GLCA
GIP Report

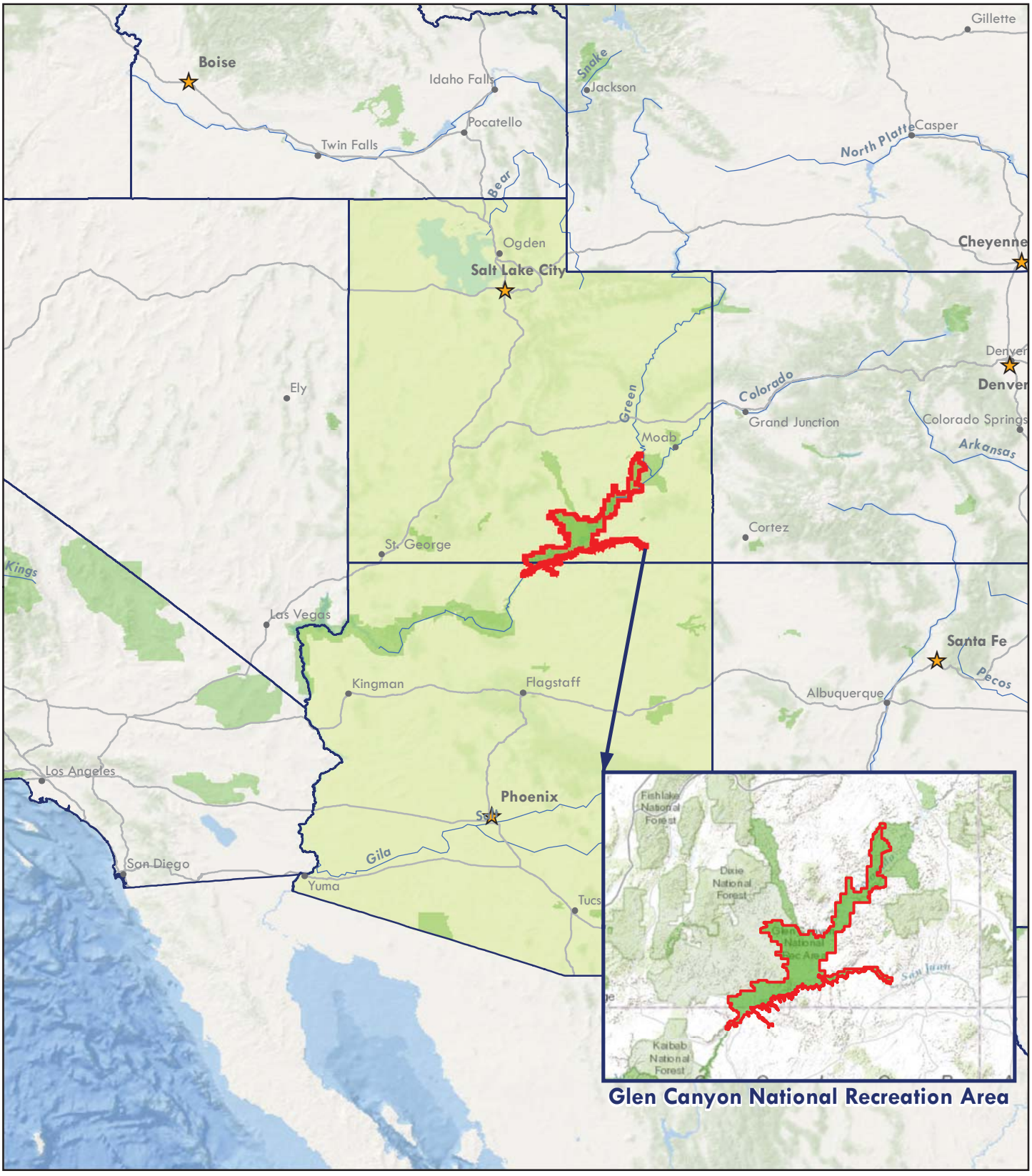
NPS Guardwall/Rail Inventory Program
Glen Canyon National Recreation Area

Federal Lands Highway
Road Inventory Program

Prepared By:
Federal Highway Administration
Eastern Federal Lands Highway Division
Road Inventory Program (RIP)

Data Collection Date: April 2010
Report Date: November 2015

Glen Canyon National Recreation Area
in
Arizona and Utah



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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Introduction

Glen Canyon National Recreation Area

Federal Lands Highway
Road Inventory Program

Introduction

In support of the NPS Facility Management Software System (FMSS) asset management program, FHWA- contracted staff completed the Guardwall/Rail Inventory Program (GIP) inspections within selected National Park Service (NPS) units between 2010 and 2011. This inventory provides static information to FMSS regarding barrier characteristics such as height, length and location, as well as dynamic information about the condition of the barrier. In addition, when barrier deficiencies were identified, repair recommendations and estimated costs, suitable for use as FMSS work orders, were generated to bring the barrier back to its "new" condition.

In over 30 parks, numerous crashworthy barriers inspected maybe in poor condition by simply applying a new overlay of asphalt without milling previous layers. In instances such as this, basically the critical element of barrier height decreased as the elevation of the roadway increased. Resulting work orders were drafted to raise w-beam barriers or to remove and reset stone masonry barriers to their original design height.

This inventory provides static information and a condition assessment of each barrier inventoried. In addition, when barrier deficiencies were identified, repair recommendations and estimated costs were drafted to bring the barrier back to its "new" condition.

Drafted work orders have been classified as being either deferred maintenance or capital improvement. This classification is based on the type of work recommended, as defined below.

- *Deferred Maintenance* can be classified as repair or replace in kind. Work done to the barrier does not include any upgrading.
- *Capital Improvement* can be classified as upgrading part of or the entire existing barrier. Typically the upgrade will be from a non-crashworthy to a crashworthy device. Other examples of capital improvements would be the addition of a curb to improve drainage.

Care was taken to maintain the cultural significance of historic barriers located in the NPS. While historic traffic barriers likely would not withstand current crashworthiness performance criteria, they are considered by the NPS to be important resources for the historic and/or cultural value. Historic barriers may be "character defining features" that contribute to the cultural significance of historic roadways. As such, these barriers have resource value in and of themselves which may be somewhat independent from their functionality as barriers as previously defined. The consideration of both the crashworthiness and resource value of historic barriers was a significant challenge for the NPS and the FHWA when designing the GIP, to the point that for historic stone masonry barriers, the barrier height had to be more than 6-in below its design height before any work would be considered to deal with height issues. To preserve historic stone masonry barriers, typical drafted work orders for historic barriers were to remove and reset the barrier to the barrier's original design height on a concrete footer, as compared to replacing it with a similar crashworthy barrier.

This report is organized in a tiered approach from the broad park overview perspective (Tier 1) to a route overview perspective (Tier 2), then down to the details of each barrier (Tier 3). Tier 1 presents park barrier location maps and an overall park-specific summary narrative of the results of the guardwall/rail inventory program. Tier 2 presents route overview maps with associated barrier summary information. Tier 3 presents individual barrier information in a one-page detailed format, including a photograph of each barrier. Appendix A provides a condensed summary of guardwall/rail inventory definitions and assessment categories to assist in reading this report.

Park Barrier Location Maps

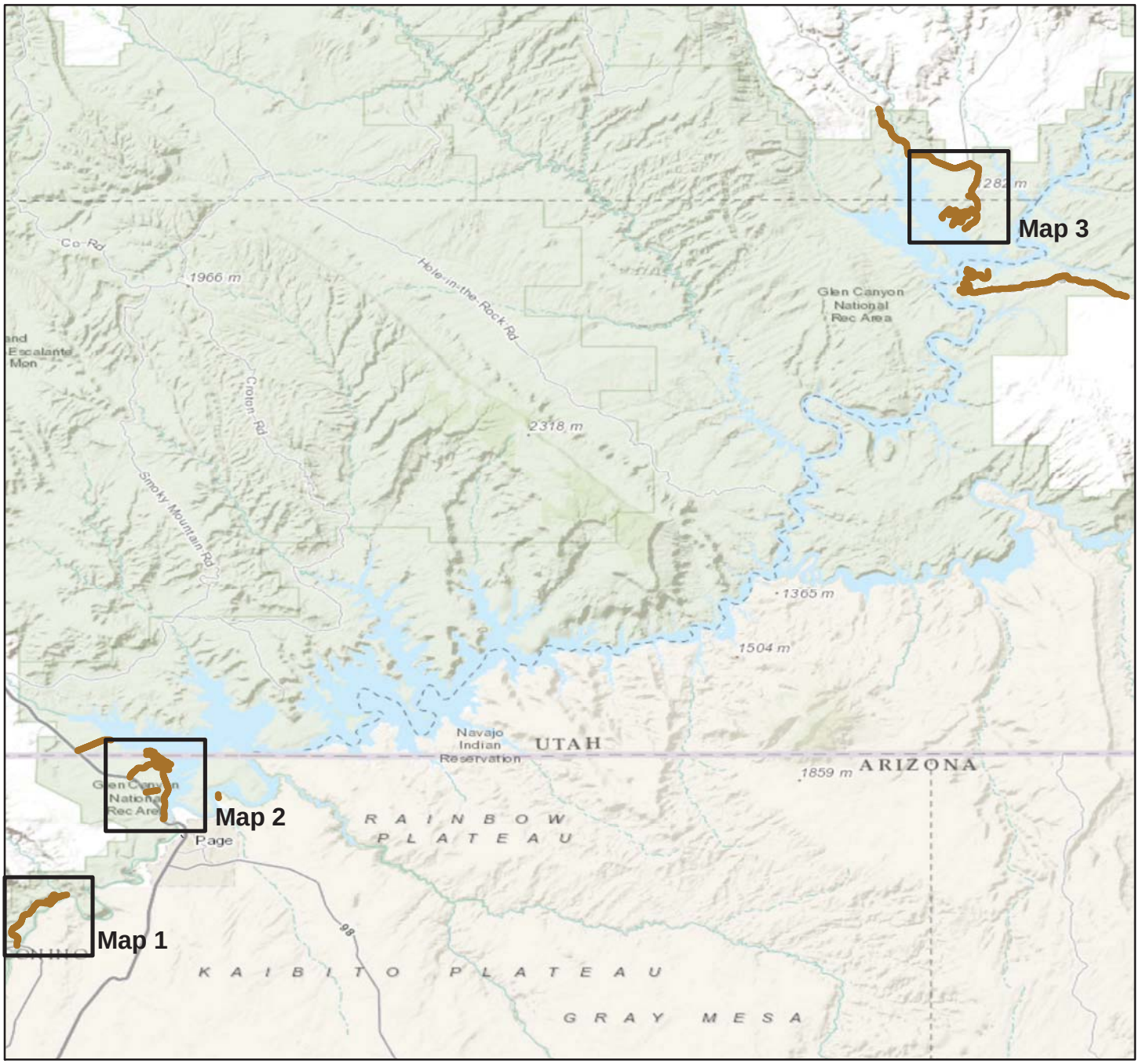
Glen Canyon National Recreation Area

Federal Lands Highway
Road Inventory Program

Glen Canyon National Recreation Area

BARRIER LOCATION MAP

Key Map



Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

RIP Collected Routes

Miles

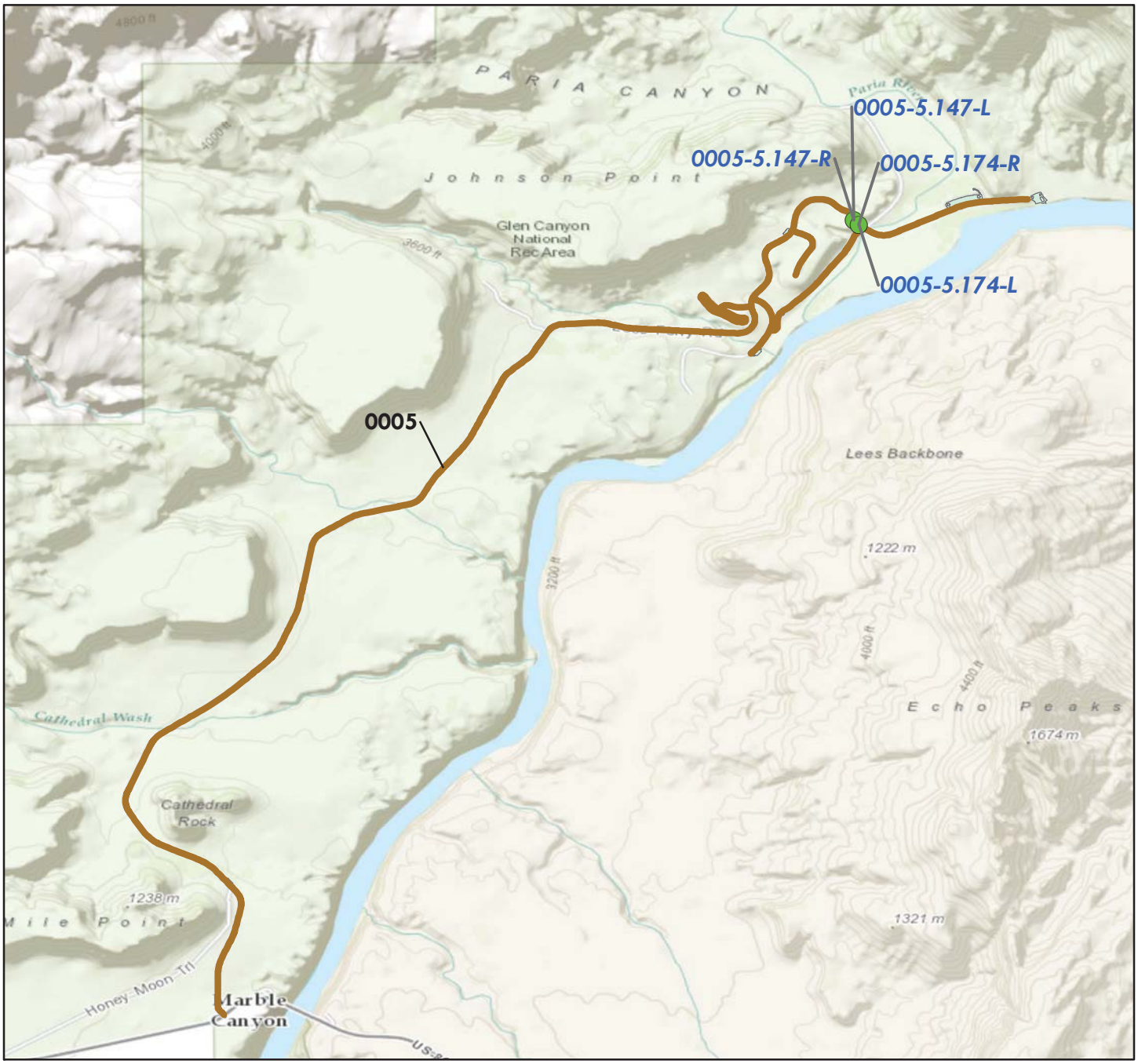
0 5 10

N

Glen Canyon National Recreation Area

BARRIER LOCATION MAP

Map 1



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Barrier Locations

RIP Collected Routes

Miles

0 0.5 1

N

Glen Canyon National Recreation Area

BARRIER LOCATION MAP

Map 2

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier Locations

RIP Collected Routes

Miles

0 0.5 1

N

Glen Canyon National Recreation Area

BARRIER LOCATION MAP

Map 3

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier Locations

RIP Collected Routes

Miles

0 0.5 1

N

Tier 1
Park Barrier Overview

Glen Canyon National Recreation Area

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Road Inventory Program

Parkwide Summary: Glen Canyon National Recreation Area

Initial barrier inspections were conducted at Glen Canyon National Recreation Area in 2010, and encompassed all known barriers associated with Park roadways. In general, walls are not included in this assessment, but were inspected under a separate effort as part of the Retaining Wall Inventory Program (WIP).

All paved roadways and parking areas listed in the RIP Route Identification Report were inspected for barriers.

The following tables provide an overview of the findings of this inspection and assessment effort. In all, 28 barriers were inventoried on the routes listed below.

Table 1: Number of Barriers by Route

Route Number	Route Name	No. of Barriers
0001	LAKESHORE DRIVE	14
0005	LEES FERRY ACCESS ROAD	4
0006	BULLFROG BASIN ACCESS ROAD	2
0204	COVES ROAD	1
0205	BULLFROG BASIN FERRY BOAT RAMP ROAD	1
0416	BULLFROG BASIN LODGE ROAD	2
0417	BULLFROG BASIN VISITOR CENTER ROAD	4

Due to the different GIP assessment criteria of barriers based on their intended use, barriers were classified as being either traffic barriers or non-traffic barriers.

