**FEDERAL LANDS HIGHWAY**

**HIGHWAY DESIGN STANDARDS**

**Project Number**: CO PRA BICA 123(1)

**Project Name**: 3R Example Road

**Location**: Eleven miles east of Cortez, CO. South of main entrance station.

**Route**: Sta 1+00 to 216+54 and 335+75 to 556+22

**Type of Project**: 3R

**Terrain**: Mountainous

**Description**: This project will provide resurfacing, restoration, and rehabilitation to the 10.5 miles of the main entrance road from the Park Entrance to Park Point. Pulverizing and a 3.0" surfacing will be used to improve the surface and ride of the existing roadway.

**National Highway System (NHS)**

**Owner/Maintaining Agency**: National Park Service

**Functional System**: National Park Roads

**Principal Park/Road Parkway**: Principal Park/Road Parkway

**Traffic**

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual ADT</th>
<th>Seasonal ADT</th>
<th>DHV</th>
<th>PERCENTAGE TRUCKS DHV</th>
<th>ADT</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>2008</td>
<td>1600</td>
<td>20</td>
<td>1</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td>Future</td>
<td>2028</td>
<td>1953</td>
<td>20</td>
<td>1</td>
<td>16</td>
<td>50</td>
</tr>
</tbody>
</table>

**Design Standards**:
- ☑ AASHTO Green Book
- ☑ Park Road Standards
- ☐ AASHTO Low Volume

**CRITERIA**

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>STANDARD</th>
<th>AS DESIGNED</th>
<th>EXCEPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Speed</td>
<td>40 MPH</td>
<td>30 MPH</td>
<td>✔ AASHTO Green Book See (1) below</td>
</tr>
<tr>
<td>Design Loading Structural Capacity</td>
<td>HL 93</td>
<td>HL 93</td>
<td>☐ AASHTO Green Book</td>
</tr>
</tbody>
</table>

**CRITERIA**

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>STANDARD</th>
<th>AS DESIGNED</th>
<th>VARIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Width</td>
<td>11 ft</td>
<td>11 ft</td>
<td>☐ Park Road Standards</td>
</tr>
<tr>
<td>Shoulder Width</td>
<td>3 ft</td>
<td>1 ft</td>
<td>✔ Park Road Standards See (2) below</td>
</tr>
<tr>
<td>Horizontal Curve Radius</td>
<td>340 ft</td>
<td>180 ft</td>
<td>✔ Park Road Standards See (3) below</td>
</tr>
<tr>
<td>Superelevation Rate</td>
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<td>~6%</td>
<td>☐ AASHTO Green Book See (4) below</td>
</tr>
<tr>
<td>Stopping Sight Distance</td>
<td>225 ft</td>
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<tr>
<td>Maximum Grade</td>
<td>13%</td>
<td>&lt;13%</td>
<td>☐ Park Road Standards</td>
</tr>
<tr>
<td>Cross Slope</td>
<td>1% -3%</td>
<td>~2%</td>
<td>✔ AASHTO Green Book</td>
</tr>
<tr>
<td>Vertical Clearance</td>
<td>14 ft</td>
<td>N/A</td>
<td>☐ AASHTO Green Book</td>
</tr>
</tbody>
</table>

For each exception provide description (including context), reasons, alternatives considered, analysis of risk, and proposed mitigation:

**Exceptions**:

(1) Design Speed:

**Description**: The NPS standards recommends a design speed of 40 MPH. The proposed design speed is 30 MPH.

**Reasons for exceptions to the standards**: The design speed was selected to match the existing design speed on the project.
**Analysis of risks:** The project design speed is consistent for these portions of the project. There are no site-specific safety issues within these two portions of the project. Risks associated with this design exception is determined to be low.

**Design features proposed to mitigate exception:** Speed limit signs will be replaced. Delineation will be improved with new pavement markings. A safety edge will be used on the edge of pavement.

**Variances:**

(2) **Shoulder:** The NPS standards recommend 3-foot wide paved shoulders. The proposed project will have 1-foot wide paved shoulders. To minimize impacts to Park resources, many of which are buried artifacts near the edge of the existing roadway, the proposed project maintains the existing shoulder width. Due to unacceptable environmental impacts, shoulder widening was not included in this project.

(3) **Horizontal curves:** There are 46 existing curves that have a centerline radius below the 340 feet for a 35 mph design speed. The proposed horizontal alignment matches existing due to environmental constraints, steep terrain with limited roadway bench width at horizontal curve locations, and excessive construction cost to meet standards.

