

APPENDIX B – PHOTOGRAPHIC GUIDE FOR CULVERT ASSESSMENT

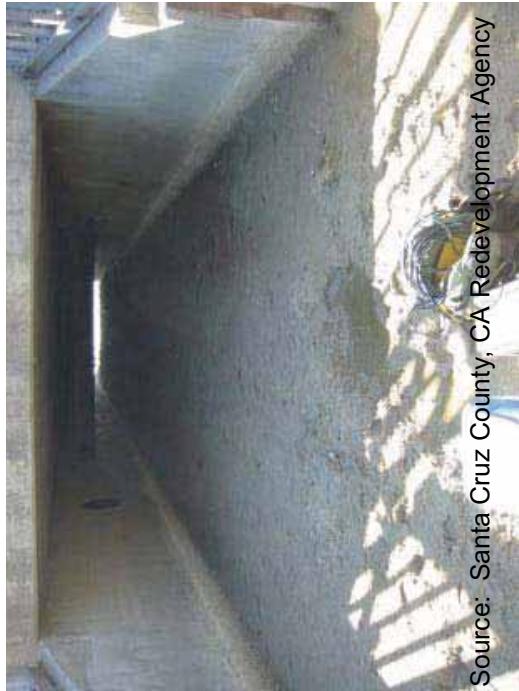
APPENDIX B – PHOTOGRAPHIC GUIDE FOR CULVERT ASSESSMENT

**FHWA FLH Culvert Assessment and Decision-Making
Procedures Manual**

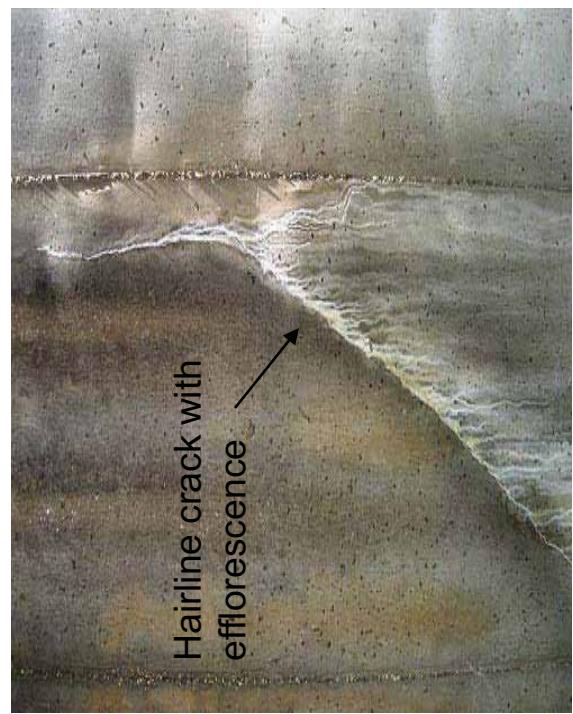
Appendix B