- *Traffic* barriers are physical devices intended to keep vehicles or people from straying into dangerous or off-limits areas. For the purpose of this inventory, a traffic barrier is categorized as roadside hardware placed longitudinally, excluding pedestrian railing and fencing.

- *Non-traffic* barriers provide a physical delineation between public access areas and restricted or protected areas in locations such as a parking lot, viewpoint or turnout. **Non-traffic barriers which inhibit access of vehicles are included in this report; non-traffic barriers which only inhibit access of pedestrians or bicyclists are not included. For the purpose of this inventory, non-traffic barriers are guidewalls and guiderails. Note: rocks, stones, boulders, fences or curbs were excluded from this inventory.**

There are instances in parks where a single barrier can switch between being classified as a traffic barrier and a non-traffic barrier. Such instances typically occur at pullouts, where a traffic barrier along the road will continue through the pullout without interruption. In such instances, the traffic barrier and non-traffic barrier were assessed using different criteria. Due to the different criteria, the GIP database was designed to record the traffic barrier and non-traffic barrier as multiple distinct barriers, even though to the eye, they appear as one barrier. Other instances where a single barrier is split into multiple barriers would be when the barrier is placed continuously along two legs of an intersection, so that one portion of the barrier may be on one road and the remaining portion of the barrier is on a different road.

Table 2: Number of Barriers by Function

Barrier Function	No. of Barriers
TRAFFIC	28

The following table shows the barrier types that were inventoried and assessed.

Table 3: Number of Barriers by Type

Primary Barrier Type	No. of Barriers
W-Beam Strong Post	24
Box Beam	4

The following table shows the number of barriers by one of four categories of recommended action along with associated work order costs and the number of barriers that are in each recommended action. All work order information is presented for individual barriers, even though some work orders were not accepted by the Park. Some work orders were later combined to simplify route deferred maintenance requests.

Table 4: Number of Barriers by Recommended Action and Associated 2008 Cost

Recommended Action	Repair Costs*	No. of Barriers
No Action	$0	2
Monitor	$0	0
Repair	$191,901	25
Replace	$57,805	1
Totals	**$249,706**	**28**

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

The following table categorizes the number of barriers that fall into one of ten cost ranges, based on the prepared work orders. The locations, work descriptions, and cost of the recommended repairs for these barriers are listed by individual barrier in Tier 3 of this report.

Table 5: Number of Barriers Grouped by Associated 2008 Cost

Cost Range*	No. of Barriers
$0	2
$1 - $25,000	25
$25,001 - $50,000	0
$50,001 - $100,000	1
$100,001 - $250,000	0
$250,001 - $500,000	0
$500,001 - $1,000,000	0
$1,000,001 - $2,000,000	0
$2,000,001 - $3,000,000	0
$3,000,001 - $4,000,000	0
Total Number of Barriers	**28**

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Data for end terminals was collected on the GIP data collection form and indicates if an end terminal meets current crashworthiness standards. End terminals are specially designed barrier ends that attenuate impacts to the ends of barriers. This is supplemental information that WASO designed into the inventory program.

A total of 44 end terminals were found on barriers at the Park. There are generally a greater number of end treatments than actual barriers because end treatments are located at both the beginning and end of each barrier.

Tier 2
Route Barrier Overview

Glen Canyon National Recreation Area

Federal Lands Highway
Road Inventory Program

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

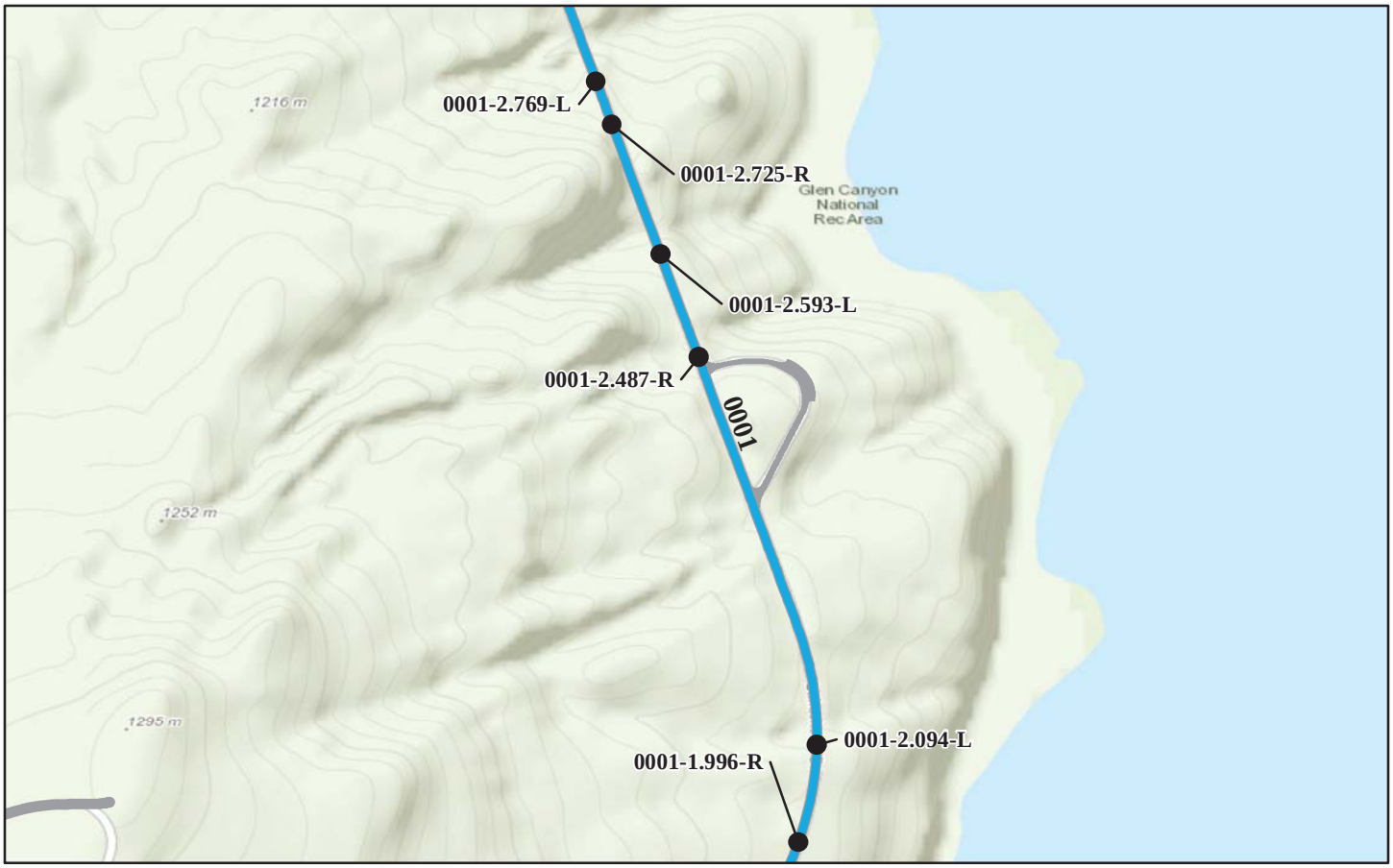
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
GLCA-0001-0.361-R 4/22/2010	238	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$3,394.00
GLCA-0001-0.498-R 4/22/2010	278	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$5,170.00
GLCA-0001-0.598-R 4/22/2010	3541	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$57,805.00
GLCA-0001-1.374-R 4/22/2010	1920	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$21,857.00
GLCA-0001-1.834-R 4/22/2010	356	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$10,219.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE



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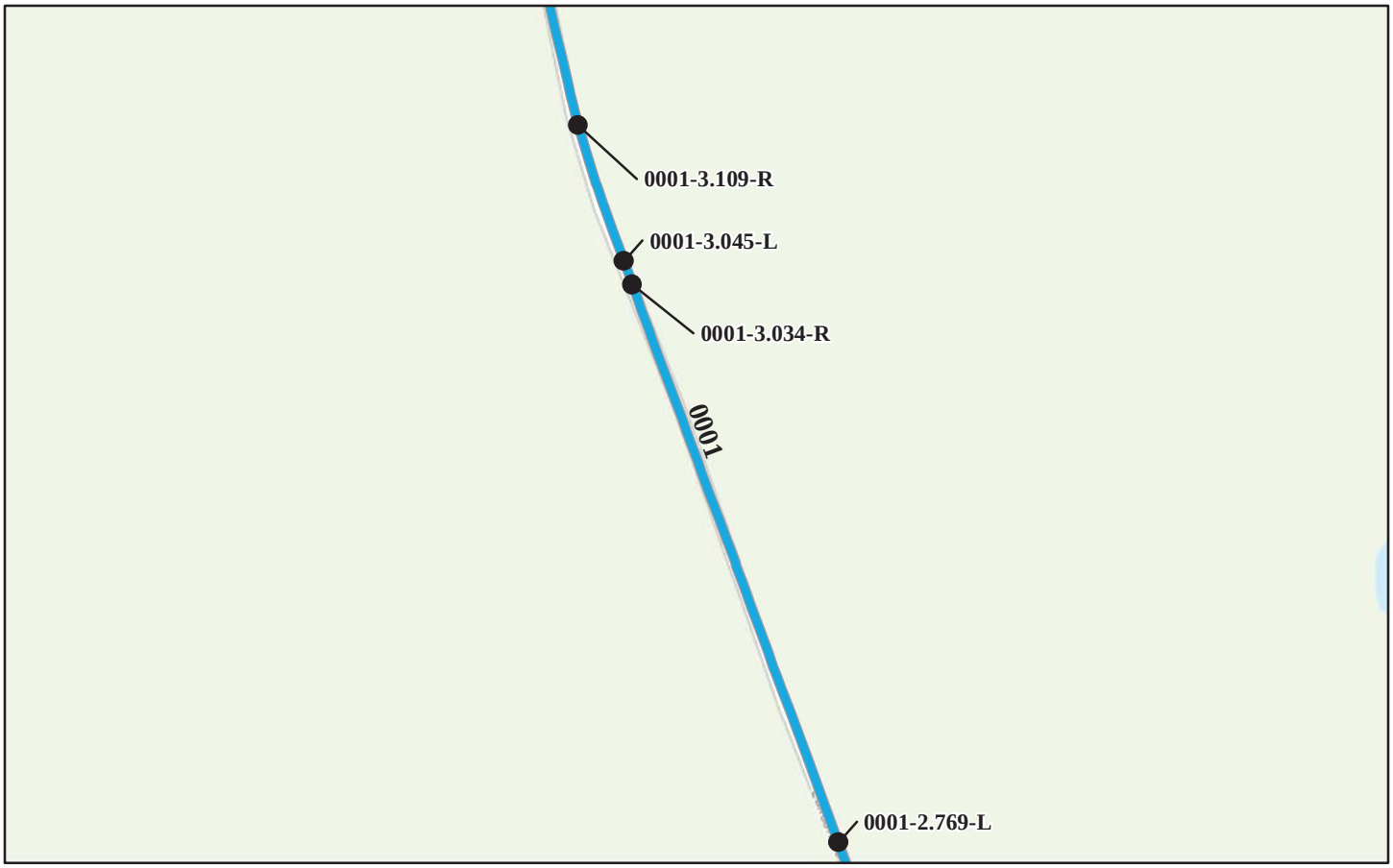
Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
GLCA-0001-1.996-R 4/22/2010	1,013	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$12,958.00
GLCA-0001-2.094-L 4/22/2010	165	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$4,950.00
GLCA-0001-2.487-R 4/22/2010	918	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$13,387.00
GLCA-0001-2.593-L 4/22/2010	241	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$8,338.00
GLCA-0001-2.725-R 4/23/2010	526	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$11,055.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE



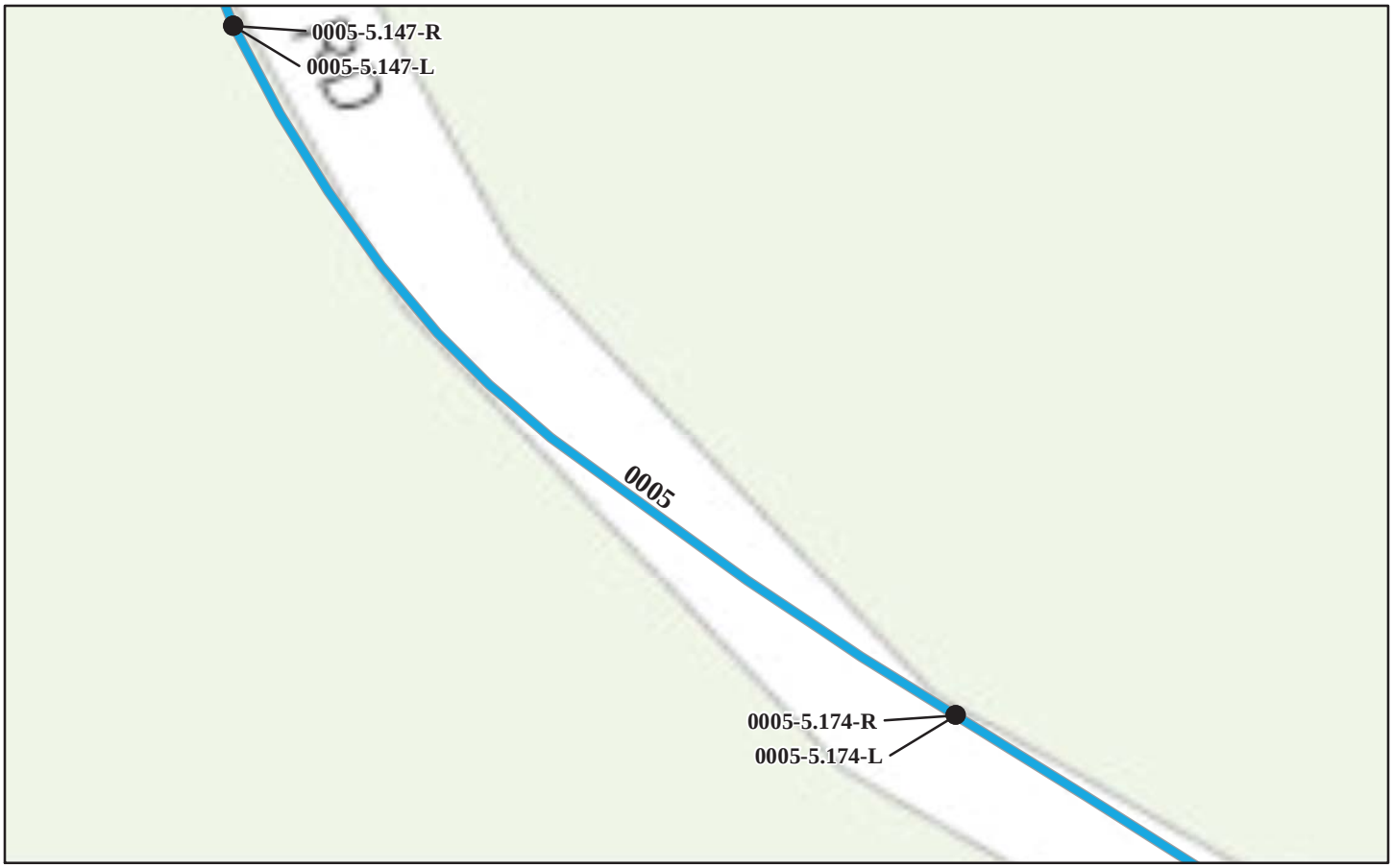
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
GLCA-0001-2.769-L 4/23/2010	402	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$10,142.00
GLCA-0001-3.034-R 4/23/2010	215	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$3,586.00
GLCA-0001-3.045-L 4/23/2010	253	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$8,503.00
GLCA-0001-3.109-R 4/23/2010	240	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$4,653.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0005: LEES FERRY ACCESS ROAD