(4) **Superelevation:** The proposed values for superelevation and relative gradient of the horizontal curves match existing. NPS maintenance staff indicated that some of the superelevation has been reduced over the years during the numerous patching and overlay projects. Specific values for existing superelevation and relative gradient are unknown, but field observations indicated that there are only minor variations from the standard criteria. Improving the existing superelevation to meet current standards would require placing embankment material outside the existing roadway bench, resulting in unacceptable environmental and cost impacts. Including superelevation adjustments in the project scope would not provide any cost-effective safety or operational improvements.
**FEDERAL LANDS HIGHWAY**  
**HIGHWAY DESIGN STANDARDS**

<table>
<thead>
<tr>
<th>Project Number</th>
<th>3R Example Road</th>
<th>Project Name</th>
<th>3R Example Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Eleven miles east of Cortez, CO. South of main entrance station</td>
<td>Route</td>
<td>Sta 216+54 to 335+75</td>
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<tr>
<td>Type of Project</td>
<td>3R</td>
<td>Terrain</td>
<td>Mountainous</td>
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</table>

This project will provide resurfacing, restoration, and rehabilitation to the 10.5 miles of the main entrance road from the Park Entrance to Park Point. Pulverizing and a 3.0” surfacing will be used to improve the surface and ride of the existing roadway.

<table>
<thead>
<tr>
<th>Functional System</th>
<th>National Park Roads</th>
<th>National Park Service</th>
<th>Owner/Maintaining Agency</th>
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</table>

<table>
<thead>
<tr>
<th>Traffic</th>
<th>Year</th>
<th>Annual ADT</th>
<th>Seasonal ADT</th>
<th>DHV</th>
<th>PERCENTAGE TRUCKS</th>
<th>ADT</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>2008</td>
<td>1600</td>
<td>20</td>
<td>1%</td>
<td>16</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Future</td>
<td>2028</td>
<td>1953</td>
<td></td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Design Standards:</th>
<th>AASHTO Green Book</th>
<th>AASHTO Low Volume</th>
<th>Park Road Standards</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>STANDARD</th>
<th>AS DESIGNED</th>
<th>EXCEPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Speed</td>
<td>40 MPH</td>
<td>50 MPH</td>
<td>AASHTO Green Book</td>
</tr>
<tr>
<td>Lane Width</td>
<td>11 ft</td>
<td>11 ft</td>
<td>AASHTO Green Book</td>
</tr>
<tr>
<td>Shoulder Width</td>
<td>3 ft</td>
<td>1 ft</td>
<td>Park Road Standards See (1) below</td>
</tr>
<tr>
<td>Horizontal Curve Radius</td>
<td>833 ft</td>
<td>200 ft</td>
<td>Park Road Standards See (2) below</td>
</tr>
<tr>
<td>Superelevation Rate</td>
<td>e(max) = 6%</td>
<td>~6%</td>
<td>AASHTO Green Book See (3) below</td>
</tr>
<tr>
<td>Stopping Sight Distance</td>
<td>400 ft</td>
<td>&gt;400 ft</td>
<td>AASHTO Green Book</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td>9%</td>
<td>&lt;9%</td>
<td>Park Road Standards</td>
</tr>
<tr>
<td>Cross Slope</td>
<td>1% -3%</td>
<td>~2%</td>
<td>AASHTO Green Book</td>
</tr>
<tr>
<td>Vertical Clearance</td>
<td>N/A</td>
<td>N/A</td>
<td>AASHTO Green Book</td>
</tr>
<tr>
<td>Design Loading Structural Capacity</td>
<td>HL 93</td>
<td>HL 93</td>
<td>AASHTO Green Book</td>
</tr>
</tbody>
</table>

For each exception provide description (including context), reasons, alternatives considered, analysis of risk, and proposed mitigation:

1. Shoulder
   **Description:** The NPS standards recommend 3-foot wide paved shoulders. The proposed project will have 1-foot wide paved shoulders.
   **Reasons for exceptions to standards:** To minimize impacts to Park resources, many of which are buried artifacts near the edge of the existing roadway, the proposed project maintains the existing shoulder width. Due to unacceptable environmental impacts, shoulder widening was not included in this project.
   **Analysis of risks:** The project is consistent with adjacent roadway segments, maintaining consistency in shoulder width along the route. Risk associated with this design exception is determined to be low considering the lack of site-specific safety issues, low vehicle speeds, and consistency of the existing roadway corridor.
Design features proposed to mitigate exception: The new pavement will have the safety edge treatment. New regulatory and warning signs will be installed on the project including speed limit, advanced curve, and grade warning signs. Pavement markings will be improved.

(2) Horizontal curves

Description: There are 2 existing curves below the required 833 feet for a 50 mph design speed. The 50 mph design exception curves are located approximately at stations: 217+62, 222+30.

Reasons for exceptions to standards: The proposed horizontal alignment matches existing due to environmental constraints, steep terrain with limited roadway bench width at horizontal curve locations, and excessive construction cost to meet standards.

Analysis of risks: Risk associated with this design exception is determined to be low considering the lack of site-specific safety issues, low vehicle speeds, low volume of truck traffic, and consistency of the existing roadway corridor.

