Managing Nevada's Scour-Critical Bridges

John Hunt, PE

Manager-Water Resources

Ayres Associates

NEVADA DEPARTMENT OF TRANSPORTATION

AYRES ASSOCIATES

Outline of Topics

- Overview of NDOT Bridge Scour Program
- Plan of Action (POA) Implementation
- POA basics
- POA contents
- Ongoing POA management

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- NDOT:
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  - Many others
- Atkins
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Bridge Scour Nationally

- Over 484,000 bridges over water
- 60 percent of bridge failures are scour related
- On average over 50 bridge failures per year from scour

Nevada's Scour Program

- Began in 1993
- Screening of 700 over-water bridges
- Detailed evaluations of scour-susceptible bridges
- Hydraulic, geotechnical, structural
- Evaluations now complete
- 106 bridges now coded scour-critical (NBI 113=3 or less)
- POA for each scour-critical bridge

Accelerated Plan of Action Implementation

- By end of 2008: POAs implemented for 23 bridges
- Started 2-year project in Aug 2009
- All 106 POAs now implemented

Plan of Action Basics

- Purposes:
  - Protect public safety
  - Protect public investment in infrastructure

Plan of Action Basics

- Content:
  - Special inspection instructions
  - High-flow monitoring and closure protocol
  - Countermeasure recommendations

Summary/Cover Page

NEVADA DEPARTMENT OF TRANSPORTATION
SCOUR CRITICAL BRIDGE PLAN OF ACTION

SECTION 1. GENERAL INFORMATION

General Bridge Information

Agency Responsible for Implementation:	NDOT	
Bridge Number:	B764 (E/W)	**Reason for Item 113 Rating:** Deep computed pier scour and contraction scour result in spread footing calculated as undermined at Piers 2 and 3. (Bent 3 and 4) **(Bridge plans identify Bent 3 and 4 as those either side of the Truckee River. Bridge Inspection reports identify these as Pier 2 and Pier 3 as does this document.)**
District:	2	
Route:	I-80	
Waterway Crossed:	Truckee River	
County:	Washoe	
Bridge Owner:	NDOT	
Location Description:	About 0.75 miles southwest of Verdi, NV	
NBIS Item 113 Code:	3	
Foundation Status:	☒ Known ☐ Unknown	

Summary of Recommended Actions

Immediate Bridge Closure:		☐ Yes	☒ No
Monitoring During High Flows?*		☒ Yes	☐ No
If Yes, Type:	☒ Observe Structure	☒ WSEL	☒ Flowrate at USGS Gage 10347460
Monitoring Summary: **(See** Section 2.2**)** Twice daily monitoring when flow exceeds 6,000 cfs at gage, or when water surface elevation exceeds 4866.6 ft elevation at downstream face of B764W. Continuous monitoring (personnel onsite) when flow exceeds 9,000 at gage or when water surface elevation exceeds 4868.8 ft elevation at downstream face of B764W.			
Fixed-Instrument Monitoring?*		☒ Yes	☐ No
If yes, equipment type: Tilt sensors on Pier 2 and Pier 3 on both B764 E and B764 W			
High Flows Bridge Closure?*		☒ Yes	☐ No
If Yes, Type: Flow greater than or equal to 12,000 cfs at gage or water surface elevation at bridge greater than 4870.5 ft. Out of range inclination of piers indicated by tilt sensors. Evidence of structural distress (see Section 2.2.1).			
Inspection Instructions?** Continue regular inspections on an annual basis and conduct post-flood inspection after any flood exceeding 6,000 cfs at USGS Gage 10347460			
Scour Countermeasures?* (See Section 4 & Attachment 2)		☒ Yes	☐ No
Scheduled for installation: Should be installed at first opportunity			

* Responsibility of Bridge Owner
** Responsibility of Nevada DOT

Plan of Action Prepared by Ayres Associates:

PROFESSIONAL ENGINEER-STATE OF NEVADA
JOHN H. HUNT
Exp: 6/30/11
CIVIL
No. 017350

Recommended Actions Summary

Summary of Recommended Actions

Immediate Bridge Closure:		☐ Yes	☒ No
Monitoring During High Flows?*		☒ Yes	☐ No
If Yes, Type:	☒ Observe Structure	☒ WSEL	☒ Flowrate at USGS Gage 10347460
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Scheduled for installation: Should be installed at first opportunity			