**Photographic Guide For Culvert
Assessment Tool**

Box & Arch Concrete – Good



Source: Santa Cruz County, CA Redevelopment Agency



Source: US Fish & Wildlife Service, Ashland NFWCO

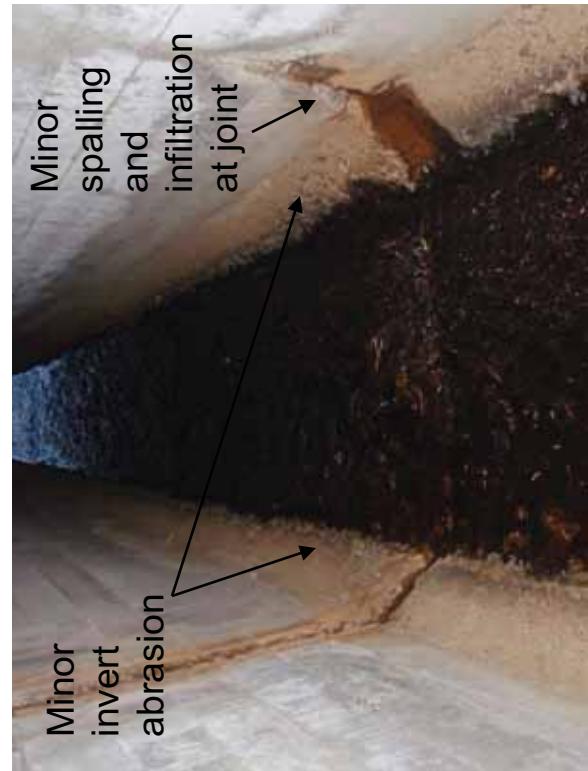
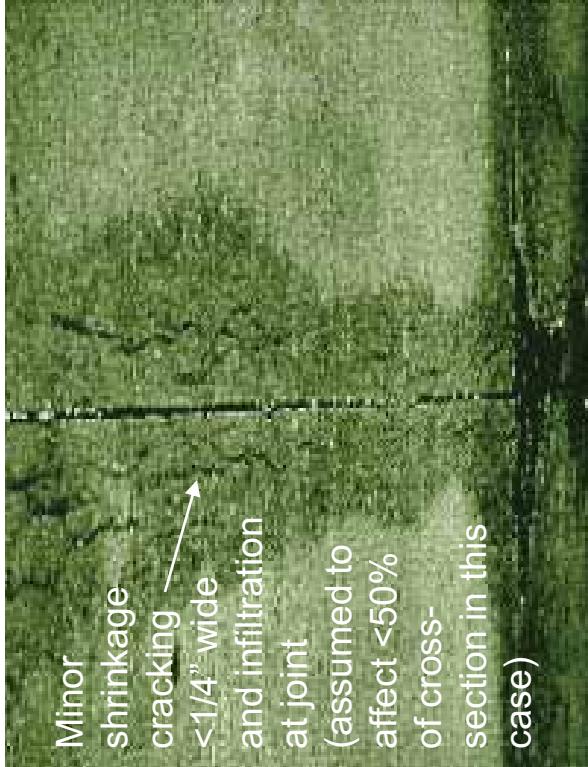
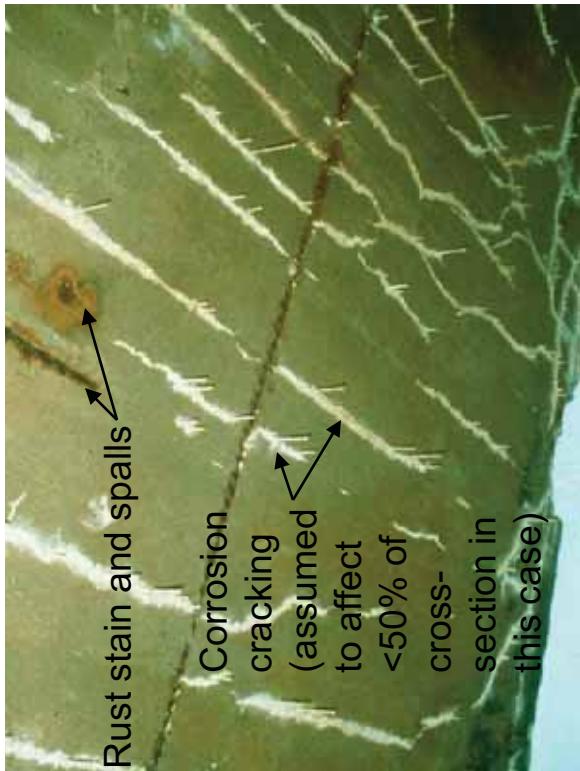
B.2

