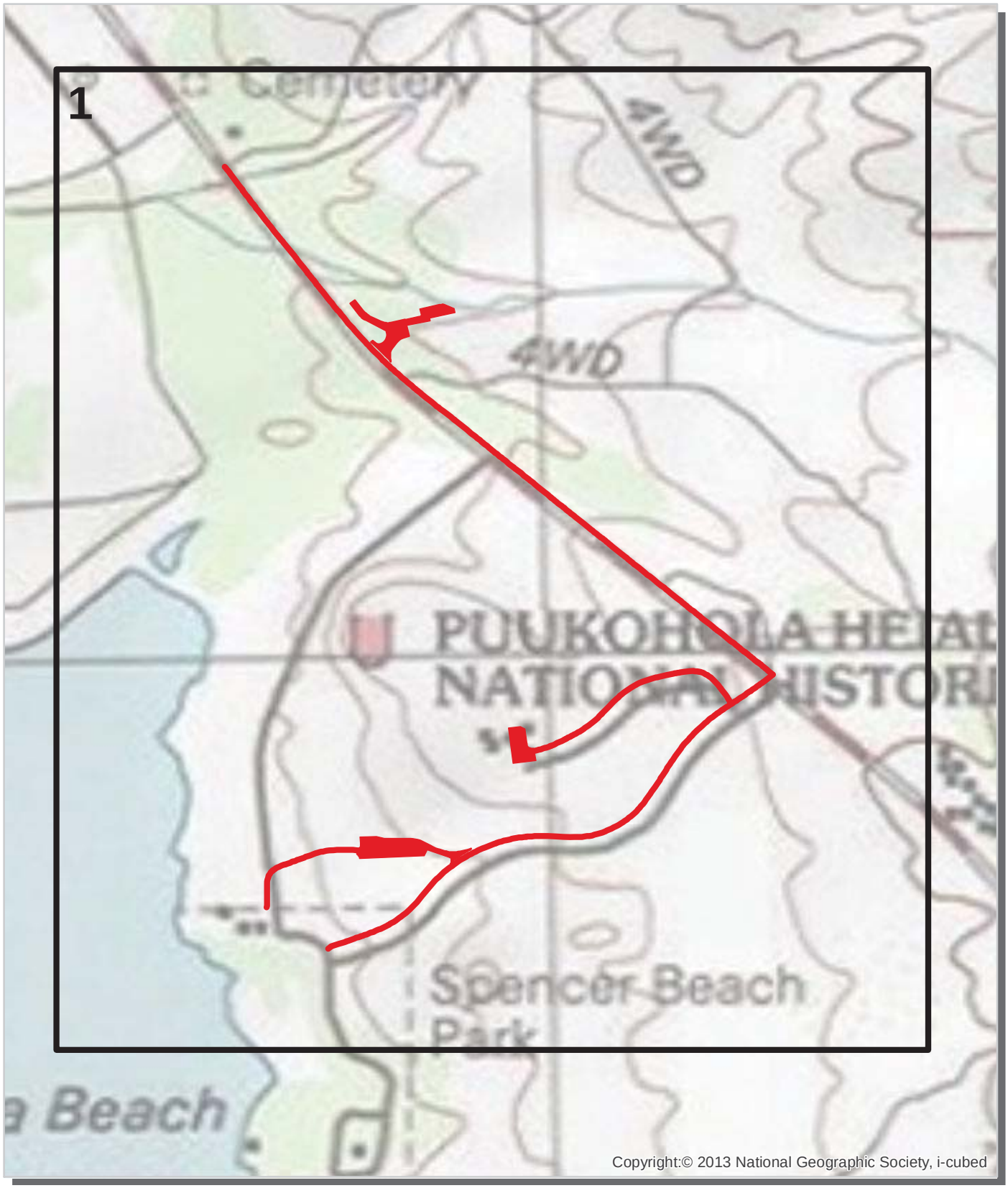


Section 4
Park Route Location Maps

Pu’ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

Pu'ukohola Heiau National Historic Site
Route Location Map
Key Map

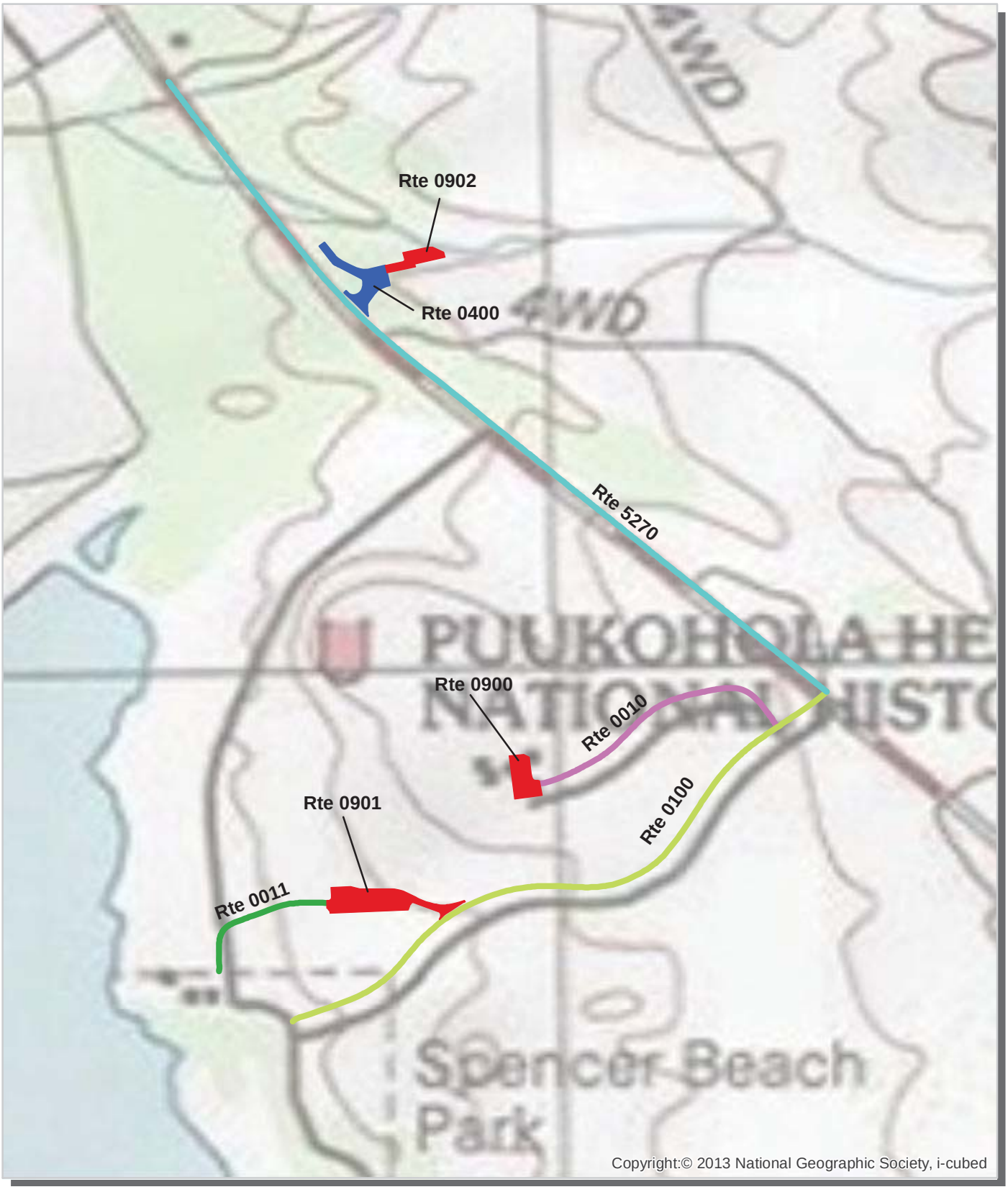


Cycle 5 Collected Routes

0.095 0.0475 0 0.095
Miles

N

Pu'ukohola Heiau National Historic Site
Route Location Map
Area 1

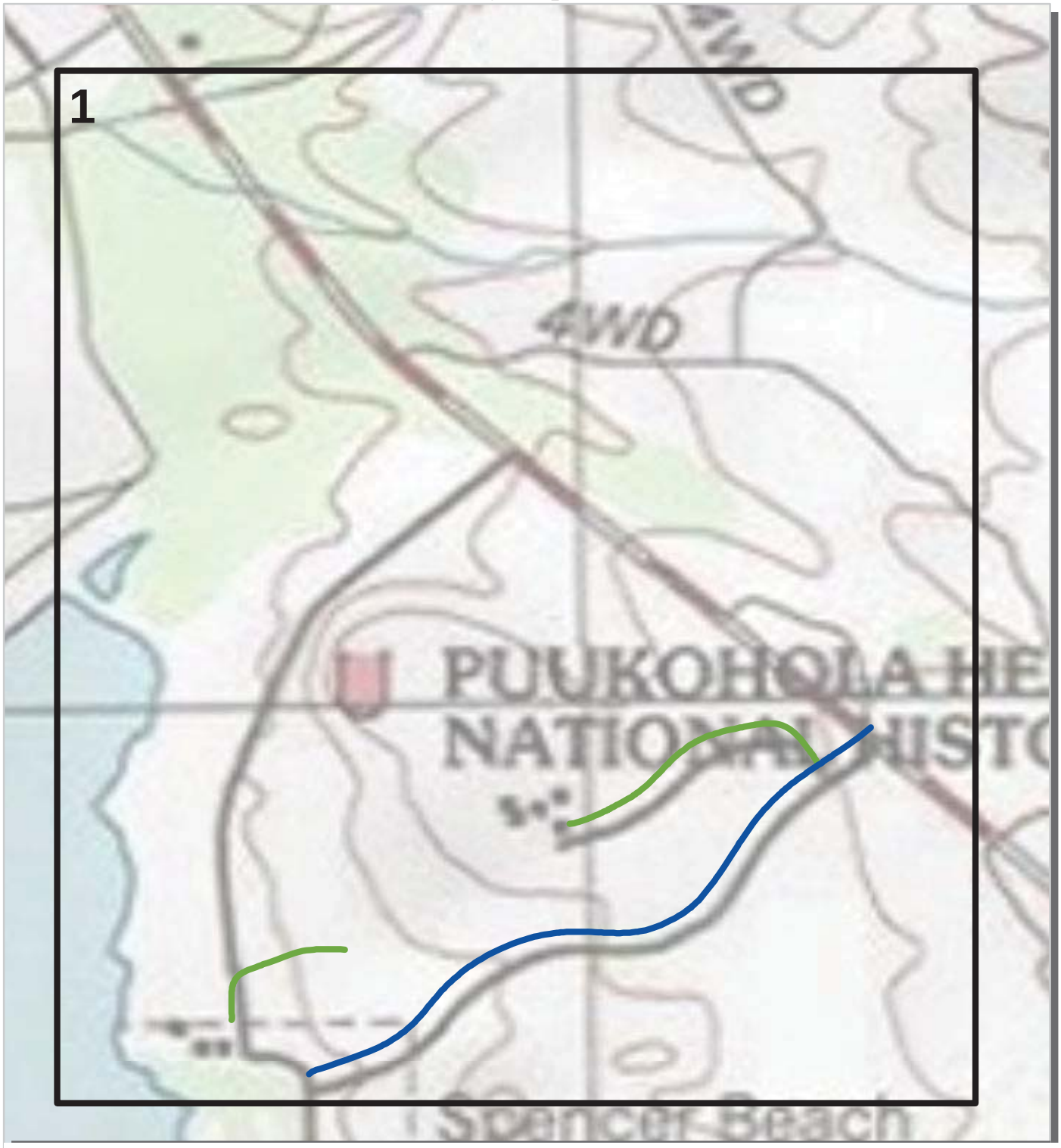


Unique colors used to differentiate routes

0.08 0.04 0 0.08
Miles

N

Pu'ukohola Heiau National Historic Site
Route Condition Map
PCR - Mile by Mile
Key Map



PCR — Poor (0 - 60) — Fair (61 - 84) — Good (85 - 94) — Excellent (95 - 100) — No Data

* If the PCR rating is not available for a section, the SCR rating will be displayed. See appendix for definitions and formulas.

Note: Only routes collected by the DCV in Cycle-5 are displayed.

0.08 0.04 0 0.08 Miles

N

Pu'ukohola Heiau National Historic Site
Route Condition Map
PCR - Mile by Mile
Area 1

PCR	Poor	Fair	Good	Excellent	No Data
	(0 - 60)	(61 - 84)	(85 - 94)	(95 - 100)	

* If the PCR rating is not available for a section, the SCR rating will be displayed. See appendix for definitions and formulas.

0.08 0.04 0 0.08
Miles

N

Section 5
Paved Route
Condition Rating Sheets

Pu’ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

PCR Poor (0 - 60) Fair (61 - 84) Good (85 - 94) Excellent (95 - 100) No Data

* If the PCR rating is not available for a section, the SCR rating will be displayed. See appendix for definitions and formulas.