* Responsibility of Bridge Owner

** Responsibility of Nevada DOT

Inspection

- Responsibility of NDOT Bridge
- Triggers for post-flood inspections
- Areas of particular concern

High-Flow Monitoring and Closure

- State-owned: Responsibility of NDOT District
- Non-state-owned: Responsibility of bridge owner
- Action thresholds
- Signs of distress triggering closure
- Closure protocol

2.2 High-Flow Bridge Monitoring (Also see Attachment 2. Supporting Narrative)

High Flow Bridge Monitoring is the Responsibility of the Bridge Owner

High-Flow Monitor? ☒ Yes ☐ No

If Yes, Trigger: Flow exceeding 6,000 cfs at USGS Gage 10347460

Types of Monitoring:

- ☒ Observe Structure
- ☒ WSEL
- ☐ Direct Bed

2.2.1 Observe Bridge Structure for Distress Triggers for Bridge Closure:

- ☒ Joint deflection
- ☒ Excessive debris buildup on pier
- ☐ Pressure flow (low chord of bridge submerged)
- ☒ Settlement at one or more piers or abutments (sight along bridge rail to discern)
- ☐ Sinkholes in road surface behind abutments
- ☒ Bridge movement under load
- ☐ Bridge or approach embankment overtopping
- ☐ High-velocity flow impinging directly on abutments or unarmored embankments
- ☒ Abutment armor failure
- ☒ Other: One or more tilt sensors indicating out-of-range inclination of pier

2.2.2 Water-Surface Elevation (WSEL)-Based Scour Monitoring

Closure WSEL Mark? ☒ Yes ☐ No

If yes, location and description: Recommend painted indicator line on the downstream end of Pier 2 and Pier 3, B764W

Reference Location for Measurements: The top of the infill walls at Piers 2 and 3 (eastbound and westbound bridges) is at 4876.0 ft (Bridge Plans Datum)

Closure WSEL (ft, DATUM): 4870.5 ft Bridge Plans

Reference Elev. (ft, DATUM): The top of the infill walls is at 4876.0 ft, Bridge Plans

Measure-down Distance (ft): 4.5 ft below the top of the wall pier

Tilt Sensor Installation Example (Colorado)