Box & Arch Concrete – Good



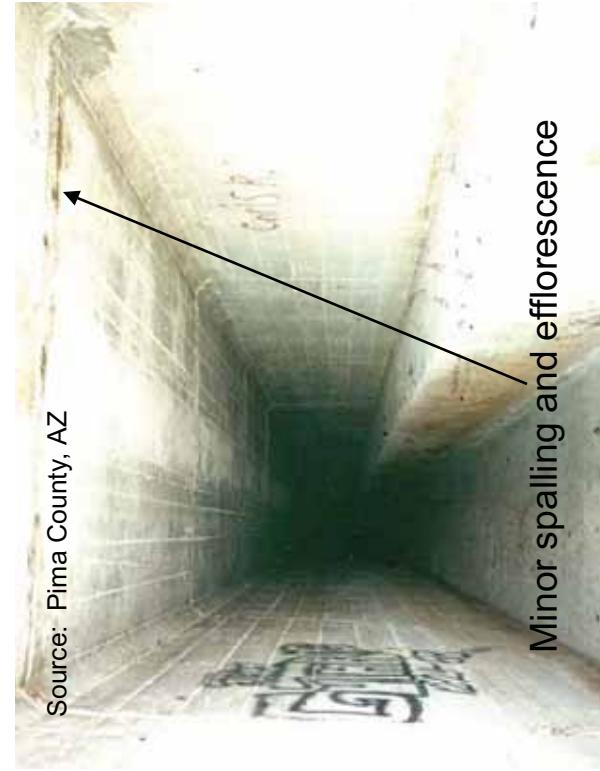
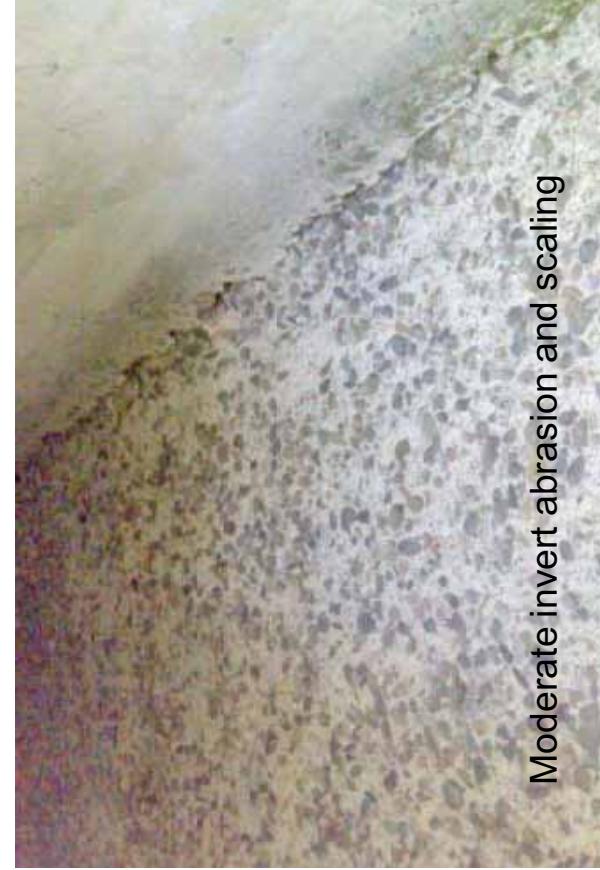
B.3