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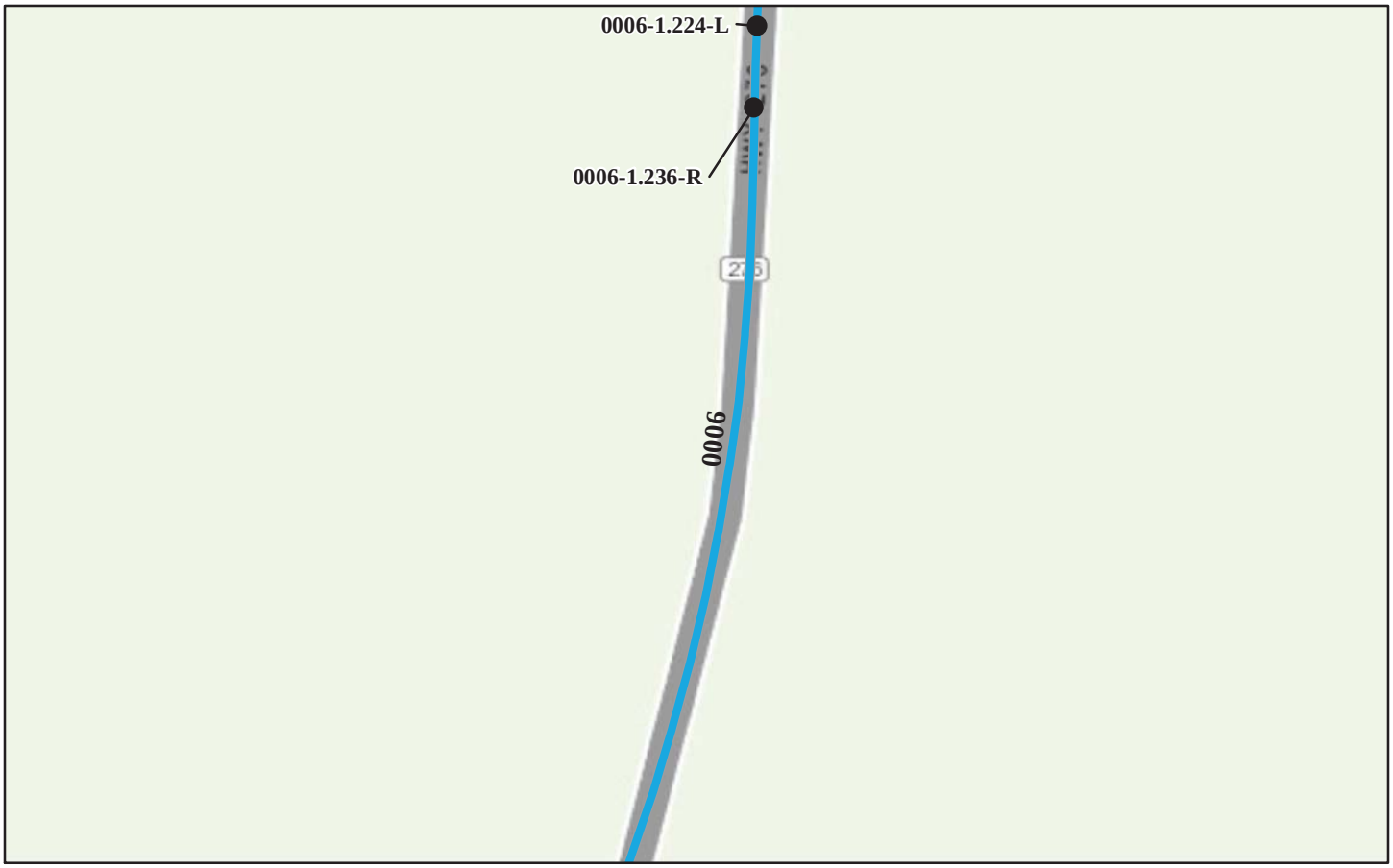
Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment Begin	 End	*Repair Cost
GLCA-0005-5.147-L 4/22/2010	34	BOX BEAM	NONE	NONE	$1,887.00
GLCA-0005-5.147-R 4/22/2010	35	BOX BEAM	NONE	NONE	$1,887.00
GLCA-0005-5.174-L 4/22/2010	55	BOX BEAM	NONE	NONE	$0.00
GLCA-0005-5.174-R 4/22/2010	29	BOX BEAM	NONE	NONE	$0.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0006: BULLFROG BASIN ACCESS ROAD



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Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
GLCA-0006-1.224-L 4/24/2010	882	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$228.00
GLCA-0006-1.236-R 4/24/2010	548	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$22,804.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0204: COVES ROAD

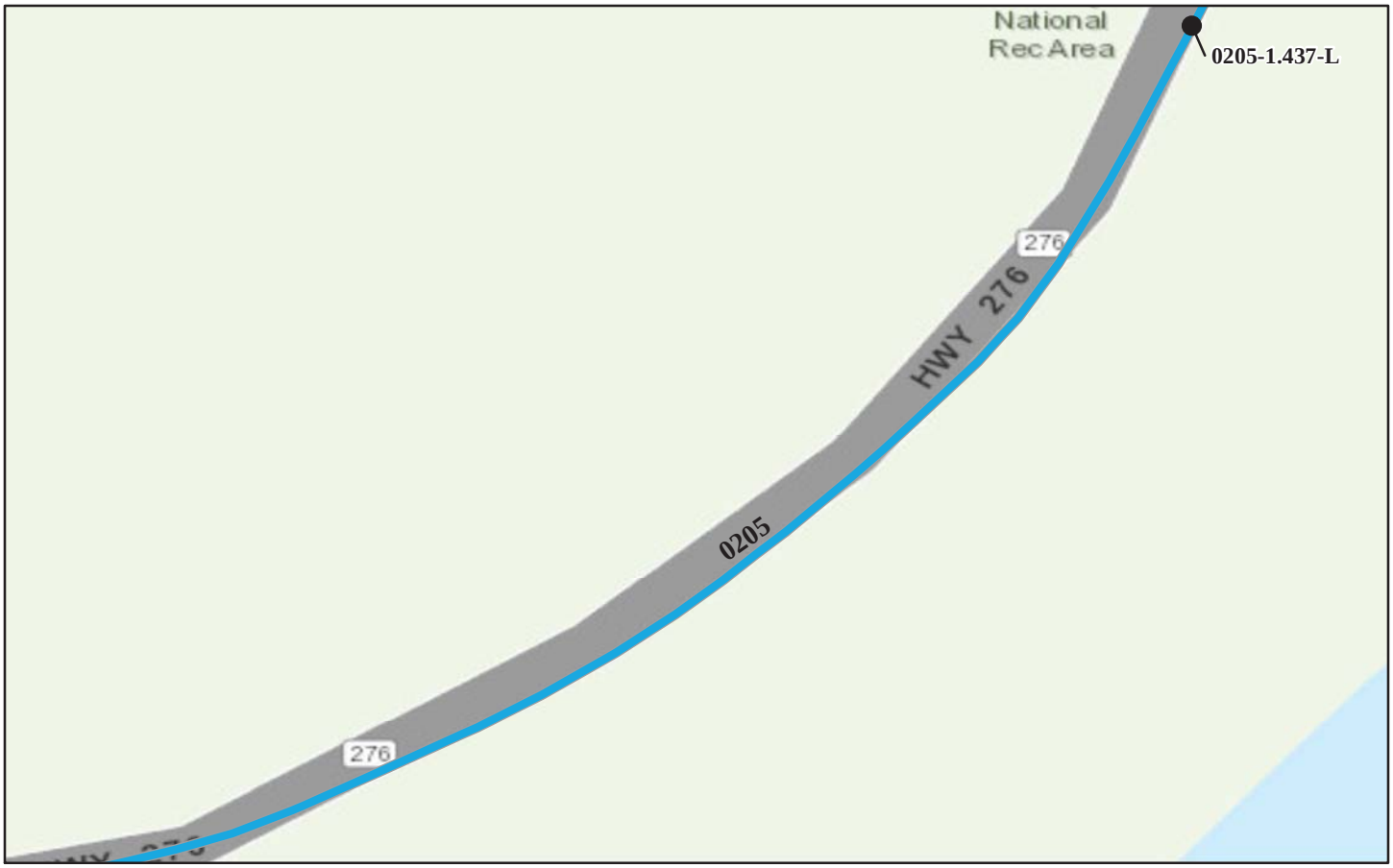
Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
GLCA-0204-0.009-L 4/22/2010	515	W-BEAM STRONG POST	NONE	NONE	$10,093.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0205: BULLFROG BASIN FERRY BOAT RAMP ROAD



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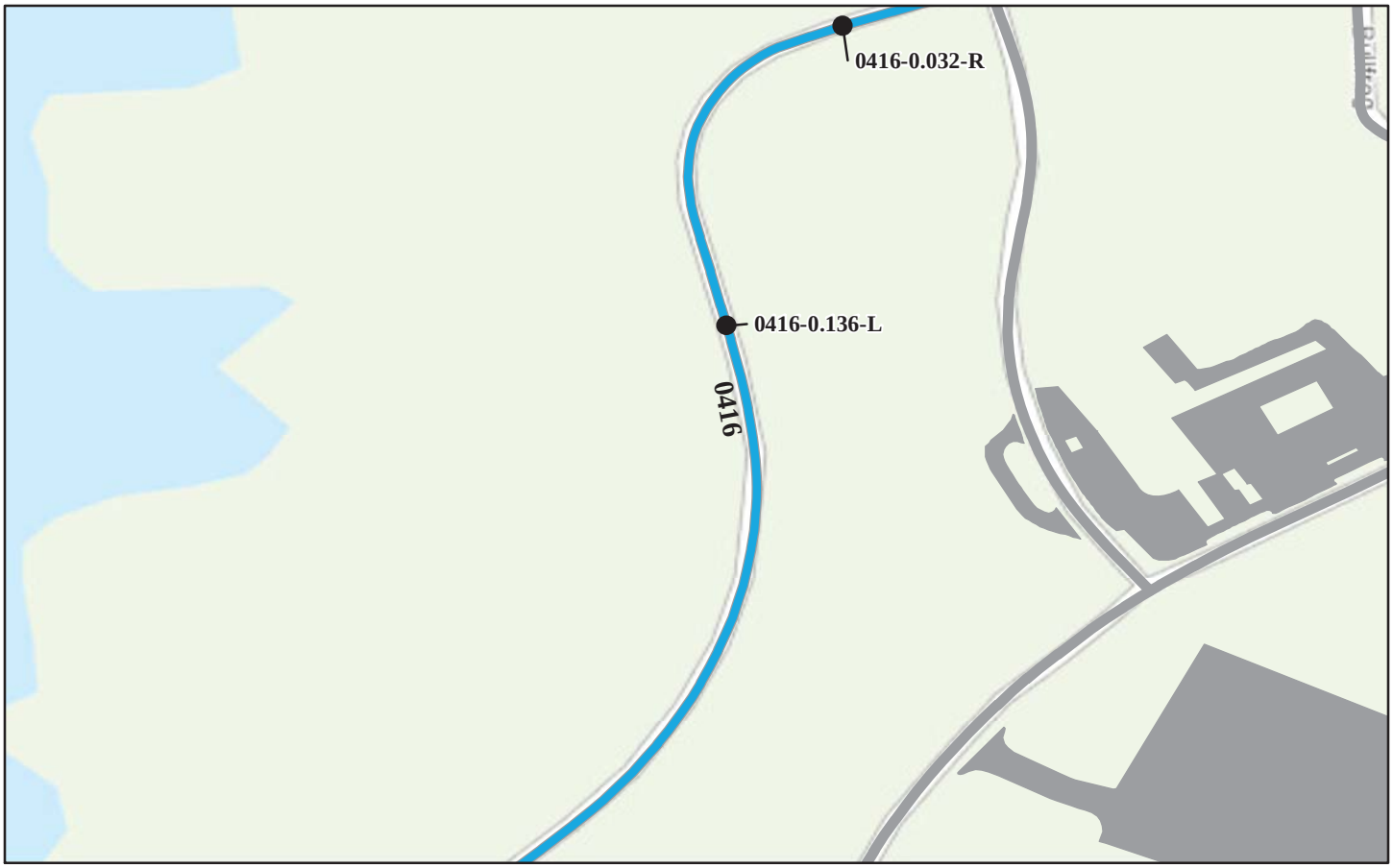
Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
GLCA-0205-1.437-L 4/24/2010	427	W-BEAM STRONG POST	W-BEAM TURN DOWN	W-BEAM TURN DOWN	$8,008.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0416: BULLFROG BASIN LODGE ROAD



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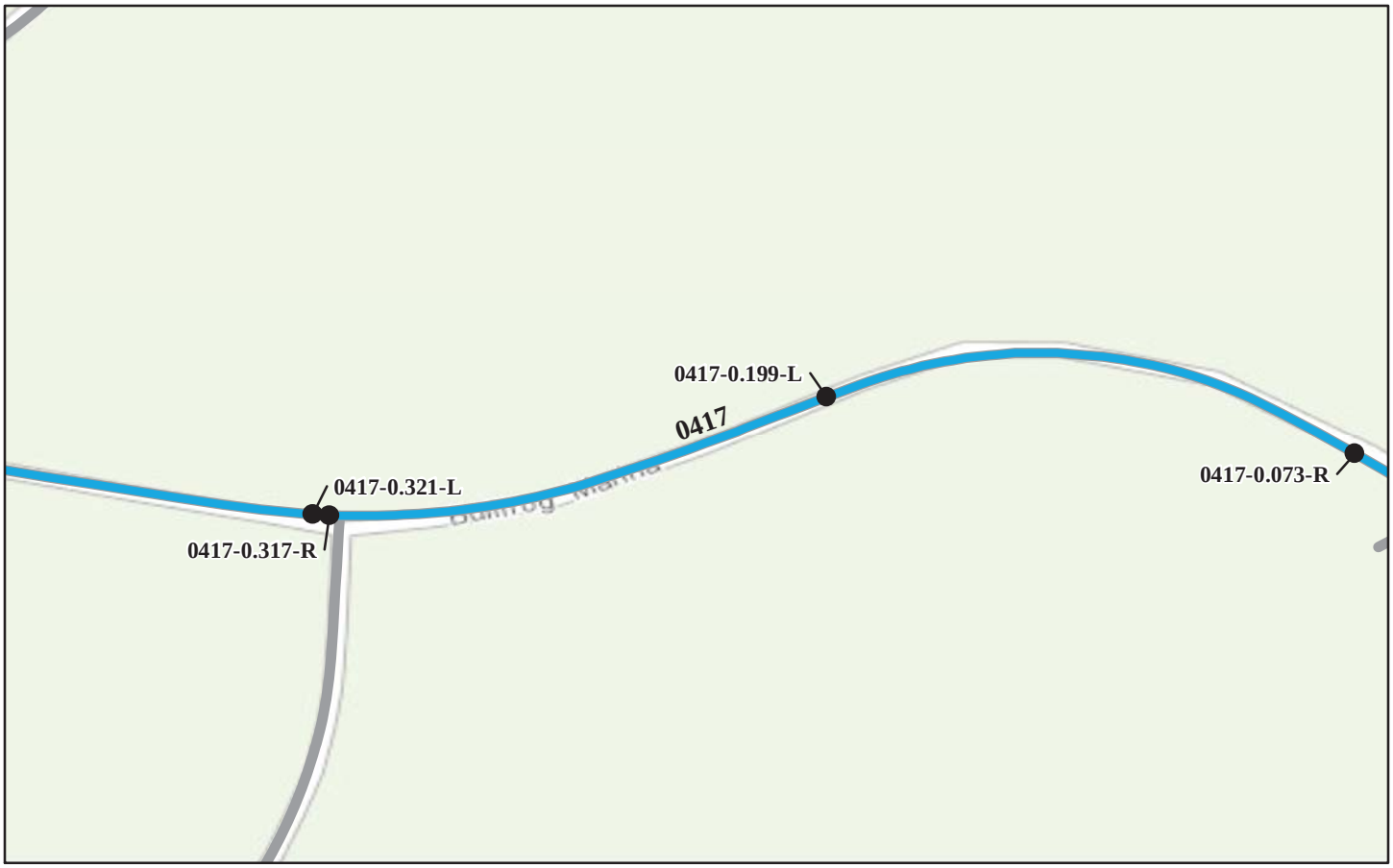
Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment		*Repair Cost
			Begin	End	
GLCA-0416-0.032-R 4/24/2010	500	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM TRAILING END	$3,383.00
GLCA-0416-0.136-L 4/24/2010	875	W-BEAM STRONG POST	W-BEAM TRAILING END	W-BEAM BCT	$16,247.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0417: BULLFROG BASIN VISITOR CENTER ROAD



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Barrier ID Inspection Date	Barrier Length (Ft.)	Barrier Type	Barrier End Treatment Begin	 End	*Repair Cost
GLCA-0417-0.073-R 4/24/2010	717	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	$1,997.00
GLCA-0417-0.199-L 4/24/2010	29	W-BEAM STRONG POST	NONE	NONE	$1,942.00
GLCA-0417-0.317-R 4/24/2010	382	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	$2,897.00
GLCA-0417-0.321-L 4/24/2010	359	W-BEAM STRONG POST	W-BEAM BCT	W-BEAM BCT	$2,316.00

*2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Tier 3
Barrier Details

Glen Canyon National Recreation Area

Federal Lands Highway
Road Inventory Program

Barrier ID:	**GLCA-0001-0.361-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	20.70

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	238
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	MEDIUM		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.3
Height (In.):	26.7	**Lateral Offset (In.):**	114.0	**Road Grade (%):**	0.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment is acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	3 blocks and 2 posts were broken. 1 (13 ft) rail piece is bent.
	Missing Elements:	There were no missing elements observed.
	Corrrosion and Weathering:	The was no corrosion or weathering observed. There was some vegetation and gravel build-up next to the guardrail.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.

