

Scour Preparedness & Response

Monitoring Bridges During Flood Events



Outline

- ▣ Brief History of Maryland's Scour Program
- ▣ Main Points of SHA's Policy and Procedure Memorandum (PPM) for Flood Response
- ▣ Most recent examples of responding to floods
- ▣ List of Lessons Learned

Brief History of Bridge Scour Evaluations

- 1990 began phase I of scour evaluations
- 1994 to 1995 completed phase II evaluations with interdisciplinary team (Hydraulic, Structural, & Geotechnical Engineers)
- *1993 started inventory of all structures 5 feet or greater and structure between 3 feet to 5 feet with less fill than their span length which added to the scour evaluation numbers
- Small structures are evaluated and given scour ratings when they become known to have scour issues

Breakdown of Scour Ratings from 1995

- ▣ Bridges that are rated scour critical (a rating of 3) were divided into three categories (3A, 3B, or 3C) so we could prioritize and address the most critical bridges first:

- ▣ Number of Bridges Scour Critical in 1995:

3A	#73	6N	#1	7	#15
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3B	#47	6	#304
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3C	#44	6R	#29
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6U	#41
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Total Rated 3 #164

Total Rated 6 or U #375

Scour Countermeasures Philosophy

- Any bridge or “small” structure (<20’) found to have a “questionable” scour issue was given a high priority to have scour countermeasures installed.
- Why? Looking at the cost of a scour study verses a the installation of scour countermeasures on the vast majority of these bridges was judged to be less or the same.
- For the most part it was a forgone conclusion that most would need countermeasures anyways.

Present Day Breakdown of Scour Ratings

- Through replacements or by installing countermeasures the number of 3Cs has been reduced to three which are scheduled for repair soon
- Installed countermeasures at 107 bridges.
- Numerous 3As were determined to be stable thru assessment with no scour ever being found and are now considered *5As.
- Several 3Bs have become 3Cs and therefore scour countermeasures were installed.
- Present Day Breakdown of scour ratings for Maryland State Highway:

<u>Scour Rating</u>	<u>Number of Bridges</u>
7	107
6	0
5A	39
5B	31
3	3 (Recently discovered scour found)
U	0

Preparedness & Response

Policy and Procedures Memorandum (PPM) For Flood Response Program

- ▣ In response to Flood Warnings, a PPM indicates what actions need to be taken before, during and after a flood event.
- ▣ In regards to scour critical bridges, FHWA requirements for all scour prone bridges to have Plans of Actions POAs

Policy & Procedure Memorandum

- Anytime the **National Weather Service** issues a **Flood Warning** for a county, the **Flood Response Program** shall be implemented for that county. Crews will contact local SHA shops.
- **Any bridge** that is reported to SIRE to be **overtopped without the National Weather Service issuing a Flood Warning**, the same inspection procedure of inspection, documentation, and notification is to be followed.
- The **SHA Flood Response Program** requires all bridges with the SIA Item 113 rated **3, 4, U, 5B, 5A** and **7** shall be checked for scour damage during and after each event. In addition, any specific bridge scour plans of action within the affected county shall be implemented.
- If possible, prior to an event such as a hurricane or tropical storm the SIRE Division Chiefs shall assign manpower, vehicles, and divers to specific areas for expected response. Each team shall consist of at least two people and have a minimum of one qualified bridge inspector.

Note Condition During Every Visit



Policy & Procedure Memorandum

(Continued)

Structures in the determined flooding/high water concern areas should be inspected in the following general order:

- Structures with reported possible flood/storm related damage
- Structures that have been determined to be scour critical. These structures should be inspected in the following order using Item 113 in the SIA 3, 4, U, 5B, 5A, & 7. However, inspection team leaders may use their discretion to inspect the structures in the most efficient manner. A list of these bridges will be provided by the Division Chief for Inspection.
- Bridges that have been overtopped

Policy & Procedure Memorandum

(Continued)

- Teams shall inspect these structures as much as they can safely do during the storm to look for indications of structural movement, changes in scour condition or protection, or other related concerns. Teams shall also inspect each structure as soon as possible after the storm event. This may require repeated visits due to unsafe conditions. If the structures are too dangerous to inspect, a visual inspection should be performed during each visit until the inspectors can safely enter the water. Scour must be evaluated by in-stream (“boot” or scour pole inspection) or by use of a diver. Diver requests should be coordinated with the Senior Project Team leader.

Policy & Procedure Memorandum

(Continued)

- ▣ Critical findings should be phoned in immediately to the single point of contact which typically is the Division Chief of Structures Inspection, followed by an email, to the responsible Engineer (or the Division Chief – Structures Remedial Design if the Engineer is not available).