Box & Arch Concrete – Fair



B.4

Box & Arch Concrete – Fair



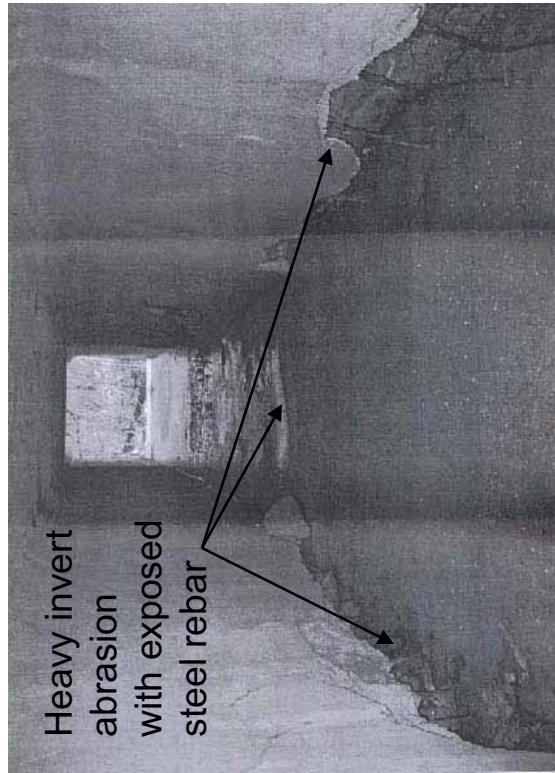
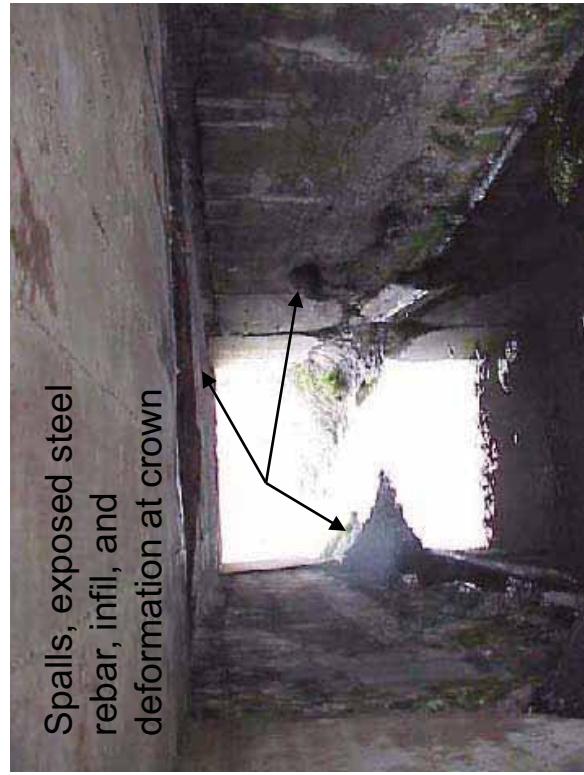
B.5

Box & Arch Concrete – Fair



B.6

Box & Arch Concrete – Poor



B.7

Box & Arch Concrete – Poor



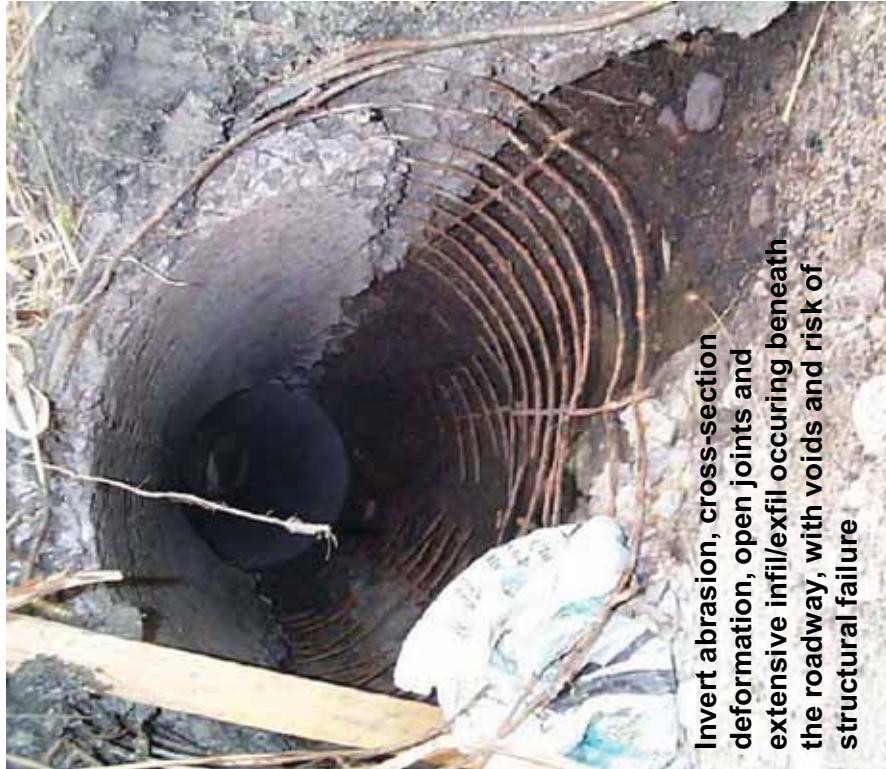
Box & Arch Concrete – Critical

Very poor joint with significant soil infil and sinkholes likely beneath roadway and risk of structural failure