Barrier ID:	**GLCA-0001-0.361-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	20.70

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$3394
Brief Workorder:	Replace 3 broken blocks 2 broken posts and 13 feet of rail. Remove vegetation growing in front of guardrail.				
Workorder:	Replace Block at $30- per -Each for 3 Block(s) = $90. Replace 3 broken blocks. Replace Post at $100- per -Each for 2 Post(s) = $200. Replace Rail at $25- per -Lin. Ft. for 13 LF = $325. Labor at $60- per -Hour for 2 Hrs = $120. Remove vegetation and gravel build-up. High Speed Traffic Control at $2350- per -Day for 1 Day(s) = $2350.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_0.361_R_1.jpg

Barrier ID:	**GLCA-0001-0.498-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	32.50

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	278
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	MEDIUM		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.0
Height (In.):	25.2	**Lateral Offset (In.):**	140.3	**Road Grade (%):**	0.10

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 200-ft was between 1 and 3-in below the 27-in design height.
	Breaking and Cracking:	One post is broken/cracked.
	Missing Elements:	No missing elements
	Corrrosion and Weathering:	Sediment is built up and vegetation is present under the barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	Sediment is built up and vegetation is present under the barrier.

Barrier ID:	**GLCA-0001-0.498-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	32.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$5170
Brief Workorder:	Raise 200 ft. of barrier up to 27-in. design height replace post remove sediment and vegetation from under barrier				
Workorder:	Replace Post at $100- per -Each for 1 Post(s) = $100. One post cracked Adjust Guardrail at $10- per -Lin. Ft. for 200 LF = $2000. Raise 200 ft. of barrier up to 27-in. design height. Loader at $125- per -Hour for 2 Hrs = $250. Remove sediment and vegetation. High Speed Traffic Control at $2350- per -Day for 1 Day(s) = $2350.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_0.498_R_1.jpg

Barrier ID:	**GLCA-0001-0.598-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	60.00

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	3541
Speed Limit (MPH):	55	**Placement with Respect to Road:**	BOTH INSIDE AND OUTSIDE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.5
Height (In.):	26.8	**Lateral Offset (In.):**	176.6	**Road Grade (%):**	0.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 800-ft was between 1 and 3-in below the 27-in design height. Approximately 200 LF is 4.5 in. above the 27 in. design height.
	Breaking and Cracking:	There are 52 cracked or broken blocks along with 16 damaged posts and 338 LF of bent and or torn rail.
	Missing Elements:	There are approximately 200 LF that the bolt that fastens the rail block and post are all missing the nut. There is also one location where all of the hardware that fastens two of the rail sections together is missing.
	Corrrosion and Weathering:	There are numerous badly cracked and/or warped blocks and posts that could be attributed to weathering and or corrosion.
End Treatments	**Alignment and Height:**	The alignment is acceptable but the height of the ending end treatment was 2.5 in below the 27 in design height.
	Breaking and Cracking:	The beginning end treatment is damaged.
	Missing Elements:	One block is missing from the ending end treatment.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.

Barrier ID:	**GLCA-0001-0.598-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	60.00

Repair Recommendations

Repair Action:	REPLACE	**FMSS Work Type:**	CAPITAL IMPROVEMENT	**Repair Cost:**	$57805
Brief Workorder:	Raise 800ft. Of barrier and lower 200ft. To 27in. Design height.				
Workorder:	Remove Guardrail at $10- per -Lin. Ft. for 30 LF = $300. Remove the damaged beginning end treatment. W-beam tangent 350 compliant at $3500- per -Each for 1 Unit(s) = $3500. Replace the beginning end treatment. Adjust Guardrail at $10- per -Lin. Ft. for 800 LF = $8000. Raise 800ft. of barrier up to 27in. design height. Adjust Guardrail at $10- per -Lin. Ft. for 200 LF = $2000. Lower 200ft. of barrier down to 27in. design height. Replace Block at $30- per -Each for 53 Block(s) = $1590. Replace all of the damaged blocks. Replace Post at $100- per -Each for 16 Post(s) = $1600. Replace the damaged post. Replace Rail at $25- per -Lin. Ft. for 338 LF = $8450. Replace the damaged rail. Labor at $60- per -Hour for 21 Hrs = $1260. Replace the nuts on the bolt that fastens the block rail and posts and remove the vegetation. High Speed Traffic Control at $2350- per -Day for 11 Day(s) = $25850.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_0.598_R_1.jpg

Barrier ID:	**GLCA-0001-1.374-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	35.50

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	1920
Speed Limit (MPH):	55	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.0
Height (In.):	26.7	**Lateral Offset (In.):**	191.8	**Road Grade (%):**	1.10

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 720-ft was between 1 and 3-in below the 27-in design height. For about 1200 ft the height was 0-3in. above the 27-in design height.
	Breaking and Cracking:	There were 25 blocks and 5 posts that were broken or badly splintered. 4 (13 ft each) rail pieces were bent. About 35 posts/blocks have loose bolts.
	Missing Elements:	There were no missing elements observed.
	Corrrosion and Weathering:	The posts and blocks are old and appear to be splintering out. Vegetation and gravel was next to the guardrail.
End Treatments	**Alignment and Height:**	Alignment acceptable. The height was 2 in below 27 in design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	The blocks and posts are old and splintering out.

Barrier ID:	**GLCA-0001-1.374-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	35.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$21857
Brief Workorder:	Raise 720 feet of barrier up to 27-in. design height. Replace 4 (13 ft each) rail pieces 25 blocks and 5 posts. Tighten bolts and remove vegetation and gravel build-up along the length of the barrier.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 720 LF = $7200. Raise 720 ft of barrier up to 27-in. design height. Replace Rail at $25- per -Lin. Ft. for 52 LF = $1300. Replace 52 ft of bent rail. Replace Block at $30- per -Each for 25 Block(s) = $750. Replace 25 damaged blocks. Replace Post at $100- per -Each for 5 Post(s) = $500. Replace 5 damaged posts. Labor at $60- per -Hour for 12 Hrs = $720. Labor to tighten loose bolts remove vegetation and gravel build-up. High Speed Traffic Control at $2350- per -Day for 4 Day(s) = $9400. 3 days to raise rail 1 day all other work.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_1.374_R_1.jpg

Barrier ID:	**GLCA-0001-1.834-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	47.00

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	356
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.3
Height (In.):	22.0	**Lateral Offset (In.):**	153.0	**Road Grade (%):**	2.30

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Entire barrier is between 4-6in. below the 27-in design height.
	Breaking and Cracking:	Four (4) posts and one (1) blockout are breaking and cracking.
	Missing Elements:	There are no missing elements.
	Corrrosion and Weathering:	Sediment and vegetation are under the barrier. Vegetation is thick and is overgrowing the w-beam.
End Treatments	**Alignment and Height:**	Alignment acceptable. Entire barrier is between 4-6in. below the 27-in design height.
	Breaking and Cracking:	One (1) post is breaking and cracking.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	Sediment and vegetation are under the barrier. Vegetation is thick and overgrowing the w-beam.

Barrier ID:	**GLCA-0001-1.834-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	47.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$10219
Brief Workorder:	Raise 356 ft of barrier up to 27-in. design height. replaced damaged barrier items and remove sediment and vegetation.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 356 LF = $3560. Raise 356 ft of barrier up to 27-in. design height. Replace Post at $100- per -Each for 5 Post(s) = $500. Replace Block at $30- per -Each for 1 Block(s) = $30. Loader at $125- per -Hour for 4 Hrs = $500. Removal of sediment and vegetation. High Speed Traffic Control at $2350- per -Day for 2 Day(s) = $4700.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_1.834_R_1.jpg

Barrier ID:	**GLCA-0001-1.996-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	66.90

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	1013
Speed Limit (MPH):	55	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.8
Height (In.):	22.6	**Lateral Offset (In.):**	143.8	**Road Grade (%):**	0.30

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 76-ft was between 1 and 3-in below the 27-in design height and 625-ft was more than 3-in. below the design height due to soil and vegetation build up in front of rail.
	Breaking and Cracking:	60 ft of w-beam is bent and torn in barrier. 7 posts are cracked or broken and 14 blocks are broken.
	Missing Elements:	2 missing blocks in barrier.
	Corrrosion and Weathering:	12-in deep gullying between posts near approach end of rail. Posts and blocks are dried and weathered with 1/4 to 1/2 inch cracks.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.

Barrier ID:	**GLCA-0001-1.996-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	66.90

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$12958
Brief Workorder:	Remove 1 to 10 inches deep of soil build up in front of 701 linear ft of barrier to bring barrier up to 27-in. design height. Replace 60 ft of W-beam 7 damaged posts and 14 damaged blocks. Add 2 missing blocks and backfill to one eroded area.				
Workorder:	Loader at $125- per -Hour for 16 Hrs = $2000. Removal of soil buildup in front of rail. Replace Rail at $25- per -Lin. Ft. for 60 LF = $1500. Replace damaged W-beam. Replace Post at $100- per -Each for 7 Post(s) = $700. Replace damaged posts. Replace Block at $30- per -Each for 16 Block(s) = $480. Replace missing or damaged blocks. Structural Backfill at $50- per -Cu. Yd. for 1 CY = $50. Add backfill to erosion area. High Speed Traffic Control at $2350- per -Day for 3 Day(s) = $7050.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_1.996_R_1.JPG

Barrier ID:	**GLCA-0001-2.094-L**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	32.50

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	165
Speed Limit (MPH):	55	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	MEDIUM		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.5
Height (In.):	23.0	**Lateral Offset (In.):**	172.0	**Road Grade (%):**	0.70

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Height of barrier is 3 in to 5 in below design height of 27 ines for entire barrier.
	Breaking and Cracking:	1/4 to 1/2 in wide minor cracking of posts and blocks.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	Minor weathering of barrier parts. Soil and gravel piling up in front of barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height is 3 in below design height of 27 ines for end treatment.
	Breaking and Cracking:	1/4 to 1/2 in wide minor cracking of posts and blocks of end treatment.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	Minor weathering of end treatment.

Barrier ID:	**GLCA-0001-2.094-L**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	32.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$4950
Brief Workorder:	Raise 165 ft. of barrier to 27-in. design height and remove soil berm.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 165 LF = $1650. Raise 165 ft. of barrier to 27-in. design height. Loader at $125- per -Hour for 4 Hrs = $500. Remove soil berm from front of barrier. High Speed Traffic Control at $2350- per -Day for 1 Day(s) = $2350.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_2.094_L_1.JPG

Barrier ID:	**GLCA-0001-2.487-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	41.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	918
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.8
Height (In.):	25.2	**Lateral Offset (In.):**	180.1	**Road Grade (%):**	1.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 174-ft was between 1 and 3-in below the 27-in design height and 200-ft was more than 3-in. below the design height.
	Breaking and Cracking:	There were six broken or cracked blocks and 38 LF of bent rail.
	Missing Elements:	There were no missing elements observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.
End Treatments	**Alignment and Height:**	Alignment acceptable but the height of the beginning end treatment was 6 in below the 27 in design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.

Barrier ID:	**GLCA-0001-2.487-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	41.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$13387
Brief Workorder:	Raise the first 374 LF of barrier up to 27-in. design height remove berm and replace 38ft. of rail and 6 blocks.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 374 LF = $3740. Raise the first 374 LF of barrier up to 27in. design height. Replace Block at $30- per -Each for 6 Block(s) = $180. Replace the six damaged blocks. Replace Rail at $25- per -Lin. Ft. for 38 LF = $950. Replace the 38 LF of damaged rail. Loader at $125- per -Hour for 2 Hrs = $250. Remove the berm that was placed at the base of the first 130 feet of the barrier. High Speed Traffic Control at $2350- per -Day for 3 Day(s) = $7050. 2 days to raise rail 1 day all other work.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_2.487_R_1.jpg

Barrier ID:	**GLCA-0001-2.593-L**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	42.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	241
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	MEDIUM		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.6
Height (In.):	22.7	**Lateral Offset (In.):**	176.0	**Road Grade (%):**	1.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. The height was 4 to 4.5 in lower than the 27 in design height for entire length of barrier.
	Breaking and Cracking:	There was 1 broken post.
	Missing Elements:	There were no missing elements observed.
	Corrrosion and Weathering:	There was sediment build-up and vegetation growing next to the guardrail.
End Treatments	**Alignment and Height:**	Alignment acceptable. The height was 4.5 in below the 27in. design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was sediment build-up and vegetation.

Barrier ID:	**GLCA-0001-2.593-L**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	42.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$8338
Brief Workorder:	Raise 241ft. of barrier up to 27 inch design height. Replace 1 broken post. Remove vegetation and sediment build-up next to the guardrail.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 241 LF = $2410. Raise 241ft. of barrier up to 27in. design height. Replace Post at $100- per -Each for 1 Post(s) = $100. Replace 1 broken post. Loader at $125- per -Hour for 2 Hrs = $250. Remove sediment build-up with loader. Labor at $60- per -Hour for 2 Hrs = $120. 2 hours to remove vegetation growth. High Speed Traffic Control at $2350- per -Day for 2 Day(s) = $4700. 1 day to raise barrier 1 day all other work.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_2.593_L_1.jpg

Barrier ID:	**GLCA-0001-2.725-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	35.70

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	526
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.3
Height (In.):	27.0	**Lateral Offset (In.):**	278.2	**Road Grade (%):**	1.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 101-ft was between 1 and 3-in below the 27-in design height and 256-ft was more than 3-in below the design height.
	Breaking and Cracking:	There are 2 broken blocks and 2 turned blocks in barrier and several minor dents less than 3-in deep in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	Two areas of gullying approximately 9-in deep and 20 in wide between posts. Minimal corrosion in w-beam; moderately weathered posts with 1/4 to 1/2 in wide cracks.
End Treatments	**Alignment and Height:**	Alignment acceptable. End treatments are below 27-in design height by 4-in.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	Minimal corrosion and weathering in end treatments.

Barrier ID:	**GLCA-0001-2.725-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	35.70

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$11055
Brief Workorder:	Raise 387ft. of barrier up to 27in. design height. Add 2cy. of backfill to fix erosion problem and remove vegetation from face of barrier.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 387 LF = $3870. Raise 387ft. of guardrail up to 27in. design height. Loader at $125- per -Hour for 8 Hrs = $1000. Loader to remove buildup of soil in front of rail. Structural Backfill at $50- per -Cu. Yd. for 2 CY = $100. Add backfill to 2 areas of erosion. Replace Block at $30- per -Each for 2 Block(s) = $60. Replace 2 broken blocks. Replace Post at $100- per -Each for 2 Post(s) = $200. Replace 2 posts Labor at $60- per -Hour for 2 Hrs = $120. Adjust turned blocks. High Speed Traffic Control at $2350- per -Day for 2 Day(s) = $4700.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_2.725_R_1.JPG

Barrier ID:	**GLCA-0001-2.769-L**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	51.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	402
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	76.0
Height (In.):	21.2	**Lateral Offset (In.):**	153.3	**Road Grade (%):**	1.70

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Barrier height is 4 to 6 in below the 27-in design height.
	Breaking and Cracking:	Minor cracking of 1/4 to 1/2 in wide cracks on barrier posts and blocks.
	Missing Elements:	No missing barrier elements.
	Corrrosion and Weathering:	No major weathering of barrier components.
End Treatments	**Alignment and Height:**	Alignment acceptable. End treatment height 4 to 6 in below design height of 27 ines.
	Breaking and Cracking:	Minor cracking of 1/4 to 1/2 in wide cracks on end treatment posts and blocks.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.

Barrier ID:	**GLCA-0001-2.769-L**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/22/2010	**Barrier Rating:**	51.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$10142
Brief Workorder:	Raise 402 ft. of barrier up to 27-in. design height and remove soil berm from in front of barrier.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 402 LF = $4020. Raise 402 ft. of barrier up to 27-in. design height. Loader at $125- per -Hour for 4 Hrs = $500. Remove soil berm from front of barrier High Speed Traffic Control at $2350- per -Day for 2 Day(s) = $4700.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_2.769_L_1.JPG

Barrier ID:	**GLCA-0001-3.034-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/23/2010	**Barrier Rating:**	28.70

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	215
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.0
Height (In.):	27.2	**Lateral Offset (In.):**	212.6	**Road Grade (%):**	0.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 20-ft was between 1 and 3-in below the 27-in design height and 20-ft was more than 3-in below the design height. Soil build-up in front of barrier for 40 ft is causing the low heights.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	1 turned block in barrier. No other missing elements.
	Corrrosion and Weathering:	1 area of erosion 8 in deep for 2 linear ft between 2 posts. No corrosion in w-beam; minor 1/4 to 1/2 in cracks in posts and blocks due to weathering.
End Treatments	**Alignment and Height:**	Alignment of end treatments is acceptable. Approach end treatment is below design height of 27 in by 5 ines. Soil build up at approach end. Ending end treatment is at 27-inch design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.