ROUTE: 0010 PARK HEADQUARTERS ENTRANCE ROAD
PUHE : PU'UKOHOLA HEIAU NATIONAL HISTORIC SITE

COLLECTED: 4/18/2014

PACIFIC WEST REGION **TOTAL LENGTH: 0.15 Miles**

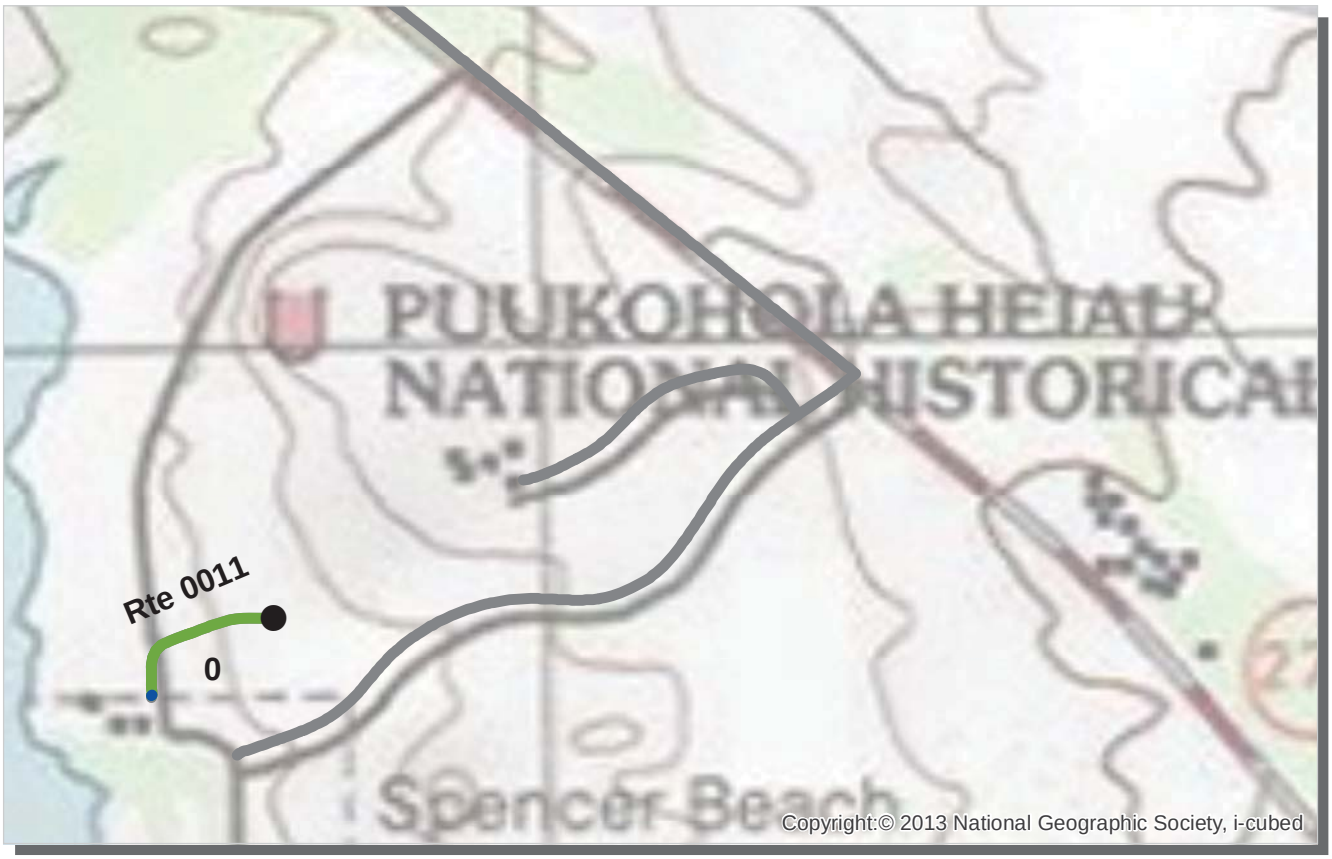
Section Number	0				
Section Length (mi)	0.15				
Cross Section Information					
Number of Lanes	1				
Paved Width (ft)	18				
Lane Width (ft)	13				
Roadway Condition Information					
SCR (Surface Condition Rating)	90				
PCR (Pavement Condition Rating)	90				
Distress Index Values					
Structural Crack Index	90				
Transverse Cracking Index	93				
Patching Index	100				
Rutting Index	99				
Roughness Condition Index (RCI)	NC				

NOTES:

Structural Crack Index is a combination of the Longitudinal Cracking Index and Alligator Cracking Index.

See Section 10 for explanation of SCR, PCR, & all Distress Index Values.

NC - Not Collected N/A - Not Applicable



PCR Poor (0 - 60) Fair (61 - 84) Good (85 - 94) Excellent (95 - 100) No Data

* If the PCR rating is not available for a section, the SCR rating will be displayed. See appendix for definitions and formulas.

ROUTE: 0011 VISITOR CENTER EXIT ROAD
PUHE : PU'UKOHOLA HEIAU NATIONAL HISTORIC SITE

COLLECTED: 4/18/2014

PACIFIC WEST REGION **TOTAL LENGTH: 0.08 Miles**

Section Number	0				
Section Length (mi)	0.08				
Cross Section Information					
Number of Lanes	2				
Paved Width (ft)	20				
Lane Width (ft)	10				
Roadway Condition Information					
SCR (Surface Condition Rating)	87				
PCR (Pavement Condition Rating)	87				
Distress Index Values					
Structural Crack Index	93				
Transverse Cracking Index	87				
Patching Index	100				
Rutting Index	99				
Roughness Condition Index (RCI)	NC				

NOTES:

Structural Crack Index is a combination of the Longitudinal Cracking Index and Alligator Cracking Index.

See Section 10 for explanation of SCR, PCR, & all Distress Index Values.

NC - Not Collected N/A - Not Applicable

PCR Poor (0 - 60) Fair (61 - 84) Good (85 - 94) Excellent (95 - 100) No Data

* If the PCR rating is not available for a section, the SCR rating will be displayed. See appendix for definitions and formulas.

ROUTE: 0100 SPENCER BEACH PARK ROAD
PUHE : PU'UKOHOLA HEIAU NATIONAL HISTORIC SITE

COLLECTED: 4/18/2014

PACIFIC WEST REGION **TOTAL LENGTH: 0.35 Miles**

Section Number	0				
Section Length (mi)	0.35				
Cross Section Information					
Number of Lanes	2				
Paved Width (ft)	29				
Lane Width (ft)	11				
Roadway Condition Information					
SCR (Surface Condition Rating)	100				
PCR (Pavement Condition Rating)	100				
Distress Index Values					
Structural Crack Index	100				
Transverse Cracking Index	100				
Patching Index	100				
Rutting Index	100				
Roughness Condition Index (RCI)	NC				

NOTES:

Structural Crack Index is a combination of the Longitudinal Cracking Index and Alligator Cracking Index.

See Section 10 for explanation of SCR, PCR, & all Distress Index Values.

NC - Not Collected N/A - Not Applicable

Section 6
Manually Rated Paved Route Condition Rating Sheets

Pu’ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

Pu'ukohola Heiau National Historic Site

MANUALLY RATED PAVED ROUTE CONDITION RATING SHEETS

Manually rated roads are non-linear roads or roads not suitable for the Data Collection Vehicle (DCV). The manually rated roads at Pu'ukohola Heiau National Historic Site (PUHE) were collected twice in Cycle 5 by the Road Inventory Program (RIP).

- January 2012: First manual collection (no automated vehicle collection)
- April 2014: Automated vehicle and second manual collection

Following the 2012 data collection effort, the RIP Automated Data Collection Vehicle (DCV) visited Hawaii in April of 2014 to perform automated collection on all NPS paved roads. During the DCV collection visit, a second manual condition assessment was performed on parking areas and manually rated roads and the previous Cycle 5 manual condition ratings were updated.

The 2014 condition assessment at PUHE incorporated new manual rating methodologies designed to improve the identification of treatment recommendations and pavement condition descriptions for Manually Rated Routes. These new methodologies will be used in future Cycle 6 collections and were included in this 2014 Final Cycle 5 Report. A detailed description of the new manual rating procedures can be found in the Appendix of this Report.

To facilitate comparisons of the 2012 and 2014 manual ratings, both condition rating sheets for each route are included in this final Cycle 5 Report.

- Section 6A: Updated Ratings from April of 2014
- Section 6B: Previous Ratings from January of 2012

SECTION 6A

MANUALLY RATED PAVED ROUTE CONDITION RATING SHEETS

FROM

APRIL 2014

Pu'ukohola Heiau National Historic Site

ROUTE 0400: MAINTENANCE FACILITY ACCESS ROAD

Manual Rating

FROM ROUTE 5270 (STATE ROUTE 270)

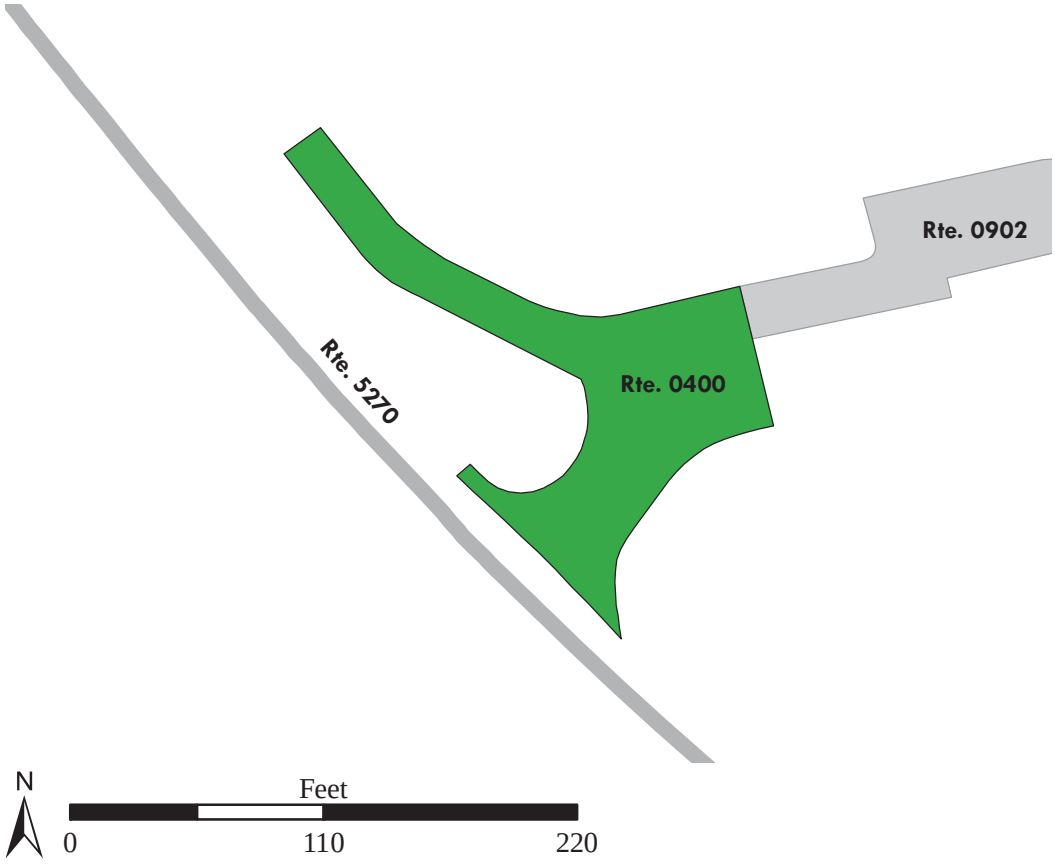
TO ROUTE 0902 (MAINTENANCE FACILITY PARKING AREA)

Inspection Date	FMSS Number	User Access	Surface Type
4/8/2014	108666	PUBLIC	ASPHALT
Area (Sq. Ft.)	**Lane Miles (11' Widths)**	**Curb Reveal (Inches)**	**Curb Recommendation**
10,301	0.18	NOT APPLICABLE	N/A
Curb Type		**Curb & Gutter Type**	
NO CURB		NO CURB AND GUTTER	
Culverts	**Drop Inlets**	**Gates**	
0	0	2	
Pavement Recommendation		**Condition Rating / PCR**	
PREVENTIVE MAINTENANCE		GOOD / 90	

Route Condition Legend – Pavement Condition Rating (PCR)