Policy & Procedure Memorandum

(Continued)

- Each visit to these structures shall be reported on a **Flood Response Form**. If inspection requires multiple visits then a Flood Response Form shall be filled out for each visit. Once a full inspection of the bridge's foundation is completed, it shall be reported as a **Flood Inspection** and properly code Item **92P**. Each report must indicate at a minimum:
 - Reason for inspection (scour critical, requested by District, other). Record in Pontis Element 003 (FYI Information).
 - Method of inspection (visual, wading/probing, diving). Record in Pontis Element 003 (FYI Information)
 - Findings (using standard Pontis elements and sketches).
 - Required follow-up (Engineer's Requests, District Maintenance Requests)

Flood Response Form

Flood Response Bridge Inspections

Bridge No: _____ Date of Inspection _____
Location: _____ over _____

Reason for Inspection: Bridge is on Scour Critical List
 Inspection Requested by others (who) _____

Method of Inspection Visual (Substructure currently inaccessible) Wading/Probing Diving

Summary of Findings

Streambed changes (compared to previous soundings/reports)
_____ No significant changes _____
_____ Moderate changes _____
_____ Significant changes _____

Status of Bridge
_____ Bridge may reopen/remain open
_____ Bridge should be closed/stay closed

Need for Follow-Up
_____ No additional follow-up required
_____ Need to return without a diver _____
_____ Need to return with a diver _____
_____ Engineer follow-up required _____

Required Repairs/Maintenance Due to Scour/Flood Damage
_____ No repairs/maintenance required _____
_____ Debris removal required _____
_____ Other minor maintenance required _____
_____ Repairs required, Engineer should inspect _____
_____ Unable to determine at this time _____

COMMENTS: _____

Submissions/Notifications
_____ Notified _____ by phone - date: _____
_____ Screamer attached _____
_____ Soundings attached _____
_____ Sketches attached _____
_____ Maintenance Request submitted to _____ date: _____

Inspectors: _____

Team Leader Signature: _____ date: _____

c:\document\charts\floodfm.doc

Implementing

Response Due to Localized Storm Event or Notification by Local Shop of Bridge Being Overtopped

- ▣ Field Inspection Team Leader assigned to that area contacts the shop to determine flooding issues and performs flood inspections in accordance with the PPM. If additional resources are needed then, the team leader notifies headquarters.

Implementing Statewide Flood Response (Hurricanes & Tropical Depressions)

- In the case of Hurricanes notification can be days before so planning can be extensive
- Assign the responsibilities for managing inspection activities, notifying management, working with other agencies, getting environmental permits, traffic detours, etc.
- Coordinate Inspection Teams:
 - Pair up engineers with inspectors
 - Assign bridges to each team which they are to inspect until they are complete
 - Assign vehicles, cameras, scour poles, flash lights, safety equipment, etc.
 - Setup spreadsheet with contact information of each team, designated assigned locations, contact information of all local shops, etc. and distribute to all staff so they can communicate with others in their area if needed, **CDs of plans for every bridge**
- Single point of contact for all teams is the Inspection Team Leader
- Locate teams in distance areas prior to the start of a storm
- Put on alert that possible services will be required for this event: (Establish how many teams of each will be supplied by each company)
 - Engineer Consultants to be ready to supply inspection teams or designers on a as need basis
 - Diving companies to be ready with diving teams
 - Our “open-end” contractors to be ready to supply manpower and materials (grout bags, pumps, riprap on call for next day)

Resources for Teams

- ▣ Scour Inventory book
- ▣ Past reports and plans of all bridges on CD
- ▣ Contact information of other teams
- ▣ Lists of Consultant & Diver Contact Information
- ▣ Typical inspection equipment, boots, scour poles, depth finders, etc.

Scour Inventory Book

- ▣ Maryland SHA Coding Description for Item 113
 - ▣ Example Flood Response Forms & Sounding Sheets
 - ▣ Copy of the Manual on Hydrologic and Hydraulics Design Chapter 7 “Scour Program for Existing Bridges”
 - ▣ List of all Bridges by County in the order of Br. No. & Scour Rating
 - ▣ A location map of every county with icons identifying every structures with a scour rating of 3, 4, 5A, 5B, U, & 7.
 - ▣ Contact Information for HQ Office, Districts, Local Shops, and Consultants, Diving Company
- *Every Inspection Team has copies