Barrier ID:	**GLCA-0001-3.034-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/23/2010	**Barrier Rating:**	28.70

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$3586
Brief Workorder:	Remove 40 linear feet of soil build up in front of barrier so face is at 27-inch design height. Adjust 20 ft. of barrier up 2 to 4 in. at approach end to 27-in. design height. Add backfill to erosion area; adjust one block.				
Workorder:	Loader at $125- per -Hour for 4 Hrs = $500. Loader to remove soil build up in front of rail. Adjust Guardrail at $10- per -Lin. Ft. for 30 LF = $300. Raise 30 ft. of approach end up to 27-in. design height. Structural Backfill at $50- per -Cu. Yd. for 1 CY = $50. Add backfill to area of erosion between posts. Labor at $60- per -Hour for 1 Hrs = $60. Adjust block. High Speed Traffic Control at $2350- per -Day for 1 Day(s) = $2350.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_3.034_R_1.JPG

Barrier ID:	**GLCA-0001-3.045-L**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/23/2010	**Barrier Rating:**	55.50

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	253
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.0
Height (In.):	14.3	**Lateral Offset (In.):**	140.0	**Road Grade (%):**	0.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. The barrier height is 12 in below design height of 27 in for entire length of barrier.
	Breaking and Cracking:	Minor cracking 1/4 to 1/2 in wide cracks on barrier posts and blocks.
	Missing Elements:	No missing barrier elements.
	Corrrosion and Weathering:	No major weathering of barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height of end treatments is 12 in below design height of 27 ines.
	Breaking and Cracking:	Minor cracking of end treatment posts and blocks of 1/4 to 1/2 in wide cracks.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.

Barrier ID:	**GLCA-0001-3.045-L**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/23/2010	**Barrier Rating:**	55.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$8503
Brief Workorder:	Raise 253 ft. of barrier up to 27-in. design height and remove soil berm in front of barrier.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 253 LF = $2530. Raise 253 ft. of barrier up to 27-in. design height. Loader at $125- per -Hour for 4 Hrs = $500. Remove soil berm from front of barrier regrade ditch. High Speed Traffic Control at $2350- per -Day for 2 Day(s) = $4700.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_3.045_L_1.JPG

Barrier ID:	**GLCA-0001-3.109-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/23/2010	**Barrier Rating:**	33.00

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	240
Speed Limit (MPH):	55	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-3	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.6
Height (In.):	24.7	**Lateral Offset (In.):**	236.3	**Road Grade (%):**	0.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 46-ft was between 1 and 3-in below the 27-in design height and 92-ft was more than 3-in below the design height. Soil and vegetation build up in front of barrier.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No corrosion in w-beam. Minor weathering 1/4 to 1/2 in wide cracks in posts and blocks.
End Treatments	**Alignment and Height:**	Alignment acceptable. Approach end treatment is at 27-in design height. Trailing end treatment is below design height by 5 in.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.

Barrier ID:	**GLCA-0001-3.109-R**		
Route Name:	LAKESHORE DRIVE		
Inspection Date:	04/23/2010	**Barrier Rating:**	33.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$4653
Brief Workorder:	Raise 138ft. of barrier up to 27-inch design height. Remove soil and vegetation from in front of barrier for 138 linear feet.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 138 LF = $1380. Raise 138 ft. of barrier up to 27-in. design height. Loader at $125- per -Hour for 4 Hrs = $500. Remove soil and vegetation build up for 138 linear feet. High Speed Traffic Control at $2350- per -Day for 1 Day(s) = $2350. Estimate 1 day traffic control.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0001: LAKESHORE DRIVE

Barrier Condition Photos

GLCA_0001_3.109_R_1.JPG

Barrier ID:	**GLCA-0005-5.147-L**		
Route Name:	LEES FERRY ACCESS ROAD		
Inspection Date:	04/23/2010	**Barrier Rating:**	14.10

Barrier Description

Type:	BOX BEAM	**Barrier Function:**	TRAFFIC
Barrier Material:	OTHER: STEEL	**Post Material:**	OTHER: STEEL
Blockout Type:	N/A	**Length (ft.):**	34
Speed Limit (MPH):	25	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	27	**Width (In.):**	4.0	**Post Spacing (In.):**	74.0
Height (In.):	23.0	**Lateral Offset (In.):**	57.0	**Road Grade (%):**	3.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Gravel piled in front of barrier for 22 linear ft makes the barrier 6 to 8 in below 27-in design height. Remainder of barrier is at design height.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	Minor rust where paint has chipped.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**GLCA-0005-5.147-L**		
Route Name:	LEES FERRY ACCESS ROAD		
Inspection Date:	04/23/2010	**Barrier Rating:**	14.10

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1887
Brief Workorder:	Remove approximately 15 cubic feet of gravel from in front of barrier for 22 linear feet.				
Workorder:	Labor at $60- per -Hour for 4 Hrs = $240. Estimated 4 hours labor to remove gravel. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0005: LEES FERRY ACCESS ROAD

Barrier Condition Photos

GLCA_0005_5.147_L_1.JPG

Barrier ID:	**GLCA-0005-5.147-R**		
Route Name:	LEES FERRY ACCESS ROAD		
Inspection Date:	04/23/2010	**Barrier Rating:**	17.00

Barrier Description

Type:	BOX BEAM	**Barrier Function:**	TRAFFIC
Barrier Material:	OTHER: STEEL	**Post Material:**	OTHER: STEEL
Blockout Type:	N/A	**Length (ft.):**	35
Speed Limit (MPH):	25	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	27	**Width (In.):**	4.0	**Post Spacing (In.):**	73.0
Height (In.):	27.6	**Lateral Offset (In.):**	43.2	**Road Grade (%):**	3.20

Physical Condition

Barrier	**Alignment and Height:**	Alignment is acceptable. Height is within 1-in of 27-in design height. Soil buildup in front of barrier affects design height.
	Breaking and Cracking:	No breaking or cracking of barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No corrosion or weathering of painted barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**GLCA-0005-5.147-R**		
Route Name:	LEES FERRY ACCESS ROAD		
Inspection Date:	22/04/2010	**Barrier Rating:**	17.00

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1887
Brief Workorder:	Remove soil berm in front of barrier.				
Workorder:	Labor at $60- per -Hour for 4 Hrs = $240. Remove soil berm in front of barrier. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0005: LEES FERRY ACCESS ROAD

Barrier Condition Photos

GLCA_0005_5.147_R_1.JPG

Barrier ID:	**GLCA-0005-5.174-L**		
Route Name:	LEES FERRY ACCESS ROAD		
Inspection Date:	04/22/2010	**Barrier Rating:**	8.00

Barrier Description

Type:	BOX BEAM	**Barrier Function:**	TRAFFIC
Barrier Material:	OTHER: STEEL	**Post Material:**	OTHER: STEEL
Blockout Type:	N/A	**Length (ft.):**	55
Speed Limit (MPH):	25	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	MEDIUM		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	27	**Width (In.):**	4.0	**Post Spacing (In.):**	75.0
Height (In.):	29.2	**Lateral Offset (In.):**	27.0	**Road Grade (%):**	3.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment is acceptable. Height was 2in. above the 27-in design height.
	Breaking and Cracking:	No breaking or cracking in barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	Minor rust in few places where paint is chipped.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**GLCA-0005-5.174-L**		
Route Name:	LEES FERRY ACCESS ROAD		
Inspection Date:	04/22/2010	**Barrier Rating:**	8.00

Repair Recommendations

Repair Action:	NO ACTION	**FMSS Work Type:**	N/A	**Repair Cost:**	$0
Brief Workorder:	N/A				
Workorder:					

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0005: LEES FERRY ACCESS ROAD

Barrier Condition Photos

GLCA_0005_5.174_L_1.JPG

Barrier ID:	**GLCA-0005-5.174-R**		
Route Name:	LEES FERRY ACCESS ROAD		
Inspection Date:	04/22/2010	**Barrier Rating:**	8.00

Barrier Description

Type:	BOX BEAM	**Barrier Function:**	TRAFFIC
Barrier Material:	OTHER: STEEL	**Post Material:**	OTHER: STEEL
Blockout Type:	N/A	**Length (ft.):**	29
Speed Limit (MPH):	25	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	MEDIUM		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	27	**Width (In.):**	4.0	**Post Spacing (In.):**	75.0
Height (In.):	29.0	**Lateral Offset (In.):**	43.5	**Road Grade (%):**	2.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment is acceptable. Height was 2in. above the 27-in design height.
	Breaking and Cracking:	No breaking or cracking of barrier.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No corrosion of this painted barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**GLCA-0005-5.174-R**		
Route Name:	LEES FERRY ACCESS ROAD		
Inspection Date:	04/22/2010	**Barrier Rating:**	8.00

Repair Recommendations

Repair Action:	NO ACTION	**FMSS Work Type:**	N/A	**Repair Cost:**	$0
Brief Workorder:	N/A				
Workorder:					

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0005: LEES FERRY ACCESS ROAD

Barrier Condition Photos

GLCA_0005_5.174_R_1.JPG

Barrier ID:	**GLCA-0006-1.224-L**		
Route Name:	BULLFROG BASIN ACCESS ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	36.50

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	882
Speed Limit (MPH):	45	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	MEDIUM		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.0
Height (In.):	26.6	**Lateral Offset (In.):**	79.8	**Road Grade (%):**	5.70

Physical Condition

Barrier	**Alignment and Height:**	Alignment is acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	There were 9 blocks and 3 posts that were broken.
	Missing Elements:	There were no missing elements observed.
	Corrrosion and Weathering:	There was some weathering and wear to the posts and blocks but they were still in good condition.
End Treatments	**Alignment and Height:**	Alignment is acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	There was 1 block that was twisted and needs to be replaced.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	The blocks and posts show weathering but were still in good condition.

Barrier ID:	**GLCA-0006-1.224-L**		
Route Name:	BULLFROG BASIN ACCESS ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	36.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$228
Brief Workorder:	Replace 10 broken or twisted blocks and 3 broken posts.				
Workorder:	Replace Block at $30- per -Each for 10 Block(s) = $300. Replace 10 broken and twisted blocks. Replace Post at $100- per -Each for 3 Post(s) = $300. Replace 3 broken posts. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0006: BULLFROG BASIN ACCESS ROAD

Barrier Condition Photos

GLCA_0006_1.224_L_1.jpg

Barrier ID:	**GLCA-0006-1.236-R**		
Route Name:	BULLFROG BASIN ACCESS ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	32.50

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	548
Speed Limit (MPH):	45	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	MEDIUM		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.3
Height (In.):	24.2	**Lateral Offset (In.):**	62.2	**Road Grade (%):**	5.70

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 488-ft was between 1 and 3-in below the 27-in design height and 60-ft was more than 3-in below the design height.
	Breaking and Cracking:	8 blockouts broken or cracked.
	Missing Elements:	There are no missing elements.
	Corrrosion and Weathering:	There is significant erosion around 25 of the posts and for 150 under the barrier. There is also significant erosion of the slope behind the barrier.
End Treatments	**Alignment and Height:**	Alignment acceptable. 30-ft was between 1 and 3-in below the 27-in design height.
	Breaking and Cracking:	Two blockouts are broken.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	No corrosion or weathering around the end treatments.

Barrier ID:	**GLCA-0006-1.236-R**		
Route Name:	BULLFROG BASIN ACCESS ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	32.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$22804
Brief Workorder:	Raise 548 ft. of barrier up to 27-in. design height replace 10 damaged blocks fix erosion issues and place HMA curb.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 548 LF = $5480. Raise 548 ft. of barrier up to 27-in. design height. Replace Block at $30- per -Each for 10 Block(s) = $300. Backhoe at $125- per -Hour for 8 Hrs = $1000. Asphalt Curb at $12- per -Lin. Ft. for 548 LF = $6576. Low Speed Traffic Control at $1475- per -Day for 5 Day(s) = $7375. 3 days to raise barrier 2 days all other work.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0006: BULLFROG BASIN ACCESS ROAD

Barrier Condition Photos

GLCA_0006_1.236_R_1.jpg

Barrier ID:	**GLCA-0204-0.009-L**		
Route Name:	COVES ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	31.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	515
Speed Limit (MPH):	35	**Placement with Respect to Road:**	BOTH INSIDE AND OUTSIDE
Hazard Behind Barrier:	LOW		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.6
Height (In.):	33.5	**Lateral Offset (In.):**	146.3	**Road Grade (%):**	1.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Barrier exceeds 27-in design height by more than 4-in for 419 linear ft and exceeds design height by 1 to 4 in for 20 linear ft.
	Breaking and Cracking:	1/4 to 1/2 in wide weathering cracks in posts and blocks in barrier.
	Missing Elements:	Most blocks are turned and loose in barrier and may be missing nails.
	Corrrosion and Weathering:	Blocks and posts in barrier are moderately weathered with 1/4 to 1/2 in wide cracks.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**GLCA-0204-0.009-L**		
Route Name:	COVES ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	31.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$10093
Brief Workorder:	Lower 439 ft. of barrier down to the 27-in. design height. Right the turned blocks.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 439 LF = $4390. Lower 439ft.of guardrail down by 1 to 9 inches to the 27in. design height. Labor at $60- per -Hour for 6 Hrs = $360. Right turned blocks. Low Speed Traffic Control at $1475- per -Day for 3 Day(s) = $4425.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0204: COVES ROAD

Barrier Condition Photos

GLCA_0204_0.009_L_1.JPG

Barrier ID:	**GLCA-0205-1.437-L**		
Route Name:	BULLFROG BASIN FERRY BOAT RAMP ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	44.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	427
Speed Limit (MPH):	15	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TURN DOWN	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TURN DOWN	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.0
Height (In.):	22.2	**Lateral Offset (In.):**	61.7	**Road Grade (%):**	5.30

Physical Condition

Barrier	**Alignment and Height:**	The alignment is acceptable but the height of the entire barrier is from 4.5 to 5 in below the 27 in design height.
	Breaking and Cracking:	There was no breaking or cracking observed.
	Missing Elements:	There were no missing elements observed. Loose fasteners and bolts were observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.
End Treatments	**Alignment and Height:**	The alignment is acceptable but the height of both end treatments is between 4.5 and 5 in below the 27 in design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was no corrosion or weathering observed.

Barrier ID:	**GLCA-0205-1.437-L**		
Route Name:	BULLFROG BASIN FERRY BOAT RAMP ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	44.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$8008
Brief Workorder:	Raise 427 ft of barrier up to 27-in. design height and tighten the loose fasteners.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 427 LF = $4270. Raise 427 ft of barrier up to 27-in. design height. Labor at $60- per -Hour for 1 Hrs = $60. Tighten loose fasteners. Low Speed Traffic Control at $1475- per -Day for 2 Day(s) = $2950.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0205: BULLFROG BASIN FERRY BOAT RAMP ROAD

Barrier Condition Photos

GLCA_0205_1.437_L_1.jpg

Barrier ID:	**GLCA-0416-0.032-R**		
Route Name:	BULLFROG BASIN LODGE ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	31.30

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	500
Speed Limit (MPH):	20	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM TRAILING END	**Ending End Trtmt Crashhworthy?:**	YES		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.6
Height (In.):	25.7	**Lateral Offset (In.):**	87.0	**Road Grade (%):**	2.90

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 40-ft was between 1 and 3-in below the 27-in design height and 60-ft was more than 3-in below the design height.
	Breaking and Cracking:	There were 5 blocks and 2 posts that were broken.
	Missing Elements:	There were no missing elements observed.
	Corrrosion and Weathering:	There was some weathering and wear in the blocks and posts but were still in overall good condition. There was gravel and sediment build-up next to the guardrail.
End Treatments	**Alignment and Height:**	Alignment is acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	There was some weathering in posts and blocks but were still in good condition.

