




## NPS Wall Inventory Program

### Program Development and Implementation



U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## NPS Program Focus

- ◆ Inventory of wall assets
- ◆ Condition assessment
- ◆ Deferred maintenance \$\$\$
- ◆ Report/archive wall data
- ◆ Top 33 of 394 Parks (80% of walls)
- ◆ NPS conducts LCCA via FMSS Asset System




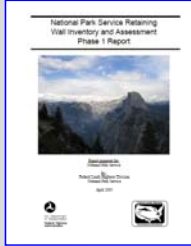

U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## 2005 Feasibility Study

### What's been done by others?

- ◆ 23 DOT's, FLMA's, Muni's
- ◆ One-third w/wall program
- ◆ Simple catalogue, new walls only, or specific wall type
- ◆ CO, OR, WA, OH, UT, NY
- ◆ City of Cincinnati


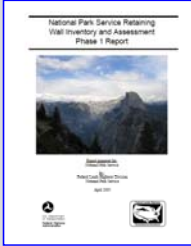
U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## 2005 Feasibility Study

### What's been done by others?

- ◆ 23 DOT's, FLMA's, Muni's
- ◆ One-third w/wall program
- ◆ Simple catalogue, new walls only, or specific wall type
- ◆ CO, OR, WA, OH, UT, NY
- ◆ City of Cincinnati

U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

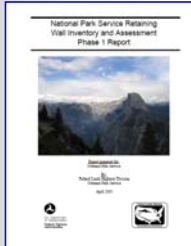
## 2005 Feasibility Study


---

### What's been done by others?

- ◆ 23 DOT's, FLMA's, Muni's
- ◆ One-third of wall program
- ◆ Simple catalogue of wall types  
\$\$\$ or specific wall type
- ◆ CO, OR, WA, OH, UT, NY
- ◆ City of Cincinnati

National Park Service Retaining  
Wall Inventory and Assessment  
Phase 1 Report





Engineering America's Scenic Highways

## Wall Failures

---



Mount Ranier NP



Engineering America's Scenic Highways

## Wall Failures

---



2005 Riverside Drive &  
Henry Hudson Parkway



Engineering America's Scenic Highways

## 2006 Program Development

---

**Pre-Field Activities**

- Inventory planning
- Visidata acquisition
- Initial Park contact
- Park inventory packet
  - Visidata review
  - Field inventory prep

**Field Activities**

- Kick-off meeting
- Wall reconnaissance
- Conduct Field Inventory
- Close-out meeting

**Post-Field Activities**

- Data upload to database
- Central database update
- Park findings packet

**Data Management Activities**

- FMSS data transfer
- RIP data transfer
- Document archive








Engineering America's Scenic Highways

## Wall Acceptance Criteria???


- ◆ Earth retaining structure
- ◆ Belongs to a roadway asset
- ◆ Supports/protects the roadway
- ◆ Failure impacts the road or requires wall replacement
- ◆ Max. height  $\geq 4$  ft
- ◆ Face angle  $\geq 45$  degrees
- ◆ Culverts included


U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## Wall Attributes




- Type, Size, & Location Data
- Action Assessment
- Work Order Cost Estimate




U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## Wall Condition Elements




- Primary Elements
- Secondary Elements
- Wall Performance




U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## Data Management



*WIP Database*



U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## 2007-08 Implementation

- ◆ 33 parks inventoried
- ◆ 3,500+ walls assessed
- ◆ ~20 walls/day/team
- ◆ 1-3 weeks/park
- ◆ \$1.8M program cost
- ◆ ~\$400-\$450M asset value






U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## Preliminary Findings

◆ **Wall Function:**

- 90% fill walls
- 10% cut walls
- Nearly 50% of fill walls were culvert headwalls
- <1% specialty walls
  - ◆ Switchback walls
  - ◆ Bridge walls
  - ◆ Slope protection
  - ◆ Flood walls

U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway



*Engineering America's Scenic Highways*

## Preliminary Findings

◆ **Wall Function:**

◆ **Wall Type:**

- 17 wall types inventoried
- 50% mortared stone masonry
- 25% dry-laid stone masonry
- 15% concrete gravity/cantilever
- Bins, MSE, pile walls

U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

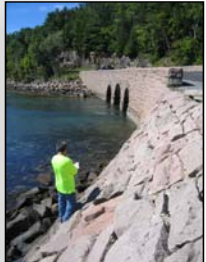

## Preliminary Findings

◆ **Wall Function:**

◆ **Wall Type:**

◆ **Recommended Actions:**

- 25% require corrective action
- <3% require major repair
- < 1% require replacement

U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*



## Recommended Actions




U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## Recommended Actions

U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## Recommended Actions




U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## Recommended Actions






U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*

## Preliminary Findings

- ◆ *Wall Function:*
- ◆ *Wall Type:*
- ◆ *Recommended Actions:*
- ◆ *Work Orders:*
  - ~ \$3K – maintenance
  - ~ \$35K – minor/major repair
  - ~\$250K – replacement





U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway



Engineering America's Scenic Highways


## Lessons Learned

**\$15+M Total Deferred Maintenance**

**\$400+M Total Wall Assets**

**FCI = 0.04**

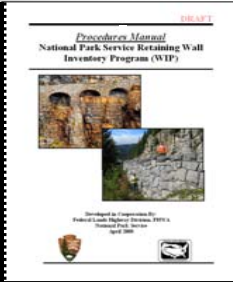



U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

Engineering America's Scenic Highways

## Current Developments

- ◆ Completion of NPS WIP Procedures Manual 2008



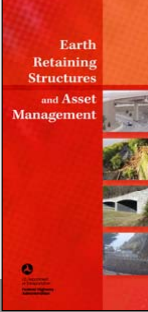



U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

Engineering America's Scenic Highways

## Current Developments

- ◆ Completion of NPS WIP Procedures Manual 2008
- ◆ New ERS Brochure from FHWA Office of Asset Management  
<http://www.fhwa.dot.gov/asset/if08014/>





U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

Engineering America's Scenic Highways



## Current Developments

- ◆ Completion of NPS WIP Procedures Manual 2008
- ◆ New ERS Brochure from FHWA Office of Asset Management
- ◆ NCHRP SCOH 20-7: “State of Practice for Inventorying, Assessing and Managing Earth Retaining Structures (ERS)”



U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*



## NPS Wall Inventory Program



U.S. Department of Transportation  
Federal Highway Administration  
Federal Lands Highway

*Engineering America's Scenic Highways*