Poor (0 - 60) Fair (61- 84) Good (85 - 94) Excellent (95 - 100) Not Rated

See Appendix for definitions and formulas



SECTION 6B

MANUALLY RATED PAVED ROUTE CONDITION RATING SHEETS

FROM

JANUARY 2012

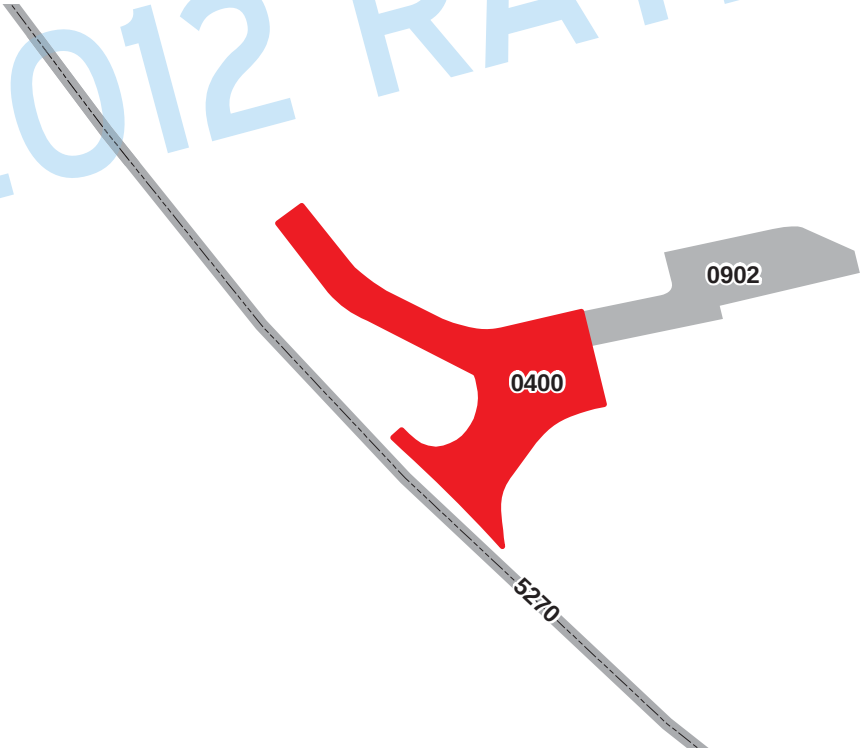
Pu'ukohola Heiau National Historic Site
MRP Route 0400

MAINTENANCE FACILITY ACCESS ROAD

FROM ROUTE 5270 (STATE ROUTE 270)
TO ROUTE 0902 (MAINTENANCE FACILITY PARKING AREA)

Route Number	Public / Non Public	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0400	NONPUBLIC	1/19/2012	10301	0.177	AS
Culverts	**Drop Inlets**	**Gates**	**Curb & Gutter**	**Curb**	**PCR**
0	0	2	NO	NO	90 GOOD

* Lane miles are based on 11' lane widths



90 45 0 90 180 Feet

N

Section 7
Parking Area
Condition Rating Sheets

Pu’ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

Pu'ukohola Heiau National Historic Site

PARKING AREA CONDITION RATING SHEETS

Parking areas at Pu'ukohola Heiau National Historic Site (PUHE) were collected twice in Cycle 5 by the Road Inventory Program (RIP).

- January 2012: First manual collection (no automated vehicle collection)
- April 2014: Automated vehicle and second manual collection

Following the 2012 data collection effort, the RIP Automated Data Collection Vehicle (DCV) visited Hawaii in April of 2014 to perform automated collection on all NPS paved roads. During the DCV collection visit, a second manual condition assessment was performed on parking areas and manually rated roads and the previous Cycle 5 manual condition ratings were updated.

The 2014 condition assessment at PUHE incorporated new manual rating methodologies designed to improve the identification of treatment recommendations and pavement condition descriptions for Manually Rated Routes. These new methodologies will be used in future Cycle 6 collections and were included in this 2014 Final Cycle 5 Report. A detailed description of the new manual rating procedures can be found in the Appendix of this Report.

To facilitate comparisons of the 2012 and 2014 manual ratings, both condition rating sheets for each route are included in this final Cycle 5 Report.

- Section 7A: Updated Ratings from April of 2014
- Section 7B: Previous Ratings from January of 2012

SECTION 7A

PARKING AREA CONDITION RATING SHEETS

FROM

APRIL 2014

Pu'ukohola Heiau National Historic Site

ROUTE 0900: PARK HEADQUARTERS PARKING LOT

Manual Rating

FROM END OF ROUTE 0010 (PARK HEADQUARTERS ENTRANCE ROAD)

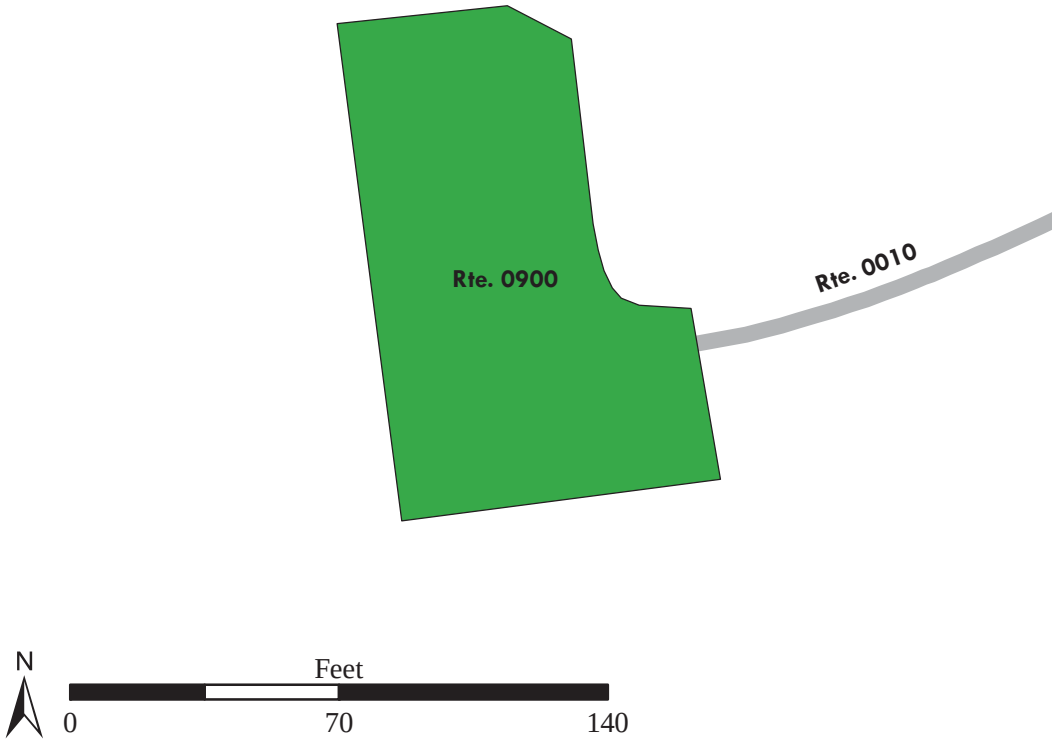
TO PARKING

Inspection Date	FMSS Number	User Access	Surface Type
4/8/2014	104734	PUBLIC	ASPHALT
Area (Sq. Ft.)	**Lane Miles (11' Widths)**	**Curb Reveal (Inches)**	**Curb Recommendation**
8,243	0.14	NOT APPLICABLE	N/A
Curb Type		**Curb & Gutter Type**	
NO CURB		NO CURB AND GUTTER	
Culverts	**Drop Inlets**	**Gates**	
0	0	0	
Pavement Recommendation		**Condition Rating / PCR**	
PREVENTIVE MAINTENANCE		GOOD / 90	

Route Condition Legend – Pavement Condition Rating (PCR)

Poor (0 - 60) Fair (61- 84) Good (85 - 94) Excellent (95 - 100) Not Rated

See Appendix for definitions and formulas



Pu'ukohola Heiau National Historic Site

ROUTE 0901: VISITOR CENTER PARKING LOT

Manual Rating

FROM ROUTE 0100 (SPENCER BEACH PARK ROAD)

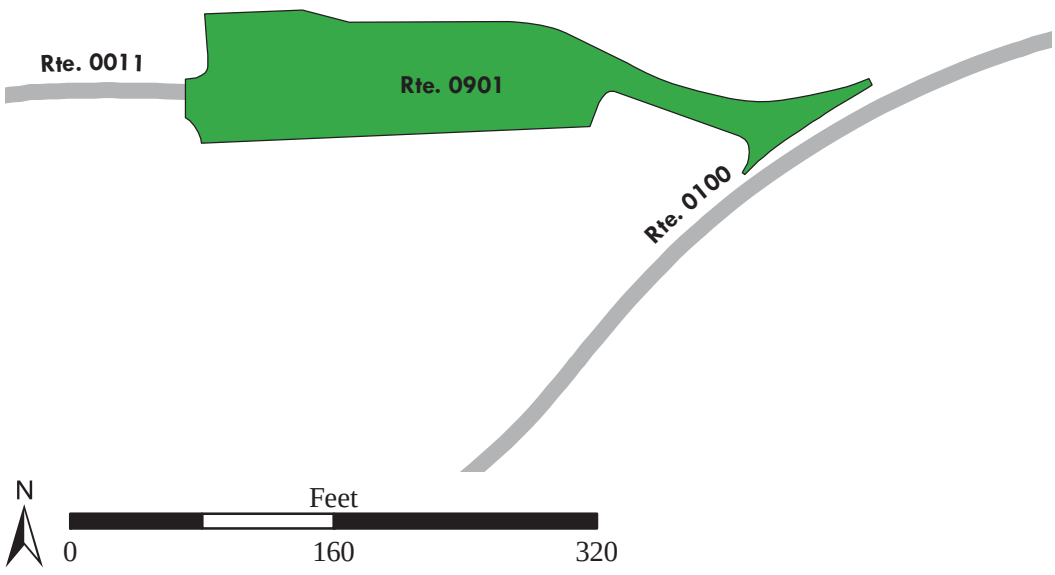
TO ROUTE 0011 (VISITOR CENTER EXIT ROAD)

Inspection Date	FMSS Number	User Access	Surface Type
4/8/2014	108664	PUBLIC	ASPHALT
Area (Sq. Ft.)	**Lane Miles (11' Widths)**	**Curb Reveal (Inches)**	**Curb Recommendation**
18,796	0.32	5	DO NOTHING
Curb Type		**Curb & Gutter Type**	
CONCRETE CURB		NO CURB AND GUTTER	
Culverts	**Drop Inlets**	**Gates**	
0	0	1	
Pavement Recommendation		**Condition Rating / PCR**	
PREVENTIVE MAINTENANCE		GOOD / 90	

Route Condition Legend – Pavement Condition Rating (PCR)

Poor (0 - 60) Fair (61- 84) Good (85 - 94) Excellent (95 - 100) Not Rated

See Appendix for definitions and formulas



Pu'ukohola Heiau National Historic Site

ROUTE 0902: MAINTENANCE FACILITY PARKING AREA

Manual Rating

FROM ROUTE 0400 (MAINTENANCE FACILITY ACCESS ROAD)

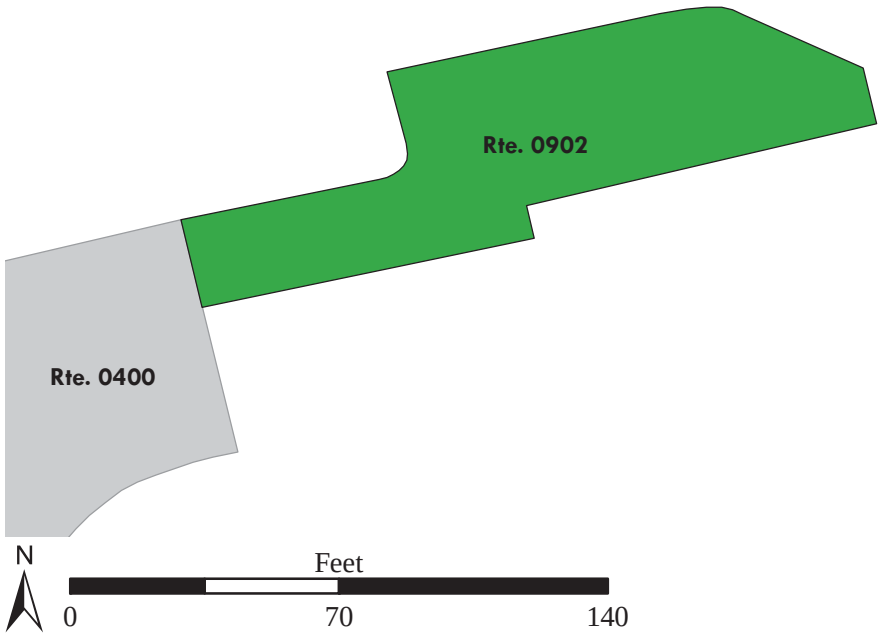
TO PARKING

Inspection Date	FMSS Number	User Access	Surface Type
4/17/2014	108667	NONPUBLIC	ASPHALT
Area (Sq. Ft.)	**Lane Miles (11' Widths)**	**Curb Reveal (Inches)**	**Curb Recommendation**
5,795	0.10	5	DO NOTHING
Curb Type		**Curb & Gutter Type**	
CONCRETE CURB		NO CURB AND GUTTER	
Culverts	**Drop Inlets**	**Gates**	
0	0	1	
Pavement Recommendation		**Condition Rating / PCR**	
PREVENTIVE MAINTENANCE		GOOD / 90	

Route Condition Legend – Pavement Condition Rating (PCR)