Barrier ID:	**GLCA-0416-0.032-R**		
Route Name:	BULLFROG BASIN LODGE ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	31.30

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$3383
Brief Workorder:	Raise 100 feet of barrier up to 27-in. design height replace 5 broken blocks 2 broken posts and remove gravel and sediment build-up next to the guardrail.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 100 LF = $1000. Raise 100 feet of barrier up to 27-in. design height. Replace Block at $30- per -Each for 5 Block(s) = $150. Replace 5 broken blocks. Replace Post at $100- per -Each for 2 Post(s) = $200. Replace 2 broken posts. Loader at $125- per -Hour for 2 Hrs = $250. 2 hours to remove gravel and sediment build-up next to guardrail. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0416: BULLFROG BASIN LODGE ROAD

Barrier Condition Photos

GLCA_0416_0.032_R_1.jpg

Barrier ID:	**GLCA-0416-0.136-L**		
Route Name:	BULLFROG BASIN LODGE ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	51.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	875
Speed Limit (MPH):	20	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-1	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM TRAILING END	**Is Beg. End Trtmt Crashhworthy?:**	YES	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	75.4
Height (In.):	23.5	**Lateral Offset (In.):**	84.1	**Road Grade (%):**	0.70

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. Barrier height is 3 to 4 in below 27-in design height for entire barrier.
	Breaking and Cracking:	Most posts and blocks in barrier are 5% to 50% cracked but retain original cross section.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No corrosion in w-beam. Posts and blocks are moderately weathered.
End Treatments	**Alignment and Height:**	Trailing end treatment is more than 6-in out of alignment. Both end treatments are 5 to 6 ines below 27-inch design height.
	Breaking and Cracking:	Approach end treatment has 1 broken block; trailing end treatment has 3 broken turned blocks.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	No corrosion in end treatments; moderate weathering in posts and blocks.

Barrier ID:	**GLCA-0416-0.136-L**		
Route Name:	BULLFROG BASIN LODGE ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	51.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$16247
Brief Workorder:	Raise 875ft. of barrier up to 27-inch design height. Replace 4 broken blocks in end treatments. Monitor cracking in posts and blocks and monitor vegetation build up.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 875 LF = $8750. Raise 875 ft. of barrier up to 27-in. design height. Replace Block at $30- per -Each for 4 Block(s) = $120. Replace broken blocks in end treatments. Low Speed Traffic Control at $1475- per -Day for 4 Day(s) = $5900.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0416: BULLFROG BASIN LODGE ROAD

Barrier Condition Photos

GLCA_0416_0.136_L_1.JPG

Barrier ID:	**GLCA-0417-0.073-R**		
Route Name:	BULLFROG BASIN VISITOR CENTER ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	40.20

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	717
Speed Limit (MPH):	35	**Placement with Respect to Road:**	OUTSIDE OF CURVE
Hazard Behind Barrier:	EXTREME		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.5
Height (In.):	26.6	**Lateral Offset (In.):**	47.5	**Road Grade (%):**	4.50

Physical Condition

Barrier	**Alignment and Height:**	Alignment is acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	All posts and blocks are cracked over 5% to 50% but retain original cross section. 6 blocks and 1 post are broken.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No corrosion in w-beam. Moderately weathered posts and blocks.
End Treatments	**Alignment and Height:**	Alignment is acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	No corrosion in end treatments but moderate weathering in posts and blocks.

Barrier ID:	**GLCA-0417-0.073-R**		
Route Name:	BULLFROG BASIN VISITOR CENTER ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	40.20

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1997
Brief Workorder:	Replace 6 blocks and 1 post. Adjust 1 turned block. Monitor all posts and blocks for cracking.				
Workorder:	Replace Block at $30- per -Each for 6 Block(s) = $180. Replace broken blocks. Replace Post at $100- per -Each for 1 Post(s) = $100. Replace broken post. Labor at $60- per -Hour for 1 Hrs = $60. Adjust turned block. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0417: BULLFROG BASIN VISITOR CENTER ROAD

Barrier Condition Photos

GLCA_0417_0.073_R_1.JPG

Barrier ID:	**GLCA-0417-0.199-L**		
Route Name:	BULLFROG BASIN VISITOR CENTER ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	15.50

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	29
Speed Limit (MPH):	35	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	LOW		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	NONE	**Is Beg. End Trtmt Crashhworthy?:**	N/A	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	NONE	**Ending End Trtmt Crashhworthy?:**	N/A		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.3
Height (In.):	24.6	**Lateral Offset (In.):**	54.2	**Road Grade (%):**	4.40

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 29-ft was between 1 and 3-in below the 27-in design height.
	Breaking and Cracking:	Minor cracking 1/4 to 1/2 in wide cracks on barrier posts and blocks.
	Missing Elements:	No missing elements in barrier.
	Corrrosion and Weathering:	No major weathering of barrier.
End Treatments	**Alignment and Height:**	
	Breaking and Cracking:	
	Missing Elements:	
	Corrrosion and Weathering:	

Barrier ID:	**GLCA-0417-0.199-L**		
Route Name:	BULLFROG BASIN VISITOR CENTER ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	15.50

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$1942
Brief Workorder:	Raise 29ft. of barrier up to 27in. design height.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 29 LF = $290. Raise 29ft. of barrier up to 27in. design height. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0417: BULLFROG BASIN VISITOR CENTER ROAD

Barrier Condition Photos

GLCA_0417_0.199_L_1.JPG

Barrier ID:	**GLCA-0417-0.317-R**		
Route Name:	BULLFROG BASIN VISITOR CENTER ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	23.70

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	382
Speed Limit (MPH):	35	**Placement with Respect to Road:**	TANGENT
Hazard Behind Barrier:	MEDIUM		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.5
Height (In.):	25.2	**Lateral Offset (In.):**	37.2	**Road Grade (%):**	2.60

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 113-ft was between 1 and 3-in below the 27-in design height.
	Breaking and Cracking:	Minor cracking 1/4 to 1/2 in wide cracks on posts and blocks in barrier.
	Missing Elements:	1 broken block.
	Corrrosion and Weathering:	No major weathering of barrier elements.
End Treatments	**Alignment and Height:**	Alignment acceptable. Height of end treatment at approach end is 3 in below design height of 27 ines.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	No major weathering of end treatments was observed.

Barrier ID:	**GLCA-0417-0.317-R**		
Route Name:	BULLFROG BASIN VISITOR CENTER ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	23.70

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$2897
Brief Workorder:	Raise 113ft. of barrier up to 27in. design height and replace 1 block.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 113 LF = $1130. Raise 113 ft. of barrier up to 27-in. design height. Replace Block at $30- per -Each for 1 Block(s) = $30. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0417: BULLFROG BASIN VISITOR CENTER ROAD

Barrier Condition Photos

GLCA_0417_0.317_R_1.JPG

Barrier ID:	**GLCA-0417-0.321-L**		
Route Name:	BULLFROG BASIN VISITOR CENTER ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	25.60

Barrier Description

Type:	W-BEAM STRONG POST	**Barrier Function:**	TRAFFIC
Barrier Material:	WEATHERING STEEL/CORTEN	**Post Material:**	WOOD
Blockout Type:	WOOD	**Length (ft.):**	359
Speed Limit (MPH):	35	**Placement with Respect to Road:**	INSIDE OF CURVE
Hazard Behind Barrier:	HIGH		

Barrier Crashworthiness

Appropriate Test Level:	TL-2	**Barrier Test Level:**	TL-3	**Is Barrier Crashworthy?:**	YES
Beg. End Trtmt Type:	W-BEAM BCT	**Is Beg. End Trtmt Crashhworthy?:**	NO	**Approach Transition Type:**	NONE
Ending End Trtmt Type:	W-BEAM BCT	**Ending End Trtmt Crashhworthy?:**	NO		

Average Measurements

Design Height (In.):	27	**Width (In.):**	0.0	**Post Spacing (In.):**	74.3
Height (In.):	26.7	**Lateral Offset (In.):**	88.3	**Road Grade (%):**	3.80

Physical Condition

Barrier	**Alignment and Height:**	Alignment acceptable. 12-ft was between 1 and 3-in below the 27-in design height.
	Breaking and Cracking:	3 blocks and 2 post mounted delineators are broken. 3 blocks are turned and 1 post is broken. 120 ft of barrier has blocks and posts that are 5% to 50% cracked but retain original cross section.
	Missing Elements:	2 post mounted delineators are broken off of barrier post; no other missing elements in barrier
	Corrrosion and Weathering:	No corrosion in w-beam. Moderate weathering of posts and blocks with one rotted post in barrier.
End Treatments	**Alignment and Height:**	Alignment is acceptable. Height is within 1-in of 27-in design height.
	Breaking and Cracking:	There was no breaking or cracking observed in the end treatments.
	Missing Elements:	No missing elements in end treatments observed.
	Corrrosion and Weathering:	No corrosion in end treatment; moderate weathering of posts and blocks in end treatments.

Barrier ID:	**GLCA-0417-0.321-L**		
Route Name:	BULLFROG BASIN VISITOR CENTER ROAD		
Inspection Date:	04/24/2010	**Barrier Rating:**	25.60

Repair Recommendations

Repair Action:	REPAIR	**FMSS Work Type:**	DEFERRED MAINTENANCE	**Repair Cost:**	$2316
Brief Workorder:	Raise 12 feet of barrier up to 27-in. design height and replace 3 broken blocks 1 rotted post and 2 broken delineators. Adjust 3 turned blocks. Monitor cracking in posts and blocks.				
Workorder:	Adjust Guardrail at $10- per -Lin. Ft. for 12 LF = $120. Raise 12ft. of barrier to 27in. design height. Replace Block at $30- per -Each for 3 Block(s) = $90. Replace broken blocks. Replace Post at $100- per -Each for 1 Post(s) = $100. Replace rotted post. Delineators on Curve and Tangent at $100- per -Each for 2 Unit(s) = $200. Replace 2 post mounted delineators. Labor at $60- per -Hour for 2 Hrs = $120. Adjust 3 turned blocks. Low Speed Traffic Control at $1475- per -Day for 1 Day(s) = $1475.				

2008 cost estimate (ASTM Class D), preliminary for comparison to other repair costs only.

Glen Canyon National Recreation Area

ROUTE 0417: BULLFROG BASIN VISITOR CENTER ROAD

Barrier Condition Photos

GLCA_0417_0.321_L_1.JPG

Appendix A
Summary of GIP Definitions and Assessment

Glen Canyon National Recreation Area

Federal Lands Highway
Road Inventory Program

Appendix A:
Guardwall/Rail Inventory Program (GIP)
EXPLANATION OF REPORT TERMS

The Guardwall/rail Inventory Program (GIP) was commissioned by WASO to identify deferred maintenance related to barriers in National Parks that have more than one mile of guardwall or guardrail. GIP was designed jointly by the NPS and FHWA and the inventory process records both static characteristics of the barrier (e.g., length, height, etc.) as well as dynamic information about the condition of the barrier.

Barriers that traverse bridges are not included in this inventory, these barriers are covered in FHWA's Bridge Inventory Program (BIP); however, barriers that are approaches to bridges were part of this inventory.

The following discussion highlights each of the elements found in the reports.

Static Barrier Characteristics

BARRIER TYPE

Refers to both the design and the construction materials used:

- W-Beam, Strong Post
- W-Beam, Weak Post
- Thrie Beam/Modified Thrie Beam
- Box Beam
- Steel-Backed Timber, w/ Blockout
- Steel-Backed Timber, w/o Blockout
- Steel-Backed Log Rail
- High Tension Cable
- Three-Strand Cable
- Stone Masonry, w/o Concrete Core Wall
- Stone Masonry, w/ Concrete Core Wall
- Random Rubble Cavity Wall
- Concrete Barrier
- Concrete, with Simulated Stone Face
- W-Beam (Double Face), Strong Post
- Steel-Backed Timber (Double Face)
- Other: *Completed by field crew*

BARRIER MATERIAL

The type of material of which the barrier is composed:

- Cable
- Concrete
- Galvanized Steel
- Log/Timber/Wood
- Steel-Backed Timber/Log
- Weathering Steel/Corten
- Stone
- Other: *Completed by field crew*

LENGTH

The longitudinal distance between the beginning and end of the barrier. It should include the length of end treatments in the overall length of the barrier. For roadside barriers, this can be calculated from the start and end locations.

BARRIER FUNCTION: Traffic or Non-Traffic Barrier.
Due to the different GIP assessment criteria of barriers based on their intended use, barriers were classified as being either traffic barriers or non-traffic barriers.

> *Traffic barriers* are physical devices intended to keep vehicles or people from straying into dangerous or off-limits areas. For the purpose of this inventory and assessment, a traffic barrier is categorized as roadside hardware placed longitudinally, excluding pedestrian railing and fencing.
>
> *Non-traffic barriers* provide a physical delineation between public access areas and restricted or protected areas in locations such as a parking lot, viewpoint or turnout. Non-traffic barriers which inhibit access of vehicles are included in this report; non-traffic barriers which only inhibit access of pedestrians or bicyclists are not included. For the purpose of this inventory, non-traffic barriers are guidewalls and guiderails. Note: rocks, stones, boulders, fences or curbs were excluded from this inventory.

There are instances in parks where a single barrier can switch between being classified as a traffic barrier and a non-traffic barrier. Such instances typically occur at pullouts, where a traffic barrier along the road will continue through the pullout without interruption. In such instances, the traffic barrier and non-traffic barrier were assessed using different criteria. Due to the different criteria, the GIP database was designed to record the traffic barrier and non-traffic barrier as two distinct barriers, even though to the eye, they appear as one barrier. Other instances where a single barrier is split into multiple barriers would be when the barrier is placed continuously along two legs of an intersection, so that one portion of the barrier may be on one road and the remaining portion of the barrier is on a different road.

POST MATERIAL
The type or material that the barrier's supporting posts are made of:

- Galvanized Steel
- Wood
- Corten
- Other: *Completed by field crew*
- N/A

BLOCKOUT TYPE

The type of blockout or of what it is comprised:

- Wood
- Plastic
- Steel
- N/A

BARRIER PLACEMENT WITH RESPECT TO ROADWAY
To identify the roadway alignment the barrier is located upon:

- Tangent
- Inside of Curve
- Both Inside and Outside of Curve
- Outside of Curve

POSTED SPEED LIMIT
The posted speed limit of the roadway section.

HAZARD BEHIND BARRIER

A qualitative description of the severity of the hazard behind the barrier:

- Low
- Medium
- High
- Extreme

APPROPRIATE TEST LEVEL (TL) FOR ROAD

Based on the posted speed limit, the NCHRP 350 Crashworthiness test level appropriate for the roadway.

- TL-1, 30 mph and lower
- TL-2, 35-45 mph
- TL-3, 50 mph and higher

BARRIER TEST LEVEL (TL)

A traffic barrier is crashworthy if it was successfully crash tested under *NCHRP Report 350* at speeds along the park road or parkway or if it was accepted through analysis by FHWA, based on similarity to other crashworthy critical design element features. Non-traffic barriers are classified at N/A.

- TL-1
- TL-2
- TL-3
- No
- N/A – Non-Traffic Barrier

IS BARRIER CRASHWORTHY

This compared the appropriate crashworthy test level required for the posted speed limit to the barrier's test level.

- Yes
- No

BEGINNING END TREATMENT TYPE

An end treatment is safety hardware that mitigates impacts to the ends of a barrier. Most common end treatments are for w-beam systems. Note that stonemasonry barriers typically do not have end treatments.

The beginning end treatment is based on the travel lane closest to the barrier. A vehicle traveling in the lane closest to the barrier will encounter the barrier's beginning end treatment first. It is not based on the RIP primary direction. Identifies the barrier's beginning end treatment type:

- W-Beam Flared 350 Compliant
- W-Beam Tangent 350 Complaint
- W-Beam Buried End
- W-Beam Trailing End/CRG
- W-Beam BCT, Flared
- W-Beam, Turn Down
- SBT/Log, Flared
- SBT/Log, Buried
- Median Treatments
- Box Beam
- Cable
- Crash Cushions/Attenuator
- Other: *Completed by field crew*
- None

IS BEGINNING END TREATMENT CRASHWORTHY

Identifies if the barrier's beginning end treatment (based on direction of travel for the travel lane closest to barrier) is crashworthy, based on NCHRP-350.

- Yes
- No
- N/A

APPROACH TRANSITION TYPE

A transition is safety hardware designed to be placed between two different types of barrier. Most common transition types are between bridge rail and w-beam systems.

This identifies the barrier's transition type:

- Bridge Rail, W-Beam
- Bridge Rail, SBT
- Rigid W-Beam, W-Beam
- Rigid SBT (Wall), SBT
- Concrete/Masonry, W-Beam
- Concrete/Masonry, SBT
- Concrete/Masonry, Thrie Beam
- Other: *Completed by field crew*
- None

ENDING END TREATMENT TYPE

The ending end treatment is based on the travel lane closest to the barrier. A vehicle traveling in the lane closest to the barrier will encounter the barrier's ending end treatment last, after passing the rest of the barrier. It is not based on the RIP primary direction. Identifies the barrier's ending end treatment type:

- W-Beam Flared 350 Compliant
- W-Beam Tangent 350 Complaint
- W-Beam Buried End
- W-Beam Trailing End/CRG
- W-Beam BCT, Flared
- W-Beam, Turn Down
- SBT/Log, Flared
- SBT/Log, Buried
- Median Treatments
- Box Beam
- Cable
- Crash Cushions/Attenuator
- Other: *Completed by field crew*
- None

IS ENDING END TREATMENT CRASHWORTHY

Identifies if the barrier's ending end treatment (based on direction of travel for the travel lane closest to barrier) is crashworthy, based on NCHRP-350.