Sample Sheet Rating

Scour Ratings for Bridges in Baltimore County

03/01/2011

Br. No.	Route	Crossing	Rating	Remarks
0307400	MD 130	NORTH BRANCH	7	SSSF OSA W/USGS/T BOR.TAKEN
0308300	MD 140	N BR OF PATAPSCO RIVER	7	OSA W/USGS/T (UW INSP ⁹⁴) SCOUR COUNTERMEASURES PENDING
0308600	MD 144	PATAPSCO RIVER	7	OSA W/USGS/T AWARDED
0309100	MD 147	HAYSTACK BRANCH	7	SSSF OSA W/USGS/T
0309200	MD 147	LONG GREEN CREEK	7	SSSF OSA W/USGS/T
0309400	MD 147	GUNPOWDER FALLS	7	OSA W/USGS/T REQ BORINGS - GROUT BAGS INSTALLED - (3C/7) SSSF OSA W/USGS/T - SCOUR COUNTERMEASURES INSTALLED (3C/7)
0310000	MD 165	LITTLE GUNPOWDER FALLS	7	SSSF OSA W/USGS/T - SCOUR COUNTERMEASURES INSTALLED (3C/7)
0310500	YORK ROAD	LITTLE FALLS	7	FOSA(OSA W/USGS/T-3C)
03417X0	MD 146	OVERSHOT RUN	7	SSSF OSA W/USGS/T Previously 0330600
03424X0	MD 130	SPRING DRAIN	7	MD 130
0300300	US 1	GUNPOWDER FALLS	8L	OSA W/USGS/T BOT'LESS ARCH IN ROCK
0300700	US 1	HERBERT RUN	8L	OSA W/USGS/T TIMBER PILES
0301000	US 1	PATAPSCO RIVER	8L	OSA W/USGS/T LOW RISK
0301100	US 1 ALT	US1 NBR, AMTRAK, HERBERT	8L	OSA W/USGS/T
0301100	US 1 ALT	US1 NBR, AMTRAK, HERBERT	8L	OSA W/USGS/T
0301200	MD 7	LITTLE GUNPOWDER FALLS	8L	OSA W/USGS/T
0301300	MD 7	GUNPOWDER FALLS	8L	BUILT 1987 OSA W/USGS/T
0302000	MD 25	BLACKROCK RUN	8L	OSA W/USGS/T REPL 1995
0302800	MD 25	JONES FALLS	8L	OSA W/USGS/T BORING TAKEN
0302900	MD 25	MTA LIGHT RAIL,JONES FLS	8L	REP 1990 OSA W/USGS/T
0303403	US 40 EBR	LITTLE GUNPOWDER FALLS	8L	OSA W/USGS/T ON PILES LOW RISK
0303404	US 40 WBR	LITTLE GUNPOWDER FALLS	8L	OSA W/USGS/T ON PILES LOW RISK
0303503	US 40 EBR	GUNPOWDER FALLS	8L	OSA/SHA/T ON PILES
0303504	US 40 WBR	GUNPOWDER FALLS	8L	OSA/SHA/T ON PILES
0303600	US 40	HONEYGO RUN	8L	OSA W/USGS/T TIMBER PILES
0303900	US 40	STEMMERS RUN	8L	SSSF OSA W/USGS/T - REPL 1997
0304000	US 40	REDHOUSE CREEK	8L	OSA W/USGS/T TIMBER PILES
0304200	MD 45	WESTERN RUN	8L	SSSF OSA W/USGS/T
0304300	MD 45	BEAVERDAM RUN	8L	SSSF OSA W/USGS/T
0304700	MD 45	LITTLE FALLS	8L	SSSF OSA W/USGS/T
0305101	IS 83 NBR	MD 25, JONES FALLS	8L	OSA W/USGS/T ON PILES
0305101	IS 83 NBR	MD 25, JONES FALLS	8L	OSA W/USGS/T ON PILES
0305102	IS 83 SBR	MD 25, JONES FALLS	8L	OSA W/USGS/T ON PILES
0305102	IS 83 SBR	MD 25, JONES FALLS	8L	OSA W/USGS/T ON PILES
0305700	IS 83	WESTERN RUN	8L	OSA W/USGS/T