Poor (0 - 60) Fair (61- 84) Good (85 - 94) Excellent (95 - 100) Not Rated

See Appendix for definitions and formulas



SECTION 7B

PARKING AREA CONDITION RATING SHEETS

FROM

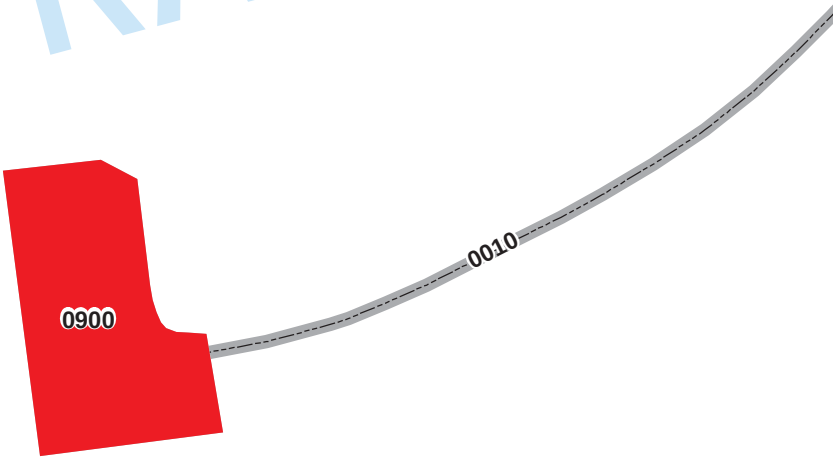
JANUARY 2012

Pu'ukohola Heiau National Historic Site
Route 0900
PARK HEADQUARTERS PARKING LOT

FROM END OF ROUTE 0010 (PARK HEADQUARTERS ENTRANCE ROAD)
TO PARKING

Route Number	Public / Non Public	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0900	PUBLIC	1/19/2012	8243	0.142	AS
Culverts	**Drop Inlets**	**Gates**	**Curb & Gutter**	**Curb**	**PCR**
0	0	0	NO	NO	90 GOOD

* Lane miles are based on 11' lane widths



125 62.5 0 125 250 Feet

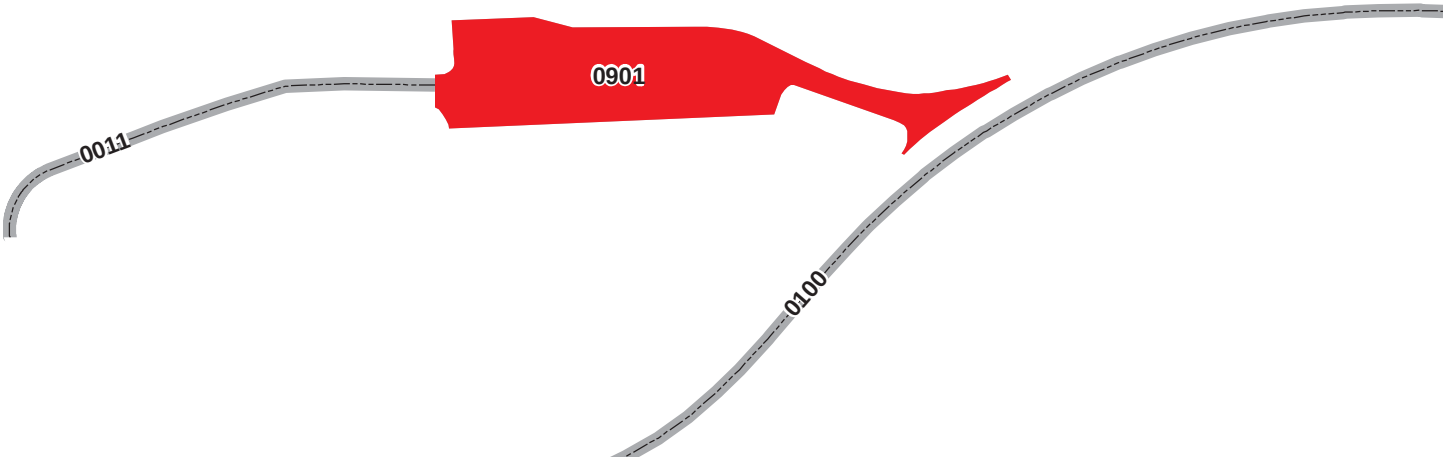
N

Pu'ukohola Heiau National Historic Site
Route 0901
VISITOR CENTER PARKING LOT

FROM ROUTE 0100 (SPENCER BEACH PARK ROAD) AT MP 0.25 (ON RIGHT)
TO ROUTE 0011 (VISITOR CENTER EXIT ROAD)

Route Number	Public / Non Public	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0901	PUBLIC	1/19/2012	18796	0.324	AS
Culverts	**Drop Inlets**	**Gates**	**Curb & Gutter**	**Curb**	**PCR**
0	0	1	NO	CONCRETE	90 GOOD

* Lane miles are based on 11' lane widths

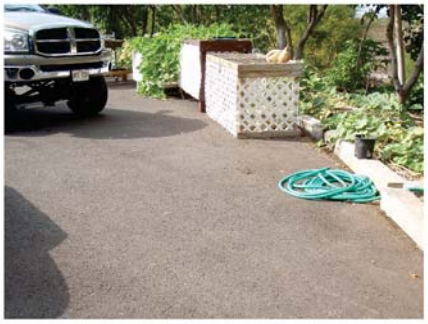


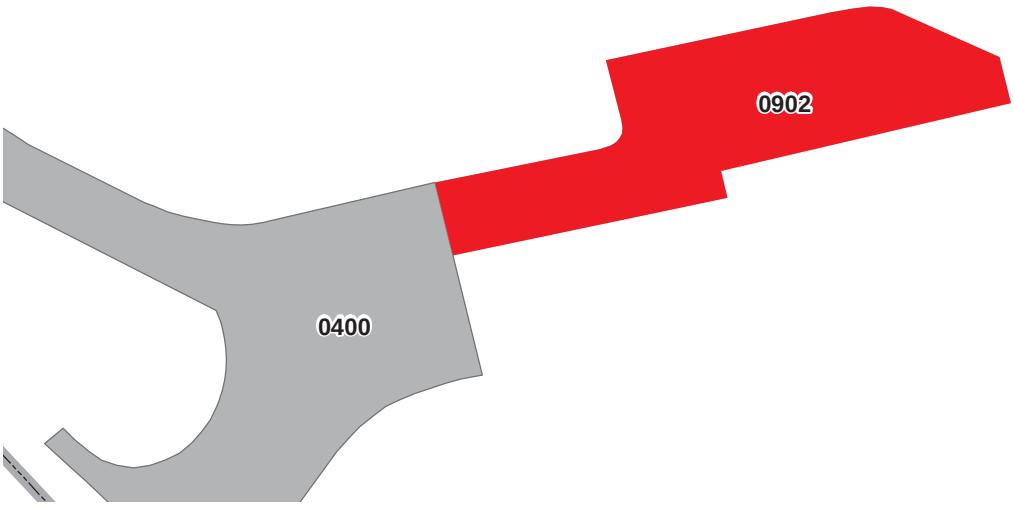
Pu'ukohola Heiau National Historic Site
Route 0902
MAINTENANCE FACILITY PARKING AREA

FROM ROUTE 0400 (MAINTENANCE FACILITY ACCESS ROAD)
TO PARKING

Route Number	Public / Non Public	Date Visited	Area (sq ft)	Lane Miles *	Surface Type
0902	NONPUBLIC	1/19/2012	5795	0.114	AS
Culverts	**Drop Inlets**	**Gates**	**Curb & Gutter**	**Curb**	**PCR**
0	0	1	NO	CONCRETE	90 GOOD

* Lane miles are based on 11' lane widths





80 40 0 80 160 Feet

N

Section 8
Parkwide/Route
Maintenance Features Summaries

Pu’ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

PUHE: PARKWIDE MAINTENANCE FEATURES SUMMARY
Includes DCV, MRL, MRP & PKG routes collected in Cycle-5

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all DCV driven routes. Culverts and drop inlets were also collected on all Manually Rated Routes and Paved Parking areas. Those totals are reflected below.

FEATURE	LINEAR FEET	COUNT
BRIDGE	--	0
CATTLE GUARD	--	0
CULVERT	--	2
CURB	0	--
DROP INLET	--	0
GATE	--	7
GUARD/GUIDE RAIL	0	--
CABLE	0	--
NON-CABLE	0	--
GUARD/GUIDE WALL	0	--
BOLLARD	0	--
TEMPORARY BARRIER	0	--
NON TEMP/BOLLARD	0	--
INTERSECTION	--	11
LOW WATER CROSSING	0	0
MILE MARKER	--	0
OVERPASS	--	0
PARK BOUNDARY	--	2
PAVED DITCH	0	--
PULLOUT	0	0
RAILROAD CROSSING	--	0
RETAINING WALL	21	1
SIGN	--	46
STATE BOUNDARY	--	0
TRAFFIC LIGHT	--	0
TUNNEL	0	0

PUHE: DCV ROUTE MAINTENANCE FEATURES SUMMARY

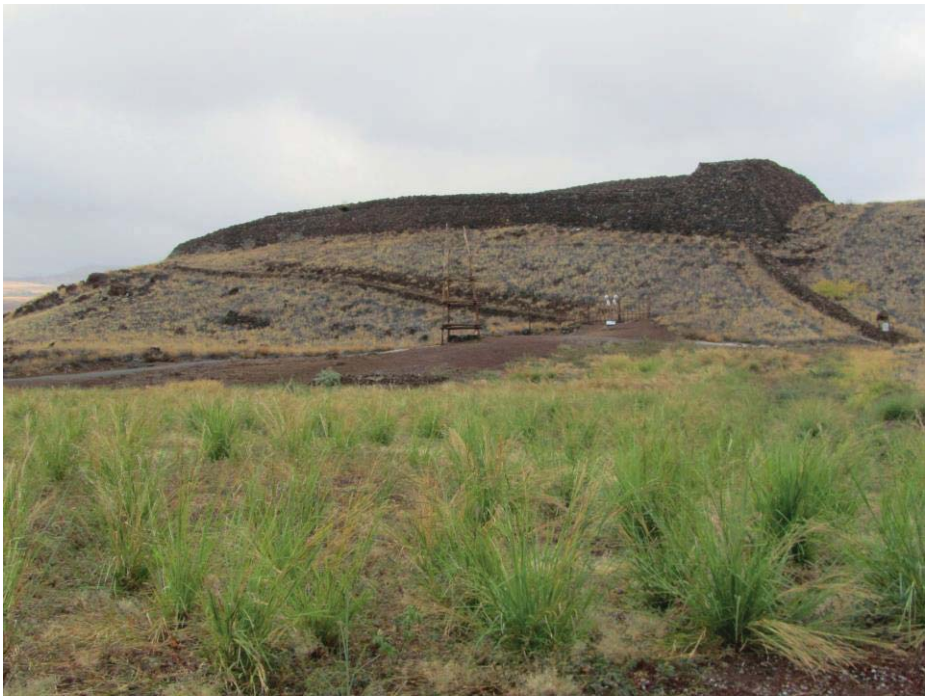
Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5.

FEATURE	ROUTE 0010 PARK HEADQUARTERS ENTRANCE ROAD	ROUTE 0011 VISITOR CENTER EXIT ROAD	ROUTE 0100 SPENCER BEACH PARK ROAD		UNIT
BRIDGE	0	0	0		EACH
CATTLE GUARD	0	0	0		EACH
CULVERT	0	0	2		EACH
CURB	0	0	0		LINEAR FEET
DROP INLET	0	0	0		EACH
GATE	1	1	1		EACH
GUARD/GUIDE RAIL	0	0	0		LINEAR FEET
CABLE	0	0	0		LINEAR FEET
NON-CABLE	0	0	0		LINEAR FEET
GUARD/GUIDE WALL	0	0	0		LINEAR FEET
BOLLARD	0	0	0		LINEAR FEET
TEMPORARY BARRIER	0	0	0		LINEAR FEET
NON TEMP/BOLLARD	0	0	0		LINEAR FEET
INTERSECTION	3	2	6		EACH
LOW WATER CROSSING	0	0	0		EACH
LOW WATER CROSSING	0	0	0		LINEAR FEET
MILE MARKER	0	0	0		EACH
OVERPASS	0	0	0		EACH
PARK BOUNDARY	0	1	1		EACH
PAVED DITCH	0	0	0		LINEAR FEET
PULLOUT	0	0	0		EACH
PULLOUT	0	0	0		LINEAR FEET
RAILROAD CROSSING	0	0	0		EACH
RETAINING WALL	0	1	0		EACH
RETAINING WALL	0	21	0		LINEAR FEET
SIGN	7	13	26		EACH
STATE BOUNDARY	0	0	0		EACH
TRAFFIC LIGHT	0	0	0		EACH
TUNNEL	0	0	0		EACH
TUNNEL	0	0	0		LINEAR FEET

STRUCTURE LIST

No data available for this section.

Section 9
Route Maintenance Features
Road Logs



Pu’ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

PUHE: ROUTE MAINTENANCE FEATURES ROAD LOG

ROUTE 0010: PARK HEADQUARTERS ENTRANCE ROAD

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all paved routes.