Closure Protocol Example

SECTION 3. BRIDGE CLOSURE PROCEDURES

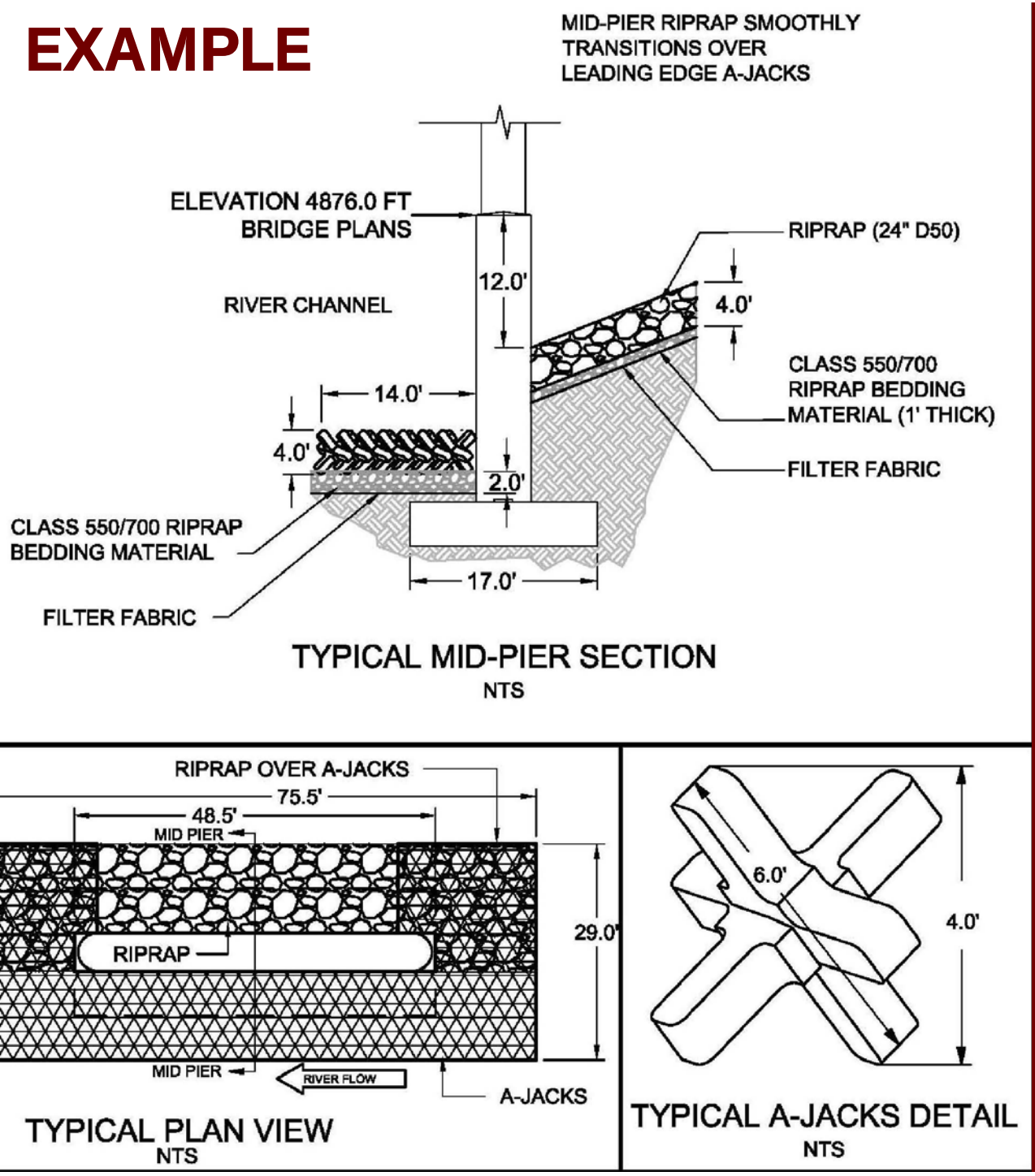
AGENCY RESPONSIBLE FOR CLOSURE: NDOT
Action required if monitoring indicates the need to close the bridge (structural distress, scour closure WSEL, or scour critical bed elevation is detected): 1. Onsite monitoring personnel: Perform emergency closure of the bridge and stay off the bridge. Remain at the bridge until formal closure is implemented. 2. Contact the Northern Nevada Road Operations Center to initiate the District bridge closure protocol 3. Contact Headquarters Structure Division and Headquarters Inspection Manager 4. Remain at the bridge until the Maintenance Supervisor arrives 5. Do not reopen the bridge until authorized by the District Engineer
Contact Information: • Northern Nevada Road Operations Center: (775) 834-8399 or (775) 834-8398 • NDOT Headquarters Bridge Section: (775) 888-7540 • NDOT Headquarters Inspection Manager: (775) 888-7547

Potential detour route during bridge closure is as follows:

Countermeasure Recommendations

- Consider importance of bridge and route
- Consider site-specific scour threats
- State-owned: Site-specific conceptual design and cost estimate
- Non-state-owned: Generic concept to address specific threats
- Wide range of acceptable countermeasure approaches

EXAMPLE


MID-PIER RIPRAP SMOOTHLY
TRANSITIONS OVER
LEADING EDGE A-JACKS
ELEVATION 4876.0 FT
BRIDGE PLANS
RIVER CHANNEL
12.0'
RIPRAP (24" D50)
4.0'
CLASS 550/700
RIPRAP BEDDING
MATERIAL (1' THICK)
FILTER FABRIC
14.0'
4.0'
2.0'
CLASS 550/700 RIPRAP
BEDDING MATERIAL
FILTER FABRIC
17.0'
TYPICAL MID-PIER SECTION
NTS
RIPRAP OVER A-JACKS
75.5'
48.5'
MID PIER
RIPRAP
29.0'
MID PIER
RIVER FLOW
A-JACKS
TYPICAL PLAN VIEW
NTS
6.0'
4.0'
TYPICAL A-JACKS DETAIL
NTS

Ongoing POA Management

- All scour-critical bridges require POAs
- Initial POA implementation is complete in Nevada
- POAs require maintenance over time
  - Changing stream conditions
  - Complete or partial countermeasure installation
  - Bridge rehabilitation or replacement

Ongoing POA Management

- Recommend standing district-wide scour committee with regular meetings
  - Multi-discipline
  - All affected bridge owners
- Recommend GIS-based system to aid in real-time response and updating