Design features proposed to mitigate exception: New curve warning and advisory speed signs will be installed on the project. Pavement markings will be improved.

(3) Superelevation

Description: The proposed values for superelevation and relative gradient of the horizontal curves match existing. NPS maintenance staff indicated that some of the superelevation has been reduced over the years during the numerous patching and overlay projects. Specific values for existing superelevation and relative gradient are unknown, but field observations indicated that there are only minor variations from the standard criteria.

Reasons for exceptions to standards: Improving the existing superelevation to meet current standards would require placing embankment material outside the existing roadway bench, resulting in unacceptable environmental and cost impacts. Including superelevation adjustments in the project scope would not provide any cost-effective safety or operational improvements.

Analysis of risks: Risk associated with this design exception is determined to be low considering the lack of site-specific safety issues, low vehicle speeds, low volume of truck traffic, and consistency of the existing roadway corridor. No new substandard superelevation areas will be created, or existing ones made worse.

Design features proposed to mitigate exception: New curve warning and advisory speed signs will be installed on the project. Pavement markings will be improved. Selected trees on the outside of curves will be removed to improve roadside safety.
RECOMMENDED ACTION:

☐ There are no exceptions to applicable standards, and the project should proceed to final PS&E.

☑ The listed exceptions to design standards and their related risks have been reviewed with the appropriate agencies and interested parties, and are considered acceptable for this project.

PREPARED BY:

LEAD DESIGNER

APPROVAL IS RECOMMENDED:

HIGHWAY DESIGN MANAGER

PROJECT MANAGER

PD BRANCH CHIEF

I CONCUR WITH THE ABOVE RECOMMENDATIONS:

PARTNER AGENCY

THE ABOVE RECOMMENDATIONS ARE APPROVED:

CHIEF OF ENGINEERING
FEDERAL LANDS HIGHWAY
HIGHWAY DESIGN STANDARDS

CA PFH 123-1(1)
Project Number
North Fork Blue River Road MP 3.6 to 13.6. Located east of Dakota, CA between Van Gordon and Alameda off of State Route 199
Location
Reconstruction
Type of Project
Grading, drainage, aggregate base, asphalt pavement, MSE walls, soil nail walls, and bridge construction
Description

Project Name
4R Example Road
Sta. 10+00 to 300+00
Route
Mountainous
Terrain

Jefferson County
Owner/Maintaining Agency

Traffic

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual ADT</th>
<th>Seasonal ADT</th>
<th>DHV</th>
<th>PERCENTAGE TRUCKS DHV</th>
<th>ADT</th>
<th>D</th>
</tr>
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<tbody>
<tr>
<td>Current</td>
<td>2017</td>
<td>211</td>
<td>21</td>
<td>1%</td>
<td>2</td>
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<td>Future</td>
<td>2037</td>
<td>314</td>
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</table>

Design Standards:
AASHTO Green Book
AASHTO Low Volume
Park Road Standards
State
Other (Describe)

CRITERIA
STANDARD
AS DESIGNED
EXCEPTION

Design Speed
20 MPH
35 MPH

Design Loading Structural Capacity
HL 93
HL 93

CRITERIA
STANDARD
AS DESIGNED
VARIANCE

Lane Width
10 ft
11 ft

Shoulder Width
2 ft
1 ft
See (1) below

Horizontal Curve Radius
340 ft
110 ft
See (2) below

Superelevation Rate
e(max) = 6%
6%

Stopping Sight Distance
250 ft
257 ft

Maximum Grade
10%
8%

Cross Slope
2%
2%

Vertical Clearance
14 ft
20 ft

For each exception provide description (including context), reasons, alternatives considered, analysis of risk, and proposed mitigation:

VARIANCES:

(1) Shoulder: The AASHTO Green Book recommends 2-foot wide paved shoulders. The proposed project will have 1-foot wide paved shoulders. The shoulder width was selected to match the existing shoulder width of the adjacent segments of the roadway (MP 0.0 to MP 3.6 and MP 13.6 to MP 20.4).

(2) Horizontal Curve Radius: The AASHTO Green Book recommends a minimum horizontal curve radius (R) of 340 ft. Three curves on this project
are below this minimum standard. These curves do not meet the minimum value due to environmental and cost constraints. The proposed curves match the existing alignment.
RECOMMENDED ACTION:

- There are no exceptions to applicable standards, and the project should proceed to final PS&E.

- The listed exceptions to design standards and their related risks have been reviewed with the appropriate agencies and interested parties, and are considered acceptable for this project.

PREPARED BY:

AE LEAD DESIGNER
A/E Lead Designer

APPROVAL IS RECOMMENDED:

AE Manager
Project Manager

I CONCUR WITH THE ABOVE RECOMMENDATIONS:

PARTNER AGENCY
County

THE ABOVE RECOMMENDATIONS ARE APPROVED:

CHIEF OF ENGINEERING
Chief of Engineering