FROM MILEPOST	TO MILEPOST	FEATURE	SIDE	COMMENT
0.000	0.000	ROUTE BEGIN	N/A	FROM ROUTE 0100 (SPENCER BEACH PARK ROAD)
0.000	0.000	INTERSECTION	RIGHT	ROUTE 0100 (SPENCER BEACH PARK ROAD)
0.000	0.000	INTERSECTION	LEFT	ROUTE 0100 (SPENCER BEACH PARK ROAD)
0.007	0.007	SIGN	LEFT	REGULATORY, STOP
0.008	0.008	GATE	N/A	N/A
0.010	0.010	SIGN	RIGHT	REGULATORY, GRAPHIC SIGN NO TEXT
0.010	0.010	SIGN	LEFT	GUIDE, UNABLE TO READ FROM VIDEO
0.010	0.010	SIGN	LEFT	REGULATORY, GRAPHIC SIGN NO TEXT
0.011	0.011	SIGN	RIGHT	GUIDE, UNABLE TO READ FROM VIDEO
0.033	0.033	SIGN	RIGHT	REGULATORY, SPEED LIMIT 15
0.138	0.138	SIGN	LEFT	REGULATORY, SPEED LIMIT 15
0.150	0.150	INTERSECTION	N/A	ROUTE 0900 (PARK HEADQUARTERS PARKING LOT)
0.150	0.150	ROUTE END	N/A	TO ROUTE 0900 (PARK HEADQUARTERS PARKING LOT)

PUHE: ROUTE MAINTENANCE FEATURES ROAD LOG

ROUTE 0011: VISITOR CENTER EXIT ROAD

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all paved routes.

FROM MILEPOST	TO MILEPOST	FEATURE	SIDE	COMMENT
0.000	0.000	ROUTE BEGIN	N/A	FROM ROUTE 0901 (VISITOR CENTER PARKING LOT)
0.000	0.000	INTERSECTION	N/A	ROUTE 0901 (VISITOR CENTER PARKING LOT)
0.007	0.007	SIGN	RIGHT	REGULATORY, SPEED LIMIT 5
0.007	0.007	SIGN	RIGHT	REGULATORY, EXIT
0.059	0.059	SIGN	RIGHT	REGULATORY, UNABLE TO READ FROM VIDEO
0.059	0.059	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
0.067	0.067	GATE	N/A	N/A
0.068	0.068	SIGN	LEFT	REGULATORY, UNABLE TO READ FROM VIDEO
0.068	0.068	SIGN	RIGHT	REGULATORY, UNABLE TO READ FROM VIDEO
0.069	0.069	SIGN	RIGHT	WARNING, UNABLE TO READ FROM VIDEO
0.071	0.075	RETAINING WALL	RIGHT	N/A
0.080	0.080	SIGN	RIGHT	REGULATORY, UNABLE TO READ FROM VIDEO
0.080	0.080	SIGN	RIGHT	REGULATORY, STOP
0.081	0.081	SIGN	N/A	REGULATORY, UNABLE TO READ FROM VIDEO
0.081	0.081	SIGN	N/A	REGULATORY, UNABLE TO READ FROM VIDEO
0.081	0.081	SIGN	N/A	REGULATORY, LITTER
0.081	0.081	SIGN	LEFT	REGULATORY, NO PARKING ANY TIME
0.081	0.081	INTERSECTION	N/A	PAVED PARKING (SPENCER BEACH COUNTY PARK PARKING / NON-NPS)
0.081	0.081	PARK BOUNDARY	N/A	N/A
0.081	0.081	ROUTE END	N/A	TO SPENCER BEACH COUNTY PARK PARKING LOT

PUHE: ROUTE MAINTENANCE FEATURES ROAD LOG

ROUTE 0100: SPENCER BEACH PARK ROAD

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all paved routes.

FROM MILEPOST	TO MILEPOST	FEATURE	SIDE	COMMENT
0.000	0.000	ROUTE BEGIN	N/A	FROM ROUTE 5270 (STATE ROUTE 270)
0.000	0.000	INTERSECTION	LEFT	ROUTE 5270 (STATE ROUTE 270)
0.000	0.000	INTERSECTION	RIGHT	ROUTE 5270 (STATE ROUTE 270)
0.000	0.000	SIGN	N/A	WARNING, GRAPHIC SIGN NO TEXT
0.000	0.000	PARK BOUNDARY	N/A	N/A
0.003	0.003	SIGN	LEFT	REGULATORY, STOP
0.027	0.027	INTERSECTION	RIGHT	ROUTE 0010 (PARK HEADQUARTERS ENTRANCE ROAD)
0.034	0.034	SIGN	RIGHT	GUIDE, PU'UKOHOLA HEIAU VISITOR CENTER PARK HEADQUARTERS
0.034	0.034	SIGN	RIGHT	GUIDE, SAMUEL SPENCER COUNTY BEACH PARK AT OHAI ULA OPEN 6:00 AM - 9:00 PM
0.039	0.039	GATE	N/A	N/A
0.040	0.040	SIGN	LEFT	REGULATORY, ROAD CLOSED
0.040	0.040	SIGN	RIGHT	REGULATORY, ROAD CLOSED
0.041	0.041	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
0.041	0.041	SIGN	LEFT	WARNING, GRAPHIC SIGN NO TEXT
0.051	0.051	SIGN	RIGHT	REGULATORY, SPEED LIMIT 25
0.056	0.056	CULVERT	N/A	N/A
0.094	0.094	SIGN	RIGHT	WARNING, 14%
0.094	0.094	SIGN	RIGHT	WARNING, USE LOW GEAR
0.106	0.106	CULVERT	N/A	N/A
0.166	0.166	SIGN	RIGHT	REGULATORY, UNABLE TO READ FROM VIDEO
0.204	0.204	SIGN	RIGHT	REGULATORY, UNABLE TO READ FROM VIDEO
0.245	0.245	SIGN	RIGHT	GUIDE, PU'UKOHOLA HEIAU NATIONAL HISTORIC SITE
0.248	0.248	INTERSECTION	RIGHT	ROUTE 0901 (VISITOR CENTER PARKING LOT)
0.289	0.289	SIGN	RIGHT	WARNING, GRAPHIC SIGN NO TEXT
0.335	0.335	SIGN	LEFT	REGULATORY, SPEED LIMIT 25
0.347	0.347	SIGN	RIGHT	REGULATORY, 3-WAY
0.347	0.347	SIGN	RIGHT	REGULATORY, STOP
0.352	0.352	INTERSECTION	RIGHT	PAVED PARKING (SPENCER BEACH COUNTY PARK PARKING / NON-NPS)

PUHE: ROUTE MAINTENANCE FEATURES ROAD LOG

ROUTE 0100: SPENCER BEACH PARK ROAD

Notice: Culverts and drop inlets were marked by NPS and inventoried by RIP in Cycle 5 on all paved routes.

FROM MILEPOST	TO MILEPOST	FEATURE	SIDE	COMMENT
0.352	0.352	SIGN	N/A	WARNING, GRAPHIC SIGN NO TEXT
0.352	0.352	SIGN	N/A	REGULATORY, UNABLE TO READ FROM VIDEO
0.352	0.352	SIGN	N/A	REGULATORY, NO KAYAKS OR SIMILAR DEVICES ALLOWED [HAZARDOUS TO SWIMMERS]
0.352	0.352	SIGN	N/A	REGULATORY, NO DRUGS DOGS ALCOHOL VIOLATERS WILL BE PROSECUTED
0.352	0.352	SIGN	N/A	REGULATORY, DO NOT LEAVE ANIMALS IN PARK
0.352	0.352	SIGN	N/A	REGULATORY, ABSOLUTELY NO DRUGS, ALCOHOL OR DOGS ALLOWED IN THIS PARK VIOLATERS WILL BE PROSECUTED
0.352	0.352	SIGN	N/A	GUIDE, SPENCER PARK AT 'OHAI'ULA BEACH DEPT. OF PARKS & RECREATION COUNTY OF HAWAII
0.352	0.352	INTERSECTION	LEFT	PAVED PARKING (SPENCER BEACH COUNTY PARK ACCESS ROAD / NON-NPS)
0.352	0.352	SIGN	N/A	WARNING, WARNING
0.352	0.352	ROUTE END	N/A	TO SPENCER BEACH COUNTY PARK ACCESS ROAD (STOP SIGN)

Section 10
Appendix

Pu'ukohola Heiau National Historic Site

Federal Lands Highway
Road Inventory Program

Explanation of Changes to the RIP Index Equations and Determination of PCR

In 2005, the FHWA began implementing the use of a Pavement Management System to assist the National Park Service in prioritizing Pavement Maintenance and Rehabilitation activities. The PMS used by FHWA is the Highway Pavement Management Application (HPMA) and this software has the ability to store inventory and condition data from RIP and forecast future performance using prediction models. Outputs include performance and condition reports at the National, Region, Park, or Route level. A regional prioritized list and optimization have been produced for most regions and the Federal Highway Deferred Maintenance is calculated via the HPMA as well.

In an effort to improve the accuracy of treatment recommendations and pavement condition descriptions in relation to the distresses and indexes that comprise the Pavement Condition Rating (PCR), an extensive study was completed throughout 2010 that resulted in changes to the Road Inventory Program condition reporting method and specifically, the calculation of PCR. It was determined that a better representation of PCR could be achieved by modifying the relative impact certain distresses would have on the overall rating.

Through the use of HPMA data, it was noted that false failure indicators existed with the existing PCR model, and that it would be necessary to reduce their impact. The distresses affected in this way were Rutting and Roughness. Conversely, experience showed that roadways with extensive cracking present were often shown to have a high PCR. Therefore, the crack index models were adjusted to be more sensitive to changes in crack severity or quantity. It was also determined that these issues were not due to a problem with data acquisition (i.e. the RIP "van"), but with the way the collected data was processed. The final change was to provide guidance on when to use the Roughness Condition Index (RCI) in the PCR calculation. Roughness data is of little value to determining overall condition on routes that, due to their length or geometrics, have lower vehicle operating speeds. Therefore, in Cycle 5, only routes that have lengths of one half mile or greater and posted speed limits of 25 mph or greater will have RCI reported and included in the PCR calculations.

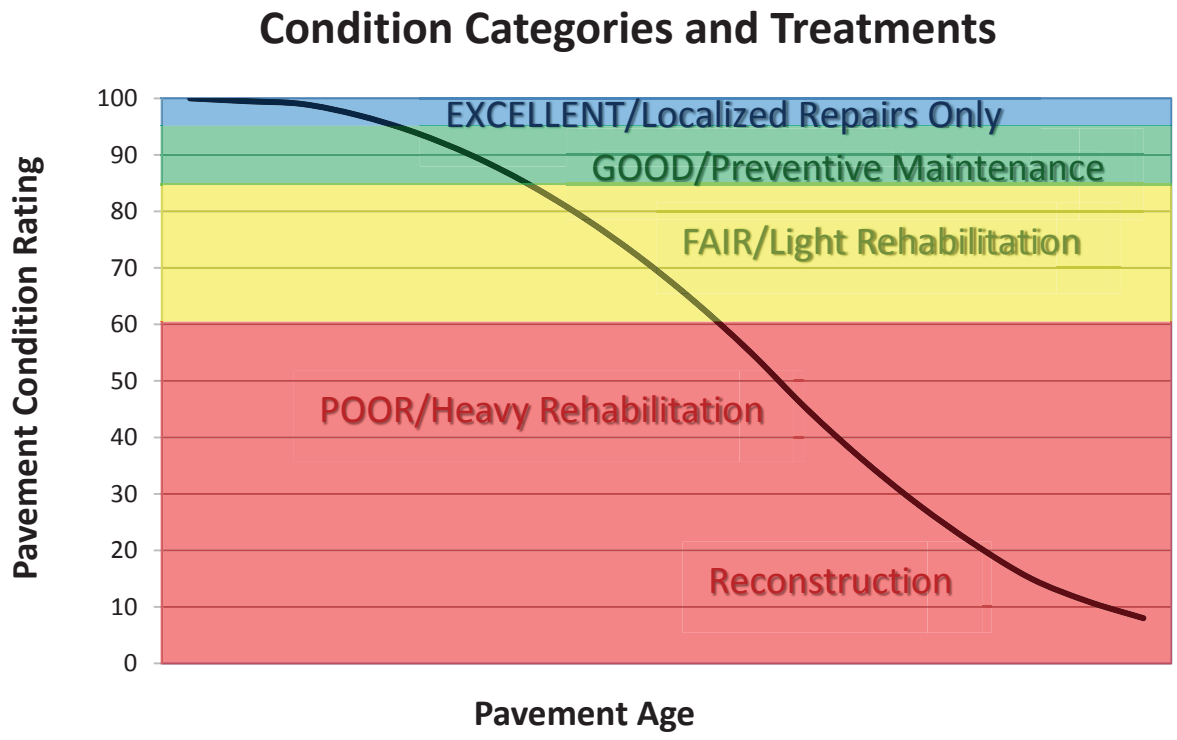
The changes that were implemented were endorsed by management at both the FHWA and NPS. In order to show the effectiveness of these changes, several sites were ground truth tested to ensure that an improvement was achieved between the relationship of PCR and the actual Maintenance and Rehabilitation needs that were represented. These changes will allow greater use of RIP and HPMA data for not simply condition data reporting, but also as a reliable tool for project identification and selection.

Explanation of the Condition Descriptions

The Pavement Condition Rating (PCR) can be used to indicate the place in the Pavement Life Cycle and the types of treatments that should be considered now and into the future.