- Yes
- No
- N/A

BARRIER DESIGN HEIGHT

Identifies the barrier's original "as-built" design height:

- 27-in, W-beam, Steel-Backed Timber, Stone Masonry w/ Concrete Core Wall
- 24-in, Stone Masonry w/o Concrete Core Wall, Log on Log
- 20-in, Timber on Wood Posts, Timber on Concrete Posts, Timber on Granite Posts
- 18/24-in, Crenellated Stone Masonry Barrier
- 18/24-in, Dry Stack Stone Wall
- 31-in, Steel-Backed Log
- 32-in, Jersey Barrier

AVERAGE MEASUREMENTS

Minimum of three measurements taken on each barrier.

First measurement approximately 50-ft from the beginning of the barrier, measured from the extreme ends of the barrier's end treatment/transition. Do not take a measurement along the end treatment
Measure and record measurement every 200-ft thereafter for the run of barrier

Last measurement approximately 50-ft from the end of the barrier. Do not take a measurement along the end treatment
If a barrier is less than 300-ft, even say 45-ft, a minimum of three measurements were still taken.

AVERAGE WIDTH

The width of the barrier. Only recorded for guardwalls; not guardrail.

AVERAGE POST SPACING

The spacing of the barrier's (not the end treatments') posts. Only recorded for guardrails; not guardwalls or non-traffic barriers.

AVERAGE BARRIER HEIGHT

The average barrier height. If the barrier has crenellations, the height is measured in the non-crenellated sections of the barrier. If the average lateral offset is less than or equal to 4-ft, average barrier height is measured from the roadway; if the average lateral offset is greater than 4-ft, average barrier height is measured at the barrier face.

AVERAGE LATERAL OFFSET

Determine the average distance between the barrier and the edge of roadway. If a white edgeline is present on the roadway, average lateral offset is measured from the outside edge of the white line to the barrier face. If no white edgeline is present, average lateral offset is measured from the edge of pavement to the barrier face.

AVERAGE ROAD GRADE and UPHILL OR DOWNHILL

Determine an average roadway grade at each barrier location, based on the direction of travel in the lane closest to the barrier.

DYNAMIC BARRIER CHARACTERISTICS – CONDITION ASSESSMENT NARRATIVES

Field crews were directed to write a narrative of the barrier's physical condition. To keep consistency between field crews, all narratives were based on severity and distress criteria, which were developed jointly by the NPS and FHWA. Condition assessments were based on barrier type and can be found directly after this description of report elements.

BARRIER ALIGNMENT/HEIGHT

Narrative completed by field crew describing the barrier's alignment and height. Height comments are based on the barrier's original "as-built" design height.

BARRIER BREAKING/CRACKING

Narrative completed by field crew describing any barrier breaking or cracking found during the inspection.

BARRIER MISSING ELEMENTS

Narrative completed by field crew describing any barrier missing elements encountered during the inspection.

BARRIER CORROSION/WEATHERING

Narrative completed by field crew describing and corrosion or weathering issues associated with the barrier.

END TREATMENTS ALIGNMENT/HEIGHT

Narrative completed by field crew describing the barrier end treatment's alignment and height, when present. Height comments are based on the end treatment's original "as-built" design height.

END TREATMENTS BREAKING/CRACKING

Narrative completed by field crew describing any barrier end treatment's breaking or cracking found during the inspection.

END TREATMENTS MISSING ELEMENTS

Narrative completed by field crew describing any barrier end treatment missing elements encountered during the inspection.

END TREATMENTS CORROSION/WEATHERING

Narrative completed by field crew describing and corrosion or weathering issues associated with the barrier's end treatments.

BARRIER PHOTOGRAPHS

During the inspection, the field crews photographed the beginning end (based on the closest lane's direction of travel) of each barrier. Additional photographs were taken of any unusual deficiencies encountered. Up to two photographs of the barrier are included in this report.

CONDITION AND SEVERITY DISTRESS TABLES

Due to the extreme number of possible conditions of the barrier, transition and end treatment, the following descriptions and matrices are guidelines created to help classify the condition of the element. While the distinction between good and fair is needed, the distinction between fair and poor is much more important since this is the threshold that defines if the element is slightly compromised or is not functional.

In all likelihood, according to these guidelines different portions of an element (most likely a barrier) may be classified differently; however, a single classification will need to be provided for the element. The survey team will use their professional judgment to determine this single classification. The single classification of each element should be considered an index value that provides a general indicator of overall performance, but not necessarily indicate that a specific treatment is warranted. The specific work order that is prepared based on the observed deficiencies will be a much more definitive indicator of the appropriate treatment based on existing distresses. The overall condition will be used as part of the risk assessment tool to evaluate the risk to driver safety associated with the physical condition of the barrier.

GOOD

The barrier performs as intended. The barrier is in fairly straight alignment but may have some small amount that is slightly out of alignment. While the height of the barrier may vary over its run, the height is relatively consistent and is close to its original "as-built" design height. Minor cracks may be visually observed on some the posts, though these cracks are neither long nor deep and the only hardware missing are isolated nuts and bolts. Minor surface corrosion on small portions of the surface is visible but there is no decay associated with connections.

The end treatment performs as intended. The end treatment is in good alignment and tension is acceptable. While the end treatment may exhibit some dents, there are no cracked rails, posts, blocks or any missing elements. Corrosion and erosion, while present, are at a minimum.

In general, all distresses observed, either in isolation or in combination, do not seriously affect the ability of the element to serve the intended functions of protecting drivers from a roadside hazard and/or contributing to the cultural value of the roadway corridor. Keep in mind that "intended function" is a relative term. In many cases, older designs were "intended" to protect drivers but would not be considered fully functional in that regard by today's standards.

FAIR

The barrier is slightly compromised. The barrier is noticeably out of alignment and the height along the run of barrier varies considerably. Cracks and broken elements are visible from the roadside. The barrier may be missing elements, such as nuts, bolts, blockouts or even a post. Surface corrosion is visible on a fair amount of the barrier but connections will still provide element interlock. Decay and minor erosion, while not always visible, may begin to reduce element strength and individual post stability.

The end treatment is slightly compromised. The end treatment may be somewhat out of alignment, have low cable anchor tension or isolated broken or cracked rail, posts or blocks. Corrosion and erosion are evident.

In general, the distresses observed, either in isolation or combination, may generate unpredictable outcomes related to the functions of the element stated above.

POOR

The barrier is not functional. The barrier will not function as intended. Any of the following could mean that the barrier is in poor condition: The barrier has fallen out of alignment or its height varies greatly from the designed height. Cracks and broken elements are visible from the roadside. The barrier is missing several elements, such as nuts, bolts, blockouts or consecutive posts. Corrosion, causing structural compromise is significant and obvious. Erosion around posts will reduce the barrier's strength and capacity.

The end treatment is not functional. The end treatment does not function as intended. There is no tension in the cable anchor. A significant portion of the end treatment has broken, cracked or dented elements. Elements are missing and corrosion or erosion is significant.

In general, the distresses observed clearly illustrate the inability of the element to perform the intended functions.

CONDITION AND SEVERITY DISTRESS TABLES – BARRIERS

Condition and Severity Distress Table for Semi-Rigid Barriers (including barriers with posts, rail elements and blocks).

	GOOD	FAIR	POOR
Alignment/Design Height			
	• Alignment off by less than 6”	• Alignment off by 6”-12”	• Alignment off by more than 12”
	• Within 1” of ***design height***	• Less than 3” lower than ***design height***	• Greater than 3” lower than ***design height***
Breaking/Cracking, an member, post or rail – due to impact loading			
	• Metal – no twisting/bending, tears or cracking	• Metal – no cracking or tearing (but minor twisting/bending is ok)	• Metal – any cracks or tears
	• Wood – no impact related cracking	• Wood – maybe cracked but retains original cross section	• Wood – cracks or tears that deform original section
	• Isolated broken blocks	• Two Consecutive broken blocks	• Consecutive broken blocks (three or more consecutive)
Missing Elements			
	• No bolts and nuts missing	• One or two bolt/nut missing at one rail/rail connection	• Three or more bolts/nuts missing at one rail/rail connection
	• n/a	• Two consecutive missing blocks	• Three or more consecutive missing blocks
	• n/a	• n/a	• One missing rail element or post
Corrosion/Decay/Weathering, all posts, rails and blocks – due to aging			
	• Loss of 5% or less of cross section	• Loss of 5% to 50% of cross section	• Loss of 50% or more of cross section
	• Erosion (less than 8” of post exposed below original groundline)	• Erosion around posts (8” or more of post exposed below original groundline) for one	• Erosion around consecutive posts (more than 8” of post exposed below original groundline)

Condition and Severity Distress Table for Rigid Concrete Barriers (including pre-cast).

	GOOD	FAIR	POOR
Alignment/Design Height			
	• Alignment off by less than 6”	• Alignment off by 6”-12”	• Alignment off by more than 12”
	• Within 1” of *design height*	• Less than 3” lower than *design height*	• Greater than 3” lower than *design height*
Breaking/Cracking– due to impact loading			
	• Minor cracks (less than ¼”) present	• Cracking present ¼” or greater but no displacement or discontinuity in face	• Barrier displaced and/or discontinuous
	• n/a	• Pieces broken from barrier 3” deep or less without exposing rebar	• Cracking exposes rebar
	• n/a	• n/a	• Pieces broken from face greater than 3” deep
Missing Elements			
	• n/a	• n/a	• n/a
Corrosion/Decay/Weathering – due to aging			
	• Surface corrosion on less than 5% of the run	• Surface corrosion on between 5-25% of the run	• Surface corrosion on more than 25% of the run
	• n/a	• Spalling 3” deep or less without exposing rebar	• Spalling greater than 3” deep
	• Erosion (less than 8” below groundline) around base	• Erosion (8” or more below groundline) around base	• Erosion (8” or more below groundline)
	• n/a	• Less than 50% undermined (less than half barrier width)	• 50% or more undermined (less than half barrier width)

Condition and Severity Distress Table for Rigid Stone/Masonry Barriers (including all types of stone or masonry barriers).

	GOOD	FAIR	POOR
Alignment/Design Height			
	• Alignment (off by less than 6”)	• Alignment (off by 6”-12”)	• Alignment (off by more than 12”)
	• Within 3” of *design height*	• Between 3.1 - 6” lower than *design height*	• Greater than 6.1” lower than *design height*
Breaking/Cracking – due to impact loading			
	• Minor cracks (less than ¼”) present	• Cracks, less than ½” present	• Cracks greater than ½” present
		• Stones broken/displaced extending less than 1/3 of width of barrier	• Stones broken/displaced extending 1/3 width or more through the barrier
Missing Elements			
	• n/a	• n/a	• n/a
Corrosion/Decay/Weathering – due to aging			
	• Cracks in mortar joints 1/4” or less and/or single loose or missing stones	• Mortar joints deteriorated resulting in two - three loose or missing adjacent stones (without impact)	• Mortar joints deteriorated resulting in more than three continuous/adjacent loose or missing stones (without impact)
	• Erosion (less than 8” below groundline) around base	• Erosion (8” or more below groundline) around base	• Erosion (8” or more below groundline)
	• n/a	• Less than 50% undermined (less than half barrier width)	• 50% or more undermined (less than half barrier width)

Condition and Severity Distress Table for Flexible Barriers, (including cable barriers and weak-post systems designed without blocks).

	GOOD	FAIR	POOR
Alignment/Tension/Design Height			
	• No bent posts	• Bent posts; one to three consecutive posts	• Bent posts; four or more consecutive posts
	• Cable has tension	• Cable under-tensioned/sagging	• No cable tension
	• Less than 1” too low	• 1-3” too low	• Greater than 3” too low
Breaking/Cracking			
	• No cracked or broken posts	• One to three isolated broken posts	• Four or more consecutive broken posts
	• n/a	• Cable frayed	• Cable broken or severed
Missing Elements			
	• No bolts and nuts missing at anchors	• n/a	• Bolts and nuts missing or loose at anchors
	• n/a	• n/a	• Any missing posts or cable for any length of run
Corrosion/Decay/Weathering – due to aging			
	• Loss of 5% or less of cable cross section	• Loss of 5% to 15% of cable cross section	• Loss of 15% or more of cross section
	• Erosion (less than 8” of post exposed below original groundline)	• Erosion around one post (8” or more of post exposed below original groundline)	• Erosion around consecutive posts (more than 8” of post exposed below original groundline)

CONDITION AND SEVERITY DISTRESS TABLES – END TREATMENTS

Condition and Severity Distress Table for Flexible End Treatments, (including cable end terminals).

	GOOD	FAIR	POOR
Alignment/Tension			
	• Alignment off by less than 4”	• Alignment off by 4”-8”	• Alignment off by more than 8”
	• Adequate cable tension	• Low cable anchor tension	• No cable anchor tension
Breaking/Cracking – due to impact loading			
	• No broken or cracked elements	• Minor cable fraying but still with adequate tension	• Broken or cracked cables or posts
	• No damage to posts, cable or anchor	• Slight damage to posts without cracking or tearing (*but minor twisting/bending on isolated posts is OK)*	• Cable broken or severed on any cable
Missing Elements			
	• No bolts and nuts missing at anchors; No missing cables	• n/a	• Any missing element (post, cable, bolts, nuts, or anchor)
Corrosion/Decay/Weathering – due to aging			
	• Loss of 5% or less of cable cross section	• Loss of 5% to 15% of cable cross section	• Loss of 15% or more of cross section
	• Connections weathered but still provide element interlock on less than 5% of the end treatment	• Connections weathered but still provide element interlock on between 5% to 15% of the end treatment	• Connections weathered but still provide element interlock on more than 15% of the end treatment

Condition and Severity Distress Table for Semi-Rigid End Treatments, including Flared and Tangent

	GOOD	FAIR	POOR
Alignment/Tension			
	• Alignment of flares and offsets off by less than 4”	• Alignment of flares and offsets off by 4”-8”	• Alignment of flares and offsets off by more than 8”
	• Within 1” of ***design height***	• Less than 3” lower than ***design height***	• Greater than 3” lower than ***design height***
For *Aesthetic Barriers* (i.e. – SBT and SBL guardrail) that do not have crashworthy terminals:	• Approach barrier terminals are buried, anchored, and flared away from the travel lane	• Approach barrier terminals are buried, anchored, and flared away from the travel lane	• Approach barrier ends are NOT buried, anchored, nor flared away from the travel lane
Breaking/Cracking – due to impact loading			
	• Metal – no twisting/bending, tears or cracking	• Metal – no cracking or tearing (but minor twisting or bending is ok)	• Metal – any cracks or tears
	• Wood – no impact related cracking	• Wood – maybe cracked but retains original cross section	• Wood – cracks or tears that deform original section
	• No broken blocks	• One broken block	• Two consecutive broken blocks
Missing Elements			
	• No missing elements, including breakaway cables and struts	• Isolated bolts, nuts, or blocks loose on non-consecutive posts	• Any missing element, including blocks, rails, posts cables, or struts
	• No bolts, nuts, or blocks missing or loose	• Breakaway strut present but vertical height off by more than 2”	• Missing nuts / bolts on consecutive posts
Corrosion/Decay/Weathering – due to aging			
	• Surface corrosion / decay / connections weathered with a loss of 5% or less of cross section of interlocking elements	• Surface corrosion / decay / connections weathered with between 5-25% loss of cross section along transition interlocking elements	• Surface corrosion / decay / connections weathered with more than 25% loss of cross section along transition interlocking elements
	• Erosion (less than 8” of post exposed below original groundline)	• Erosion around 1 post (8” or more of post exposed below original groundline)	• Erosion around consecutive posts (8” or more of post exposed below original groundline)

SPECIFIC RISK ELEMENTS

The potential risk to a motorist after a vehicle impacts a traffic barrier depends on the crashworthiness of the traffic barrier as well as traffic exposure factors. Variables relating to the roadside, the traffic barrier's crashworthiness and traffic data include the following:

ADT. The number of vehicles (in both directions) that travel the roadway on which the traffic barrier is located.