Indicate Bridges Condition During Every Follow-up Inspection



Visual Inspection of Scour Countermeasures During Flood



Note Debris Buildup

Assign Clean-Up to Local Shop

MD 68 over Concocheague Crk
Bridge No. 2103600



Contact Divers & Open-End Contractors to Schedule Repairs

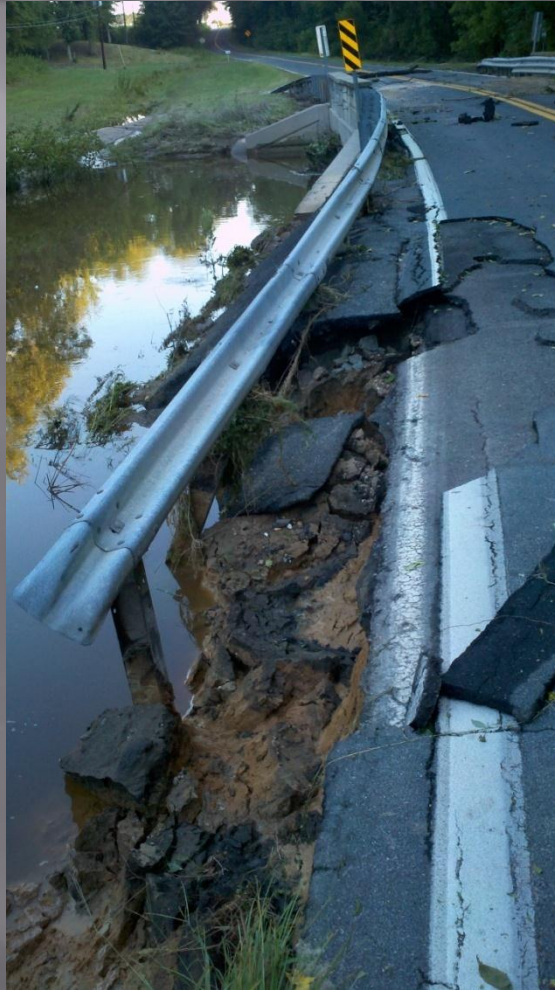
Bridge No. 2001000
MD 303 over Norwich Creek



Confirm Bridges Condition

Bridge No. 2002100

MD 662B over South Br Skipton Crk



Mobilized Contractor to Install Temporary Replacement

Structure No. 16178X0
MD 381 over Timothy Branch



Schedule Replacement for Weekend Closure

Structure No. 02005X0

MD 214 over Tributary to Beards Creek



Slope Washouts

Structure No. 14043X0

MD 299 over Branch of Jacobs Creek



Close Roadway and Install Detour Bridge No. 0803600 MD 234 over Allen's Fresh



Water Way Permits

- Team of environmental personnel from the that coordinate with the Maryland Department of Environment (MDE) for all waterway permits regarding our maintenance type repairs.
 - This team has an established a good relationship with their MDE counterparts and with the Engineering Design teams.
 - This team understands the work we do and can convey information to MDE in a way to expedite getting “permission” to do work.
 - This team is the sole point of contact between SHA and MDE and they track the progress of permit applications. Follow up with MDE on progress of permits, etc.
 - **During emergencies, the only water way permit requirement is to notify this team regarding the scope of work we are doing and follow-up later with an “after the fact” permit application.**

Lessons Learned

- Distribute all contact information to all teams including diving teams and consultant engineering firms.
- Notify and put on stand by Consultant engineering firms and diving teams as early as possible. They may have other commitments with other agencies, municipalities or counties.
- Identify one person as the point of contact to gather information on progress of follow-up inspections.
 - Responsible for all reallocating resources
- Have teams report status every one or two hours.
 - Accurate and up to date information of findings can be provided to upper management/senior official

Lessons Learned (Continued)

- ▣ Based on updates, you may find you need to redistribute the inspection work load if some areas are falling behind and need more resources.
- ▣ An even distribution of bridges means an optimum usage of the inspection resources which ensures a quicker completion of the inspection of all bridges.
- ▣ Assign teams to areas as soon as possible
 - Engineers can review reports for issues with the bridge along with a copy past sounding reports, CDs with copies of all bridge plans, etc. if needed.
 - Time is needed to plot out the tour route.

Lessons Learned (Continued)

- Make up inspection teams with one engineer and one inspector from that area. If possible, always keep inspectors with the bridges they inspect:
 - Inspectors may recognize a change in condition more easily at a particular bridge.
 - Inspectors know the areas so they know how to get around the areas if a roadway is closed due to flooding.
 - The Engineers can perform on the spot analysis if needed.
- Setup Tracking System for:
 - Status of Inspections:
 - Inspections completed
 - Areas still need to be visited
 - Need for return visits
 - Awaiting divers inspection
 - Bridges still closed

Lessons Learned (Continued)

- Track actions being taken and who is responsible:
 - List of repair activities needed to be done – debris removal, roadway pavement repairs, minor or major bridge repairs, scour countermeasures, etc.
 - Identify Lead Office doing the repairs –District Office, Local Shop, State wide Open-end Contractor, etc.
 - Identify who is getting MOT permits/Setting up Traffic detours.
 - Identify who is submitting for Environmental permits.

Lessons Learned (Continued)

- ▣ Track Repair Costs, Completion Dates, & Priority:
 - ▣ Estimate cost of each repair
 - ▣ If possible, identify source of funding to do each repair
 - ▣ Final cost to your budget
 - ▣ Estimated time line for when repairs are to be completed
 - ▣ Use the list to priorities repair work

Questions?