- Excellent/New: PCR of 95-100. Pavements in this range will require only spot repairs
- Good: PCR of 85-94. Pavements in this range will likely be candidates for Preventive
- Maintenance. Examples include Chip and Slurry Seals, Micro Surfacing and Thin Overlays.
- Fair: PCR of 61-84. Pavements in this range will likely be candidates of Light Rehabilitation (L3R).
- Examples include single-lift overlays up to 2.5 inches in total thickness, milling and overlays.
- Poor: PCR of 60 or below. Pavements in this range will likely be candidates of Heavy Rehabilitation or Reconstruction (H3R or 4R). Examples include Pulverization, Multiple Lift Overlays, and Reconstruction.

At this time, specific Maintenance and Rehabilitation activities should be evaluated and recommended at the project level. Site-specific conditions that influence treatment type should be determined based on performing a subsurface investigation and/or pavement condition survey, and not be based solely on RIP data. Additionally, RIP produces a snapshot of conditions the year in which the data was collected. For further information or to obtain additional Pavement Management System's data from our Highway Pavement Management Application (HPMA) please contact the Eastern Federal Lands pavement team.



Description of Pavement Treatment Types

1. Preventive Maintenance is a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without significantly increasing the structural capacity). Preventive maintenance is typically applied to pavements in good condition having significant remaining service life. As a major component of pavement preservation, preventive maintenance is a strategy of extending the service life by applying cost-effective treatments to the surface or near-surface of structurally sound pavements. Examples of preventive treatments include asphalt crack sealing, chip sealing, slurry or micro-surfacing, thin and ultra-thin hot-mix asphalt overlay, concrete joint sealing, diamond grinding, dowel-bar retrofit, and isolated, partial and/or full-depth concrete repairs to restore functionality of individual slabs.

2. Pavement Rehabilitation consists of structural enhancements that extend the service life of an existing pavement and/or improve its load carrying capacity. Rehabilitation techniques include restoration treatments and structural overlays. Rehabilitation projects extend the life of existing pavement structures either by restoring existing structural capacity through the elimination of age-related, environmental cracking of embrittled pavement surface or by increasing pavement thickness to strengthen existing pavement sections to accommodate existing or projected traffic loading conditions. Two sub-categories result from these distinctions, which are directly related to the restoration or increase of structural capacity.

    - **Light Rehabilitation (L3R)** - Examples include single-lift overlays up to 2.5 inches in total thickness and milling and overlays for flexible pavements

    - **Heavy Rehabilitation (H3R)** – Requires rehabilitation with grade improvement. H3R stands for resurfacing, restoration, and rehabilitation projects. H3R projects typically involve multi-depth (overlays > 2.5 inches) pavement improvement work (short of full-depth replacement) and targeted safety improvements. H3R projects generally involve retention of the existing three-dimensional alignment.

3. Reconstruction (4R) is defined as the replacement of the entire existing pavement structure by the placement of the equivalent or increased pavement structure. Reconstruction usually requires the complete removal and replacement of the existing pavement structure. Reconstruction may utilize either new or recycled materials incorporated into the materials used for the reconstruction of the complete pavement section. Reconstruction is required when a pavement has either failed or has become functionally obsolete.

Description of Automated Vehicle Ratings

DESCRIPTION OF RATING SYSTEM

The Federal Highway Administration (FHWA), National Park Service Road Inventory Program (NPS-RIP), collects condition data on paved roads, parkways, and parking areas in park units nationwide. Road surface condition data is collected using an automated Data Collection Vehicle (DCV). Roads having brick, cobblestone, or wood surfaces are not normally surveyed with the DCV, but are manually rated for the purpose of assigning a condition rating. Unpaved roads, parkways, and parking areas are not currently being evaluated for condition. Paved campground pads and driveways are also not currently being evaluated for condition.

The FHWA RIP is implemented based on the premise that an accurate pavement surface condition assessment can be accomplished using automated crack detection technology as applied to digital images. Various methods of pavement condition assessment have been developed over the years with varying degrees of accuracy and acceptance. The use of digital photography to record pavement images and subsequent crack detection and classification has undergone continuous improvements over the past decade. Digital cameras with increasingly superior resolution and high definition have become more affordable, and the proprietary programming code and algorithms have been improved in crack detection software.

With the use of high quality digital photography and automated crack detection software, FHWA RIP is tasked with executing a pavement condition assessment on about 5000 miles of National Park Service roads and parkways. Foremost in setting up the basis of pavement distress identification is employing the distress identification protocols used by FHWA. There is no single distress identification system that is universal among entities conducting a program of distress identification. For the purpose of the NPS-RIP, FHWA employs distress identification protocols that are specific to this program.

FHWA has referenced the *"Distress Identification Manual for the Long-Term Pavement Performance Program", Publication No. FHWA-RD 03-031, June 2003,* as the point-of-reference for distress types on NPS pavement. The FHWA RIP distress types are similar to those described in the LTPP manual with some modifications. The document, *"Distress Identification Manual for the NPS Road Inventory Program, Cycle 5, 2010-2013"* was developed using the *"Distress Identification Manual for the Long-Term Pavement Performance Program"* as a guideline. Definitions of severity levels based on crack width contained in this document adhere to the LTPP Distress ID Manual. Modifications have been made to the definition of Alligator and Longitudinal Cracking and determination of Alligator Cracking severity. This manual also addresses Rutting and Roughness and its application to NPS-RIP.

In 2010, FHWA RIP began the fifth cycle of data collection in national parks. For Cycle 5, data will be collected in approximately 81 large parks (10 or more paved route miles) on Functional Class 1, 2, and 7 routes plus any new routes or parking areas previously not collected, totaling an estimated 4,459 paved route miles. Additionally, 231 small parks will be collected comprising approximately 529 paved route miles and associated paved parking areas. The data is used to support the National Park Service road maintenance program and Pavement Management System (PMS) developed and maintained by FHWA.

This **"*Distress Identification Manual for the NPS Road Inventory Program, Cycle 5, 2010-2013*"** will be used as a reference resource in crack detection and classification, determination of distress severity and extent, and in the calculation of distress index values for the FHWA RIP Cycle 5.

SURFACE DISTRESSES

Surface Condition Rating - SCR

Surface distresses are measured in the primary lane only. In the classification and measurement of all paved surface condition data, results will be reported in the database in record intervals of 0.02 miles (105.6 feet) (smallest granularity) along the route.

Surface distresses determined from digital images

- Transverse Cracks
- Longitudinal Cracks
- Alligator Cracks
- Patching/Potholes

Surface distress measured by DCV (Data Collection Vehicle) LRMS (Laser Rut Measuring System)

- Rutting

Each of the five surface distresses is assigned a computed surface distress index

- Transverse Crack Index
- Longitudinal Crack Index
- Alligator Crack Index
- Patching/Pothole Index
- Rutting Index

Surface distress data are classified as listed above, measured for severity, and quantified for extent. Classification, severity, and extent of these five surface distresses comprise the three main elements for calculation of SCR (Surface Condition Rating).

In addition to the five surface distresses, a **Structural Crack Index** is computed, which is a combination of the Longitudinal Crack Index and the Alligator Crack Index. The Structural Crack Index is then used in lieu of the LC and AC indices to compute SCR.

Roughness Condition Index - RCI

Additional condition data measured by DCV (lasers and accelerometers)

- Roughness (IRI)

Roughness is measured by FHWA's DCV and reported as International Roughness Index (IRI) in inches/mile. Using IRI, the Roughness Condition Index (RCI) is computed.

Pavement Condition Rating - PCR

Using the SCR (computed from the five surface distresses) and the RCI, an overall Pavement Condition Rating (PCR) is computed. The formula for PCR is:

Asphalt PCR = (0.60 * SCR) + (0.40 * RCI)
Concrete PCR = RCI

A detailed description of each distress index formula, roughness index formula, SCR and PCR is provided in this document beginning on page 8.

Each classified surface distress will fall into one or more s*everity*…LOW, MEDIUM, or HIGH based on criteria listed. For each severity, an e*xtent* is established based on the measured quantity of the distress within that severity. Within each *severity* individual distresses are assigned a *Maximum Allowable Extent* (MAE). For example, LOW severity transverse cracking may be allowed up to 21.1 cracks within a 0.02 interval before it reaches MAE and fails.

The index formulas are based on a scale of 0-100. A PCR index value of 100 would indicate a "new" road with no measurable distresses or rough ride. A PCR value of 60 is determined to be *terminable serviceability* and the road is considered failed. The range of index values with condition descriptors is:

POOR (<=60), FAIR (61 - 84), GOOD (85 - 94), EXCELLENT (95 - 100)

Index values are generally computed based on cumulative deducts of the measured severities. As shown in the index formulas below, as any single severity reaches or exceeds MAE, the index computes to a value of 60 or less, and the road fails for that 0.02 interval.

> **Note:** As a result of a unique combination of measured surface distresses and IRI, index values occasionally compute to less than 0 or greater than 100. In this instance, an index value < 0 defaults to 0. Index values > 100 default to 100. For all indices, a higher value indicates a better road condition, and a lower value indicates a poorer road condition.

On the following page, Table 1 summarizes the different types of distresses measured.

TABLE 1: Distress Summary

ASPHALT-SURFACED PAVEMENT DISTRESS TYPES with RUTTING and ROUGHNESS				
DISTRESS TYPE	**UNIT OF MEASURE…**	**…CONVERTED TO**	**DEFINED SEVERITY LEVELS?**	**MEASURED BY**
Alligator Cracking	**Square Feet**	**Percent of Lane Per 0.02 Mile**	**Yes**	**Digital Image Crack Detection Software**
Transverse Cracking	**Linear Feet**	**Number of Cracks Per 0.02 Mile**	**Yes**	**Digital Image Crack Detection Software**
Longitudinal Cracking	**Linear feet**	**Percent of Lane Length Per 0.02 Mile**	**Yes**	**Digital Image Crack Detection Software**
Patching/Potholes	**Square Feet**	**Percent of Lane Per 0.02 Mile**	**No**	**Digital Image Crack Detection Software**
Rutting	**Inches**	**Rut Depth Per 0.02 Mile**	**Yes**	**DCV – Laser Rut Measuring System (LRMS)**
Roughness	**IRI**	***RCI Per 0.02 Mile**	**No**	**DCV – Lasers /Accelerometers**

***Note: Roughness is measured on concrete roadways, but surface distresses and rutting are not measured. For concrete, PCR = RCI**

ALLIGATOR CRACKING

Description

Alligator cracking is considered a combination of fatigue and block cracking. It is a series of interconnected cracks in various stages of development. Alligator cracking develops into a many-sided pattern that resembles chicken wire or alligator skin. It can occur anywhere in the road lane. Alligator cracking must have a quantifiable area.

Severity Levels

LOW
An area of cracks with no or very few interconnecting cracks and the cracks are not spalled. Cracks are <= 0.25 in (6mm) in mean width. Cracks in the pattern are no further apart than 1 foot (0.328 m). May be sealed cracks with sealant in good condition and a crack width that cannot be determined.

MEDIUM
An area of interconnected cracks that form a complete pattern. Cracks may be slightly spalled. Cracks are >0.25 in. (6 mm) and <= 0.75 in. (19 mm) or any crack with a mean width <= 19 mm and adjacent low severity cracking. Cracks in the pattern are no further apart than 6 in. (150 mm).

HIGH
An area of interconnected cracks forming a complete pattern. Cracks are moderately or severely spalled. Cracks are >0.75 in (19mm) or any crack with a mean width <= 0.75 in (19mm) and adjacent medium to high severity random cracking.

A combination of observed crack width and crack pattern is used to determine overall severity of alligator cracking. Based on above description of each severity, the highest level of crack width and crack pattern determines overall severity. Table 2 illustrates this.

TABLE 2: Alligator Crack Severity Levels

ALLIGATOR CRACKING SEVERITY LEVELS		Crack Pattern		
		LOW	**MED**	**HIGH**
Crack Width	**LOW**	L	M	H
	MED	M	M	H
	HI	H	H	H

LONGITUDINAL CRACKING

Description

Longitudinal cracking occurs predominantly parallel to the pavement centerline. It can occur anywhere within the lane. Longitudinal cracks occurring in the wheelpath may be noteworthy.

Severity Levels

LOW
Cracks with a mean width of < 0.25 in. (6 mm). Sealed cracks with sealant in good condition and a width that cannot be determined.

MED
Cracks with a mean width > 0.25 in. (6 mm) and <= 0.75 in. (19 mm). Also, any crack with a mean width < 0.75 in. (19 mm) and adjacent random low severity cracking.

HIGH
Cracks with a mean width > 0.75 in. (19 mm). Also, any crack with a mean width < 0.75 in. (19 mm) and adjacent random medium to high severity cracking.

TRANSVERSE CRACKING

Description

Transverse cracking occurs predominantly perpendicular to the pavement centerline. It can occur anywhere within the lane.

Severity Levels

LOW
Cracks with a mean width of < 0.25 in. (6 mm). Sealed cracks with sealant in good condition and a width that cannot be determined.