Barrier Crashworthy. A traffic barrier is crashworthy if it was successfully crash tested under NCHRP Report 350 at speeds along the park road or parkway or if it was accepted through analysis by FHWA, based on similarity to other crashworthy critical design element features. If crashworthy, the appropriate test level also needs to be recorded. For crashworthy barriers, the barrier test level will be compared to the test level appropriate for the roadway (based solely on posted speed limit). The intent is to record situations in which a crashworthy barrier of a lower test level is installed on a roadway which should have a barrier of a higher test level.

Barrier Height. Determined from barrier height as collected in the physical condition assessment. The database will compare this value to the NCHRP test level height that is appropriate for the posted speed of the road and barrier type.

End Treatment Crashworthy. An end treatment is crashworthy if it has been successfully crash tested. This is for the approach end treatment, which is defined as the end treatment which a vehicle will first pass when traveling on the same side of the road as the barrier.

Existing Roadway Features. The list of roadway features is limited to the following, all of which have a documented history of reducing the number of crashes, and are found later in the GIP as possible countermeasures.

Centerline pavement markings	Grooved pavement surface
Edgeline pavement markings	Delineators on curve and tangent
Wider centerline	Chevrons
Wider edgeline	Warning sign
Centerline rumble strips	Flashing beacon on warning sign
Shoulder rumble strips	Lighting
Barrier reflectors	Speed feedback sign

Factored Crash Rate. The average annual number of crashes (on the overall road and by barrier segment), over the last 5 years. If the road has an ADT of less than 1000, evaluate a minimum of
7 to 10 years of crash data, if available.

Lateral Offset of Barrier from Edge of Traveled Way. The distance from the edge of traveled way to the face of the barrier is useful for determining impact to asset during different types of construction. Two or three measurements will be taken – beginning, middle and end of barrier run (not including the end treatments) – and the average will be used.

Posted Speed Limit. The posted speed limit(s) of the roadway section.

Roadway Grade and Uphill or Downhill. Is refers to the grade of the roadway, in the direction of travel closest to the barrier.

Severity of the Hazard behind Barrier. A rating system based on photos will be used to rate the severity of the hazard behind the barrier. Choices include:

- Low
- Medium
- High
- Extreme

RISK ASSESSMENT AND RISK SCORE

The following table shows the variables relating to the overall roadway safety in the vicinity of barriers. In addition, the table illustrates the range of values considered for each variable and associated levels of risk. For categorization purposes, variables have been placed into one of three categories: segment, site or barrier variables. The "Associated Risk" column identifies the relative risk posed by each variable. This looks at the relative risk of the each variable itself and is only a cursory evaluation.

A Risk Score or Rating ("Barrier Rating" on Tier 3 Barrier page) was created for each barrier based on the table values. The level of risk tolerated is dependent on the category of road, which will be discussed in subsequent pages.

Once the inventory has been conducted, a total risk value can be assigned to each barrier. A comparison of the relative risk to an acceptable risk threshold will be performed in order to analyze the overall risk of a given barrier.

Variable and Associated Levels of Risk

VARIABLE	RANGE	ASSOCIATED RISK
SEGMENT VARIABLES		
ADT	0 – 1000	0.0
	1001 – 4000	2.9
	4001 – 8000	5.7
	8001 – 20,000	7.1
	20,001 and greater	8.6
Crash Factor	0	0.0
	0.1 – 5.0	4.2
	5.1 – 20.0	8.7
	20.1 – 30.0	17.1
	30.1 – 75.0	25.8
	75.1 and greater	34.2
Posted Speed Limit	15 – 25 mph	0.0
	30 – 40 mph	4.3
	45 and higher	8.6
SITE VARIABLES		
Barrier Placement w/ Respect to Roadway Geometry	Tangent	0.0
	Inside of curve	2.9
	Both inside and outside of curve	8.6
	Outside of curve	8.6
Severity of Hazard behind the Barrier	Low severity	2.6
	Medium severity	5.1
	High severity	6.9
	Extreme severity	8.6
Longitudinal Length of Barrier	1 – 250-ft	0.0
	251 – 750-ft	2.9
	751 – ft and greater	5.7
Lateral Offset of Barrier from Edge of Traveled Way	4.1 – ft and greater	0.0
	2 – 4-ft	2.9
	less than 2-ft	5.7
Roadway Grade	Uphill/level/downgrade less than 3%	0.0
	Mild downgrade (3 – 6%)	4.3
	Steep downgrade (greater than 6%)	8.6
BARRIER VARIABLES		
Actual Barrier Height (compared to test level height)	0 – 1-in lower	0.0
	1.1 – 4-in lower	4.4
	4.1 – 7-in lower	12.9
	7.1 – 12-in lower	19.4
	12.1-in and greater lower	21.5
Dynamic Barrier Condition Rating (based on design height)	0 – 25	0.0
	26 – 200	4.4
	201 – 400	8.6
	401 – 600	12.9
	601 – 800	17.1
	801 and above	21.5
Barrier Conformance with Current Crashworthiness Criteria	Yes	0.0
	No	5.7
	Maximum Total Possible Risk Score	**100**

REPLACEMENT/REPAIR STRATEGIES

Information is integrated by combining static data on barrier type, materials, dimensions, etc. with the condition and risk assessments, and the asset management roadway categories (which include cultural and historic resource considerations) to come up with actionable repair strategies for barriers. In addition, repair costs are accounted for so that estimates can be made for repair actions identified. Costed repair estimates, or work orders, then form the basis for estimating deferred maintenance associated with roadside barriers.
Repair recommendations generated by this assessment are intended to provide an estimated cost of deferred maintenance of barriers. As such, the evaluation is not rigorous and may be changed when a more detailed review and assessment at a project level is completed. In addition, any repairs or replacements that are recommended by this inventory and assessment process must be vetted through a project selection, planning and design process, including compliance with the National Historic Preservation Act (NHPA) and the National Environmental Policy Act (NEPA).

Many park barriers are located in harsh environments where freeze-thaw cycles, avalanche impacts, surface erosion, rockfall and vehicle impacts damage them; consequently, they are showing signs of fatigue, at times serious. Whenever possible, historic barriers are repaired or rehabilitated in place so that the historic significance can be preserved; however, removal or reconstruction, which is typically the least preferred alternative, is at times necessary.

Barrier deficiencies can generally be categorized into one of two categories:

- Barriers that pose an unacceptable risk to the traveling public (as determined by the risk assessment methods described in Chapter Seven and including standards found in NCHRP Report 350), or
- Damaged barriers, due to either crash impacts, other loadings (e.g., snow / avalanche, etc) or deteriorated parts (from age / weathering).

Outside of the national park system, barriers that do not meet NCHRP Report 350 crashworthiness standards are typically removed and a barrier of a crashworthy design is constructed in its place. However given the sensitive natural and cultural environments found within the national park system, deficient barriers not meeting national crashworthiness standards may warrant no action, particularly where risk is low.

The type of repair strategy is often dependent on the barrier deficiency and its cultural context. Typically barriers that do not meet current crashworthiness criteria may be replaced while damaged or deteriorated barriers can be repaired. However, under unique situations found in certain national parks and as evaluated using the risk assessment and asset management roadway categories, some barriers that do not meet current crashworthiness criteria may warrant no action being taken for their replacement or repair.

Risk assessment and asset management roadway categories are integrated in the following table, which establishes different risk thresholds within each roadway category. In essence, a higher level of risk will be tolerated in Asset Management Roadway Category A, as demonstrated by the higher risk threshold (90), while less risk will be tolerated in Roadway Category B (70) and even less risk in Roadway Category C (50).

Asset Management Roadway Categories, Risk Thresholds and Treatment Recommendations.

ASSET MANAGEMENT ROADWAY CATEGORY	RISK THRESHOLD	PROGRAM-LEVEL TREATMENT RECOMMENDATION
A	90-100	1. Identify measures other than barrier replacement that could be taken to reduce risk (including engineering countermeasures). 2. Corrective action (including reconstruct/replacement, if necessary) needed to reduce risk below 90.
	Below 90	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Identify repairs needed to improve physical condition/maintain historic integrity. 3. When condition is good and risk is acceptable, no action is necessary.
B	70-100	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Corrective action (including reconstruct/replacement, if necessary) needed to reduce risk below 70.
	Below 70	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Identify repairs needed to improve physical condition/maintain historic integrity. 3. When condition is good and risk is acceptable, no action is necessary.
C	50-100	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Corrective action (including reconstruct/replacement, if necessary) needed to reduce risk below 50.
	Below 50	1. Identify measures that could be taken to reduce risk (including engineered countermeasures). 2. Identify repairs needed to improve physical condition/maintain historic integrity. 3. When condition is good and risk is acceptable, no action is necessary.

Fourteen engineering countermeasures have been specifically selected for use with the GIP risk assessment tool, and are show in the next table. This is an all-inclusive list of available countermeasures for the risk assessment toll; countermeasures not on the list should not be considered.

The concept of employing countermeasures is evident with barriers that have a risk score just above the risk threshold. For such barriers, installing countermeasures should reduce the future number of crashes by a given amount, based on the countermeasure. Depending on the factored crash rate, reducing the number of crashes will lower the overall risk score. Thus, barriers that were classified as “reconstruct/replace” may be able to be reclassified as “repair”.

The decision to include any of the engineering countermeasures can be done only when the risk score is over the risk threshold by three points or less. When countermeasures are employed to reduce the risk score, they must be based on engineering judgment. The GIP database will allow the user to select up to three countermeasures to reduce the risk score under the threshold, based on crash reduction factors from the FHWA publication “Desktop Reference for Crash Reduction Factors” FHWA-SA-07-015.

Proposed Countermeasures.

COUNTERMEASURE	CRASH REDUCTION FACTOR
Speed Feedback Signs	0.46
Flashing Beacons On Warning Signs	0.30
Centerline Pavement Marking	0.30
Lighting	0.25
Chevrons	0.20
Warning Signs	0.20
Barrier Reflectors	0.16
Grooved Pavement Surface	0.15
Edgeline Pavement Marking	0.12
Shoulder Rumble Strips	0.12
Delineators on Curve and Tangent	0.05
Centerline Rumble Strips	0.04
Wider Edgeline	0.02
Wider Centerline	0.02

Maintaining Barriers As Is

Individual barrier elements and roadside conditions are interrelated. Sometimes, barrier deficiencies will be obvious and the best course of action is apparent; however, in context sensitive environments barrier deficiencies may be marginal and a decision will be based on judgment.

If risk is low (as determined by the assessment of variables such as traffic speeds, volumes), it may be acceptable for an historical or culturally significant barrier that does not meet current crashworthiness standards to remain until changes in risk factors would require an upgrading.

If the maintaining barrier as is alternative is the preferred choice through this approach, low cost mitigation measures may be considered to improve safety, such as improving roadside delineation (e.g., pavement markings / rumble strip(e)s, etc.), improving visibility (e.g., advance warning signs, increased sign size, etc.), upgrading the roadway shoulder, or improving skid resistance of the road surface. Although these measures will not reduce crash severity of an errant vehicle impact, these improvements have been tried or proven to reduce the frequency or probability of a vehicle striking the barrier.

Barrier Repair

If a barrier has been damaged due to a crash or there are parts that have deteriorated due to age or weathering but the majority of the barrier meets current crashworthiness standards and is functionally sound, repairing the system can be considered a viable option. Examples of these improvements include replacing damaged timber rail, removing a corroded, weathered steel post and replacing with new, upgraded guardrail blockouts to meet standards on high speed facilities or repointing, resetting or replacing loose or missing stones on the concrete corewalls of stone masonry guardwalls. Pursuing a repair approach should be the first consideration for Roadway Category A and B road assets.

For barriers that do not meet crashworthiness criteria but are functionally sound and have been determined good candidates to be maintained as-is based on the risk assessment and application of asset management roadway categories, repair could include measures such as repointing deteriorated masonry, re-setting or replacing loose, broken or missing stones, restoring walls to their original height (by adding a concrete footing, for example), restoring or improving drainage through or under walls or restoring wall foundations. Alterations to improve safety may also be considered, such as adding or changing end treatments or other mitigation measures as mentioned above.

For historic, stone masonry barriers that have a risk score below the threshold, it is possible that portions of the barrier need to be removed and reset in order increase the height of the barrier. The following guidelines are provided to assist in determining when this should be done and to what height the barrier should be rebuilt:

1. If all or a portion of stone masonry guardwall has a deficient height based upon the Severity Description Charts, that is, at worst, within the fair category, do not raise it. (Other work besides raising the barrier can be specified.)

2. If a portion of a stone masonry guardwall has a deficiency in height based upon the Severity Description Charts, considered "poor" (assumed typically to be less than 18-in) write a work order to raise the poor segment to the height of the adjacent barrier with a non-poor height.

3. If the entire stone masonry guardwall is in poor condition due to height based upon the Severity Description Charts– write a work order to raise the entire segment to its design height (assumed typically to be 24-in).

For aesthetic barrier systems used on many park roads and parkways, there is not a sufficient bid history database for estimating costs to repair or replace individual elements of the system, such as posts or rail. Usually repair of an aesthetic barrier system, such as steel-backed timber guardrail consists of removing and resetting the post or rail section or raising the guardrail to meet standard height requirements.

Barrier Replacement/Reconstruction

If the risk analysis, including the application of asset management roadway categories, indicates the barrier poses an unacceptable safety risk, the first step should be an analysis to determine if there are mitigating measures that can be applied to reduce the risk to an acceptable level without the need to reconstruct the barrier. A second step is to determine if the barrier is needed. If it is practical to eliminate the shielded hazard (by removal, relocation or redesign) removal of the barrier should be considered. However, if the shielded hazard cannot be eliminated or if it is determined inappropriate to remove the barrier (e.g., it is historically significant and/or contributes to the historical or aesthetic significance of the associated road, district or landscape), reconstruction or replacement of the barrier to meet current criteria for crashworthiness may be the appropriate recommended treatment.

The typical reconstruction option used by the NPS for stone masonry guardwalls is to document then dismantle the existing barrier, construct a concrete core and build a stone masonry veneer around the concrete core using the original wall materials and using stone masonry designs that are compatible with the historic road, district or landscape. A number of concrete core stone masonry barrier types have been designed for use in national parks, including 18-in, 22-in, 24-in and 27-in barriers; however, not all have been crash tested or otherwise determined to meet current criteria for crashworthiness.

WORK ORDERS

Work order preparation is essentially determining and documenting the repair actions needed to correct the deficiencies observed during the condition assessment. Barriers are relatively simple structures so this determination can be made by trained inspectors. Keep in mind that this is not a design environment and that more rigorous analysis (if needed) may change the work that is actually performed. The intent of this effort is to prepare a credible estimate of deferred maintenance that may or may not be directly actionable. Simple repairs and/or those that require no compliance with environmental policies (which may be a large percentage of the work orders) can probably be executed without modification.

Once a repair strategy is determined, a cost must be developed for the proposed action. Work orders will be classified as being either deferred maintenance or capital improvement. This classification is based on the type of work recommended, as defined below.

Definition: *Deferred Maintenance* can be classified as repair or replace in kind. Work done to the barrier does not include any upgrading.

Definition: *Capital Improvement* can be classified as upgrading existing barrier. Typically the upgrade will be from a non-crashworthy to a crashworthy device. Other examples of capital improvements would be the addition of a curb to improve drainage or the inclusion of any countermeasure.

There are four types of work:

- No Action
- Monitor
- Repair
- Replace

"No Action" – if risk is low (based on the GIP risk score), a barrier that does not meet current crashworthy performance standards may be acceptable to remain until changes in risk factors would require upgrading.

"Monitor" – if risk is low (based on the GIP risk score), a barrier that does not meet current crashworthy performance standards may be acceptable to remain until changes in risk factors would require upgrading, however, if conditions exist that the park should monitor (e.g., erosion), then "monitor" can be selected as a recommended action.

"Repair" – considered when a barrier damaged by impact deteriorated due to age/weathering and the barrier is functionally sound in a low risk environment. The goal is to bring the barrier back to its "new" condition.

"Replacement/Reconstruction" – when a barrier poses an unacceptable safety risk:

1. If the risk score is less than 3 points above the risk threshold, determine if countermeasures can reduce risk so the barrier can be repaired.
2. Determine if the barrier is warranted and either shielded hazard or barrier itself can be removed (only when barrier NOT considered historically/culturally significant)

For all barrier repair/replace/reconstruction recommendations, the NPS will vet the recommendations through a project selection, planning and design process, including compliance with:

National Historic Preservation Act (NHPA)
National Environmental Policy Act (NEPA)

Aesthetic barriers are commensurate with an approved crashworthy design for the specific conditions at the barrier site as the basis for selecting a crashworthy structure. Types of barriers are generally selected based on emulating the existing types of barriers in the park.