MED
Cracks with a mean width > 0.25 in. (6 mm) and <= 0.75 in. (19 mm). Also, any crack with a mean width < 0.75 in. (19 mm) and adjacent random low severity cracking.

HIGH
Cracks with a mean width > 0.75 in. (19 mm). Also, any crack with a mean width < 0.75 in. (19 mm) and adjacent random medium to high severity cracking.

PATCHING AND POTHOLES

Description

Patching is an area of pavement surface that has been removed and replaced with patching material or an area of pavement surface that has had additional patching material applied. Patching may encompass partial-lane or full-lane width. On full-lane width patching; the total, contiguous length of a patch may not exceed 0.30 mi. (0.48 km). Any full-lane width patch exceeding 0.30 mi. in length is considered a pavement change, not a patch for the purposes of distress analysis. Patching must have a quantifiable area.

Potholes are bowl-shaped holes of various sizes occurring in the pavement surface.

Severity Levels

There are no stratified severities for Patching/Potholes. They either are present or they are not.

RUTTING

Description

Rutting is a longitudinal surface depression in the wheelpath.

Severity Levels

LOW
Ruts with a measured depth $\geq$ 0.20" and $\leq$ 0.49"

MED
Ruts with a measured depth $\geq$ 0.50" and $\leq$ 0.99"

HIGH
Ruts with a measured depth $\geq$ 1.00"

Ruts < 0.20" are not included in the distress calculations.

ROUGHNESS

Description

Roughness is the measurement of the unevenness of the pavement in the direction of travel. It is measured in units of IRI (International Roughness Index), inches per mile, and is indicative of ride comfort.

Severity Levels

There are no stratified severity levels for roughness. The roughness (or smoothness) of a road surface can be defined by IRI in the following table.

TABLE 3: IRI

IRI Descriptions	
Type of Road	**Typical IRI (in/mile)**
New Road, no noticeable roughness	<90
Small level of roughness	90 – 126
Road of average roughness	126 – 190
Road with above average roughness	190 – 253
Road with severe roughness	253 – 380
Nearly impassable	>380

INDEX FORMULAS

Note**:** All index formulas listed below contain MAE applicable to 0.02 mile (105.6 feet) interval.

Alligator Crack Index

AC_INDEX = 100 – 40 * [(%LOW / 35) + (%MED / 15) + (%HI / 5)]

Where:

The values *%LOW*, *%MED* and *%HI* report the percentage of the observed pavement (0.02 mile, primary lane) that contains alligator cracking within the respective severities. These values range from 0 to 100.

%LOW = Percent of total area (primary lane, 0.02 in length), low severity
%MED = Percent of total area (primary lane, 0.02 in length), medium severity
%HI = Percent of total area (primary lane, 0.02 in length), high severity

Percent of total area is computed as:

$$\frac{\text{square foot area of alligator crack severity}}{\text{0.02 mile * lane width}}$$

In AC_INDEX, the denominators 35, 15, and 5 are the Maximum Allowable Extents (MAE) for each severity. In other words, we will allow up to 35% of low severity alligator cracking for a 0.02 interval before failure, 15% for medium severity, and so on. As you can see, if any single severity reaches MAE the resulting index value is 60, or failure.

Longitudinal Crack Index

LC_INDEX = 100 – 40 * [(%LOW / 175) + (%MED / 75) + (%HI / 25)]

Where:

The values *%LOW*, *%MED*, and *%HI* report the length of longitudinal cracking within each severity as a percent of the section length (0.02 mile, primary lane).
These values are ≥ 0 and can exceed 100.

%LOW = Percent of interval length (primary lane, 0.02 in length), low severity
%MED = Percent of interval length (primary lane, 0.02 in length), medium severity
%HI = Percent of interval length (primary lane, 0.02 in length), high severity

Percent of interval length is computed as:

$$\frac{\text{length of respective longitudinal cracking}}{\text{0.02 mile (105.6 feet)}}$$

In LC_INDEX, the denominators 175, 75, and 25 are the Maximum Allowable Extents (MAE) for each severity. In other words, we will allow up to 175% of low severity alligator cracking for a 0.02 interval before failure, 75% for medium severity, and so on. As you can see, if any single severity reaches MAE the resulting index value is 60, or failure.

Structural Crack Index

SC_INDEX = [100 - ((100 - AC_INDEX) + (100 - LC_INDEX))]

Structural Crack Index is a combination of Alligator Cracking and Longitudinal Cracking, and is used in the SCR formula in lieu of AC and LC separately.

Transverse Crack Index

TC_INDEX = 100 – 40 * [(LOW / 21.1) + (MED / 4.4) + (HI / 2.6)]

Where:

The values *LOW*, *MED* and *HI* report a count of the total number of transverse cracks (reported to three decimals) within each severity level, where one transverse crack is equal to the lane width. These values are ≥ 0.

LOW = Number of cracks in interval (primary lane, 0.02 in length), low severity
MED = Number of cracks in interval (primary lane, 0.02 in length), medium severity
HI = Number of cracks in interval (primary lane, 0.02 in length), high severity

Number of cracks is computed as:

$$\frac{\text{Total length of transverse cracks}}{\text{Lane width}}$$

In TC_INDEX, the denominators 21.1, 4.4, and 2.6 are the Maximum Allowable Extents (MAE) for each severity. In other words, we will allow up to 21.1 low severity transverse cracks for a 0.02 interval before failure, 4.4 cracks for medium severity, and so on. As you can see, if any single severity reaches MAE the resulting index value is 60, or failure.

Patching Index

PATCH_INDEX = 100 – 40 * (%PATCHING / 80)

Where:

The value *%PATCHING* reports the percentage of the observed pavement (0.02 mile, primary lane) that contains patching/potholes. This value ranges from 0 to 100.

%PATCHING = Percent of total area (primary lane, 0.02 in length)

Percent of total area is computed as:

$$\frac{\text{square foot area of patching/potholes}}{\text{0.02 mile * lane width}}$$

There are no severity levels for patching. It either exists or does not.

In PATCH_INDEX, the denominator 80 is the Maximum Allowable Extent (MAE) for each severity. In other words, we will allow up to 80% patching for a 0.02 interval before failure. As you can see, if patching/potholes reaches MAE the resulting index value is 60, or failure.

Rutting Index

RUT_INDEX = 100 – 40 * [(%LOW / 535) + (%MED / 205) + (%HI / 40)]

Where:

20 rut depth measurements are taken per 0.02 interval for each of 2 wheel paths (left and right), resulting in a total of 40 measurements taken for both wheel paths. *Each wheelpath is analyzed independently for rut severities.* The values *%LOW*, *%MED* and *%HI* are a *total percentage* of left wheelpath percentage and right wheelpath percentage added together for the respective severity. These values range from 0 to 200.

%LOW = Percent of LOW ruts in left wheelpath based on 20 ruts, plus percent of LOW ruts in right wheelpath based on 20 ruts.
%MED = Percent of MED ruts in left wheelpath based on 20 ruts, plus percent of MED ruts in right wheelpath based on 20 ruts.
%HI = Percent of HI ruts in left wheelpath based on 20 ruts, plus percent of HI ruts in right wheelpath based on 20 ruts.

Percent of rut measurements within each severity can also be computed as:

$$\frac{\text{total number of ruts within each severity in both wheelpaths}}{20} * 100$$

In RUT_INDEX, the denominators 535, 205, and 40 are the Maximum Allowable Extents for each severity. In other words, the formula allows up to 535% low severity

ruts for a 0.02 interval before. However, since 200 is the highest measurable percentage allowed, 535% is unattainable and therefore, no amount of LOW severity rutting will cause the RUT_INDEX to fail a road. Similarly, since the MAE for MED severity rutting is 205, no amount of MED severity rutting will cause the RUT_INDEX to reach 60 and fail the road. As you can see, LOW severity rutting reaches MAE the resulting index value is 60, or failure. This formula was intentionally designed to minimize the impact of LOW and MED severity rutting on RUT_INDEX.

Roughness Condition Index (Asphalt)

RCI = 32 * [5 * (2.718282 ^ (-0.0041 * AVG IRI))]

Where:

The value *AVG IRI* reports the average value of the Left IRI and Right IRI measurements for the interval (0.02 mile, primary lane). This value can range from approximately 40 to 999.0.

Average IRI is computed as:

$$\frac{\text{Left wheelpath IRI + Right wheelpath IRI}}{2}$$

There is no applicable threshold for failure for this index.

Roughness Condition Index (Concrete)

RCI = $-0.0012(IRI^2) + 0.0499(IRI) + 99.542$

For concrete, PCR = RCI

Surface Condition Rating Index

SCR = *Lowest* Index Value Of: [SC_INDEX, TC_INDEX, PATCH_INDEX, RUT_INDEX]

Note: *The modified SCR equation above combines AC_INDEX and LC_INDEX, and considers that a single AC/LC index value of the Structural Crack Index (SC_INDEX). The lowest of the four computed index values (SC_INDEX, TC_INDEX, PATCH_INDEX, or RUT_INDEX) becomes the SCR.*

Where:

See above for determinations of SC_INDEX, TC_INDEX, PATCH_INDEX and RUT_INDEX.

The threshold for failure for this index is SCR = 60.

Data Collection Vehicle Subsystems

Data on paved roads in Cycle 5 is collected by FHWA using a Pathway Services Inc. Data Collection Vehicle (DCV), called PathRunner. The DCV is driven in the primary-direction lane at posted speed limits and less.

CAMERAS

Forward-facing and rear-facing video is collected as .jpg digital imagery at a frequency of 26.4 feet.

Two forward-facing cameras are mounted above the vehicle cab, one pointed straight ahead and the other to the right shoulder providing seamless 120 degree viewing.

CAMERA SPECIFICATIONS **Two Forward/ One Rear Facing**	
Camera lens/type	FUJINON CCTV LENS H16x10B-Y41
Focal length	10 mm – 160 mm
Image size	8.8 mm x 6.6mm
Image format	*.jpg
Image resolution	HD 2000 X 1200
Image pixel size	depends on distance
Zoom ratio	16x
Max Relative Aperture	1:2.5
Iris range	F25-T800 (Equivalent to F800)

Pavement images are created using a Laser Scan Imaging System. This system is composed of a single high resolution line-scan camera and two lasers configured to image an approximate 11-foot wide lane with 1 mm resolution.

CAMERA SPECIFICATIONS **Pavement Line Scan**	
Image size	4280 pixels/line
Image width	4 meters (3950 mm nominal)
Laser class	3B
Power	250W
Vehicle speed limitations	62 mph
Environment	Dry pavement, day or night
Sensor size (approx)	300 mm(H) x 375 mm(L) x 200 mm(D)
Image frame length	26.4 feet

DMI (Distance Measuring Instrument)

The DMI (Distance Measuring Instrument) obtains road length measurements that are accurate to 0.1% for speeds up to 60 mph. The DMI is connected to the hub of the rear wheel on the driver's side, and is calibrated to the revolutions of the rear vehicle axle on a regular basis.

ROUGHNESS (IRI)

The collection system includes a South Dakota type laser profiler manufactured based on active Class 1 ASTM E950 standards. The dynamic profile of the pavement surface is collected from which the IRI roughness data is computed. The sensors include one accelerometer on each wheelpath, one height sensor (laser) on each wheelpath, and a distance transducer.

IRI SPECIFICATIONS	
Reported IRI units	Inches/mile
Vehicle speed limitations	12-62 mph
IRI equipment certification	Texas Transportation Institute (TTI)
Wavelengths accommodated	6 in. – 300 feet
IRI computed & reported	World Bank Technical Paper Number 46
Environment	Dry pavement, day or night, above 32 degrees F
Adherence to specifications	ASTM E950-98 (2004), ASTM E 1926-08, AASHTO MP 11-08, AASHTO PP 49-08

RUTTING

Rutting depths are measured using an INO Laser Rut Measurement System (LRMS). This system is a transverse profiling device that detects and characterizes pavement rutting. The LRMS can acquire full 4 meter width profiles of a pavement lane at normal traffic speeds and uses two laser profilers that digitize transverse sections of the pavement.

RUTTING SPECIFICATIONS	
Reported rut depth units	Inches
Vehicle speed limitations	Up to 62 mph
Sampling rate	30-150 profiles/second
Transverse resolution	1280 points/profile
Transverse field-of-view	4 m
Depth accuracy (nominal)	+/- 1 mm
Environment	Dry pavement, day or night, above 32 degrees F
Adherence to specifications	ASTM E1703M-95 (reapproved 2005)

GPS & INERTIAL SYSTEMS

GPS is collected by an onboard system employing OmniSTAR real-time correction and a gyroscope (spin-type) to provide accurate positioning data (pitch/roll/heading) in instances of satellite obstruction. All GPS coordinates are tied to image and linear distance measurements.

GPS SPECIFICATIONS	
Static accuracy	Sub-meter
Dynamic accuracy	2-3 meters
Receiver	12 satellite tracking
Coordinate system	Lat Lon WGS 84
Environment	Day or night
Cross-slope	+- 0.5 degrees
Grade	+- 0.5 degrees

Description of Manual Ratings

Description of Manual Rating Methods

In 2013, the Federal Highway Administration updated existing Manual Rating Procedures in an effort to better align pavement conditions for Manually Rated Routes and Parking with the Highway Pavement Management Application (HPMA). HPMA is the Pavement Management System used by the FHWA to store inventory and condition data from the Road Inventory Program (RIP) and forecast future performance using prediction models. HPMA uses pavement condition data (collected by the Road Inventory Program) to develop life cycles for pavements and recommend treatments to maximize useable pavement life while minimizing costs associated with maintenance and repair.

The Federal Highway Administration (FHWA) developed a set of manual rating methods for pavement that are appropriate for Federal Roadways. Two different methods were developed for linear roads and a separate method was developed for parking areas and nonlinear roads. These methods employ a 0-100 rating scale and improve consistency and objectivity in the manual evaluation of surface distresses. They are compatible with ratings that are collected by the automated Data Collection Vehicle (DCV).

- The first of the two manual evaluation methods for roads uses rating criteria to assign index values to each distress type based on a visual evaluation of severity and extent.

- The second manual evaluation method for roads is very time demanding and is best employed on only a select set of routes which may have the highest visitor use and require a more intensive assessment. This method will be used for the Manual Rating of Function Class 1, 2, 7, and 8 Roads. This method is based on measurements that are recorded for each instance of a surface distress. These measurements are converted into index values using conversion formulas.

- Parking areas and non-linear roads are rated similar to the first method shown above, however, there are some slight differences due to the non-linear nature.

The details and criteria used for each of these rating methods are outlined below.

Visual Inspection Method for Manually Rating Secondary Roads

The visual inspection method for manually rated roads uses condition rating criteria that have been developed by FHWA. This criteria is based on a visual evaluation of the severity and extent of distresses to determine the overall condition of the roadway. This method is used for secondary roads that are Functional Class 3, 4, 5, and 6. This constitutes the majority of manually rated roads collected by the Road Inventory Program.

Rating Section Lengths

For this method, Manually Rated Roads are rated in sections. These sections may be made based on length of changes in surface type or condition as described below. The ratings are then aggregated to give an overall rating for the Route:

- Rating sections should be no longer than .25 miles in order to keep the area being rated manageable.
- A new rating section may be started based on changes in condition, width, or surface type if these changes represent a significant portion of the route (are not isolated instances).
- If the road condition, width, and surface type remain constant then new sections do not need to be created unless the road exceeds .25 miles.

Rating Criteria

For this method, Manually Rated Roads are evaluated using a visual inspection of the six distress types listed below. Each distress is assigned one of five index values. An overall Surface Condition Rating (SCR) and Pavement Condition Rating (PCR) are calculated based on these index values.

- Alligator Cracking
    - Rating based on percentage of road surface affected
- Longitudinal Cracking
    - Rating based on severity level (crack width) and percentage of road section length of longitudinal cracks
- Transverse Cracking
    - Rating based on crack width, crack spacing, and percentage of surface affected
- Patching
    - Rating based on percentage of road surface affected
- Rutting
    - Rating based on percentage of road surface affected
- Roughness
    - Only included if the overall roadway length is greater than 0.5 miles and the posted speed limit is greater than or equal to 25 mph. Subjective rating based on the overall ride comfort of the section.

Concrete Routes also receive a PCR rating based on visual evaluation of the following six distress types.

- Slab Faulting at Joints
- Slab Cracking and breakup
- Surface Delamination and Pop-outs
- Joint Distresses
- Patching

Distress Measurement Method for Manually Rating Primary Roads

A more intensive and time demanding assessment than our standard method was developed for Primary roads that are functional class 1, 2, 7, or 8. These high visitation roads are usually accessible by the automated Data Collection Vehicle but in rare instances may need to be manually rated. The method developed is based on measuring each instance of a distress. These measurements are totaled over each section length being measured and are then converted into index values between 0 and 100 (100 being a road with no distress) using index formula equations outlined below. The goal of this method is to produce measured index values which are directly comparable to the automated Data Collection Vehicle.

Rating Section Lengths

For the distress measurement method roads are broken into sections in order to rate. Distress measurements are totaled for each section separately in order to determine the index value for that particular section. The section length to be rated is determined based on the following rules:

- Rating sections are between 0.25 and 0.50 miles long
- A new rating section is created if there is a significant change in condition or pavement width
- If there are no significant changes in condition or pavement width, rating sections are broken at equal intervals, typically 0.50 miles

Manual Distress Measurements

Alligator Cracking

- Alligator cracking is measured by area (square feet). Instances of Alligator cracking are measured along the length and multiplied by the average width of the distressed area.
- The index for alligator cracking takes the total area of cracking compared to the interval length and converts it to a percentage. That percentage is then input into an index formula that yields a value between 0 and 100 (0 being the most distressed).
- Severity levels are not defined for manually measured Alligator cracks. The Alligator Crack Index formula is calculated based on an assumption of medium severity.

Longitudinal Cracking

- Longitudinal cracking (cracking in the direction parallel to the roadway) is measured by length (ft.).
- The index for longitudinal cracking takes the total length of cracking compared to the interval length and converts it to a percentage broken down by severity. That percentage is then input into a formula that yields a value between 0 and 100 (0 being the most distressed).
- Two severity levels are defined for manually measured Longitudinal Cracks. Lower severity cracks are those with a mean width of less than 0.25 inches. Sealed cracks with sealant in good condition are also considered lower severity. Higher severity cracks are those with a mean width of greater than 0.25 inches.

Transverse Cracking

- Transverse cracking (cracking in the direction perpendicular to the roadway) is measured by length (ft).
- The index for transverse cracking takes the total number of cracks (1 crack would encompass the full lane) broken down by severity. The total numbers of each severity are then put into a formula that yields a value between 0 and 100 (0 being the most distressed).

- Two severity levels are defined for manually measured Transverse Cracks. Lower severity cracks are those with a mean width of <= 0.25 inches. Sealed cracks with sealant in good condition are also considered lower severity. Higher severity cracks are those with a mean width of > 0.25 inches.

Patching and Potholes

- Patching and Potholes are measured by area (square feet). Instances of Patching are measured along the length and multiplied by the average width of the patch.
- Instances of full lane width patching cannot be longer than 0.100 miles, otherwise is should be considered a pavement change rather than a distress.
- There are no stratified severities for Patching. It is either present or it is not.

Rutting

- Visible rutting is measured by length (feet) in each wheelpath. Rutting needs only to be visible for it to be rated.
- Severity levels are not defined for manually measured rutting.

Roughness

- Roughness is given a subjective rating of Excellent, Good, Fair, or Poor based on the overall riding comfort of the section. Roughness is only included if the overall roadway length is greater than 0.5 miles and the posted speed limit is greater than or equal to 25 mph.

Index Formulas for Distress Measurement Method:

The method used to convert distress measurements into index values is shown below. The Surface Condition Rating and Pavement Condition Rating are calculated based on these index values.

Alligator Crack Index for Manual Rating:

AC_INDEX = 100 – 40 * (%ALLIGATOR / 15)

Where:

%ALLIGATOR = Percent of total area of section being rated that contains Alligator cracking.

Longitudinal Crack Index for Manual Rating:

LC_INDEX = 100 – 40 * [(%LOW / 175) + (%MED / 75)]

Where:

%LOW = Percent length of longitudinal cracks where crack width <= 0.25 inches
%HIGH = Percent length of longitudinal cracks where crack width > 0.25 inches

Transverse Crack Index for Manual Rating:

TC_INDEX = 100 – 40 * [(LOW / 21.1) + (MED / 4.4)]

Where:

LOW = Count of the total number of transverse cracks within the section length where one transverse crack is equal to the lane width and the crack width <= 0.25 inches
HIGH = Count of the total number of transverse cracks within the section length where one transverse crack is equal to the lane width and the crack width > 0.25 inches

Number of cracks is computed as:
Total length of transverse cracks/Lane width

Patching Index for Manual Rating:

PATCH_INDEX = 100 – 40 * (%PATCHING / 80)

Where:

%PATCHING = Percentage of pavement section that contains patching/potholes.

Rutting Index for Manual Rating:

RUT_INDEX = 100 – 40 * (%RUTTING / 205)

Where:

%RUTTING = Percentage length of rutting within the section being measured.

Method for Manually Rating Paved Parking Areas and Non-Linear Roads

Parking areas are evaluated based on a visual inspection using condition rating criteria that has been developed by FHWA. This criteria is based on a visual evaluation of the severity and extent of distresses to determine the overall condition of the parking area. This overall condition rating is linked to the level of repair and rehabilitation practices required.

A distress index is determined for each of the distresses listed below for Asphalt and Concrete Parking areas. The overall Pavement Condition Rating (PCR) of the parking lot is driven by the most severe distress present.

Rating Criteria:

Asphalt Parking Distress Types

- Alligator Cracking
  - Rating based on percentage of road surface affected
- Longitudinal, Transverse and Block cracking
  - Rating based on crack width, crack spacing, and percentage of surface affected
- Rutting and Distortions
  - Rating based on percentage of road surface affected
- Hot Mix Asphalt Patches
  - Rating based on overall percentage of HMA patches
- Potholes and Cold Patches
  - Rating based on percentage of road surface affected
- Surface Raveling and Bleeding
  - Rating based on percentage of road surface affected

Concrete Parking Distress Types

- Slab Faulting at Joints
  - Rating based on height differential between adjacent slabs or pieces of broken slabs
- Slab Cracking and breakup
  - Rating based on quantity of cracks and if slab is acting to able distribute load as designed
- Surface Delamination and Pop-outs
  - Rating based on percentage of road surface affected to include pop-outs, spalls and surface delamination
- Joint Distresses
  - Rating based on sealant condition and concrete distresses at/or adjacent to joints
- Patching
  - Rating based on percentage of road surface affected

Curb Inspection and Treatments

During inspections of manually rated parking lots and routes, the curb reveal and overall curb condition are evaluated. The curb condition is used to determine a recommendation.

Curb Reveal
The vertical distance on the curb face from the gutter flow line or pavement surface to the top of curb. When resurfacing adjacent to curb, the resulting curb reveal should be no less than 4 inches. Additionally, when resurfacing adjacent to a gutter, the resulting pavement surface should be flush with the gutter pan. In cases where a resurfacing would violate either of these parameters, the surface may need to be milled or removed to adjust to these field conditions.

Curb Recommendations
The following treatment categories are based on the overall percentage of distresses along the entire curb structure for a specific pavement structure. Distresses include spalling, cracking, loss of material and any other damage which prevents the curb from conveying storm runoff or failing to perform in its intended function.

- Overall curb damage ranging 0%-5%:
    - DO NOTHING
- Overall curb damage ranging 5%-20%
    - LIGHT REPAIR
- Overall curb damage ranging 20%-50%
    - MODERATE REPAIR
- Overall curb damage greater than 50%:
    - REPLACE

GPS on Manually Rated Roads (MRR)

Parking areas, some roads, and other paved areas that are not fully drivable with the Data Collection Vehicle are collected manually by field technicians. GPS is collected for these routes using portable Trimble GPS backpack units. Paved campground pads and driveways are not typically included in the inventory or GPS.

Geodatabase – Background and Metadata

In addition to this park report, a geodatabase containing both tabular and spatial data specific to this park has been provided. All data disseminated in the preceding report has been obtained from the tables and fields within said geodatabase. The geodatabase can be referenced for tabular data via Microsoft Access or for both tabular and spatial data via ESRI's ArcGIS Suite of software which consists of; ArcMap, ArcCatalog and ArcExplorer. Consolidating the RIP data into one database creates a seamless relationship of tabular and geographic data. It will allow RIP to facilitate easier updates and enhancements in the future. A geodatabase can be thought of as simply a database containing spatial data. Many different tables are contained within the park's geodatabase. A complete and thorough description of the tables and fields contained within this geodatabase can be found in the metadata. The metadata is attached directly within the geodatabase and can be accessed via ESRI's ArcCatalog. The metadata portion of the geodatabase also includes data dictionary report functionality that formats the metadata into an easy to read report.

Glossary of Terms and Abbreviations

TERM OR ABBREVIATION	DESCRIPTION OR DEFINITION
AC	Alligator Cracking
CRS	Condition Rating Sheets (Section 5)
Curb Recommendation	Curb remediation based on overall percentage of curb distress
Curb Reveal	Height of curb exposed from gutter flow line to top of curb
DCV	Data Collection Vehicle
Excellent	Excellent rating with an index value of 95 to 100
Fair	Fair rating with an index value from 61 to 84
FUNCT_CLASS	Functional Classification (see Route ID, Section 2)
Good	Good rating with an index value from 85 to 94
IRI	International Roughness Index
HPMA	Highway Pavement Management Application
Lane Width	Width from road centerline to fogline, or from centerline to edge- of-pavement when no fogline exists
LC	Longitudinal Cracking
MRR	Manually Rated Route
MRL	Manually Rated Line
MRP	Manually Rated Polygon
N/A	Not Applicable
NC	Not Collected
PATCH	Patching and Potholes
Paved Width	Width from edge-of-pavement to edge-of-pavement
PCR	Pavement Condition Rating
PKG	Parking Area
Poor	Poor rating with an index value of 0 to 60
RCI	Roughness Condition Index
SC	Structural Cracking
SCR	Surface Condition Rating
TC	Transverse Cracking