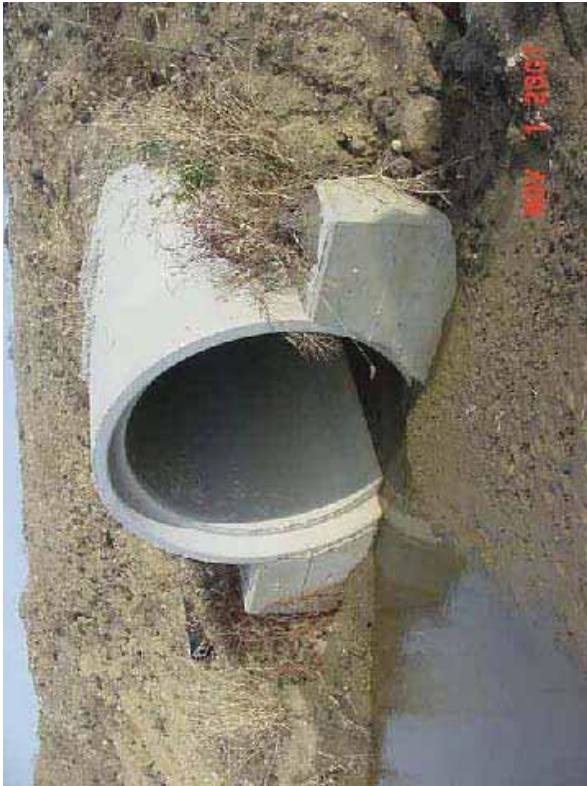


Source: Caltrans DIB 83 Supplement
to FHWA Culvert Repair Manual

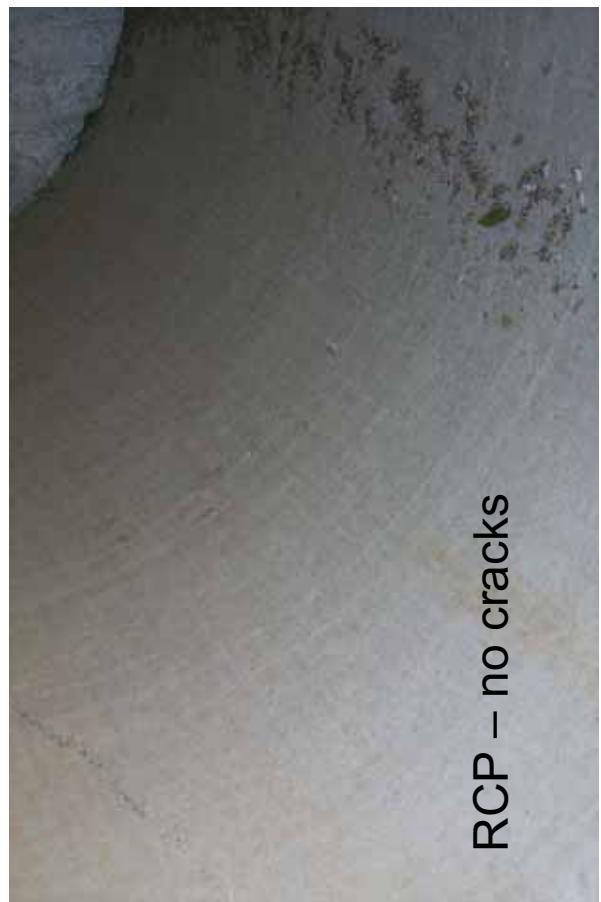
Invert abrasion, cross-section deformation, open joints and extensive infil/exfil occurring beneath the roadway, with voids and risk of structural failure



RCP – Good

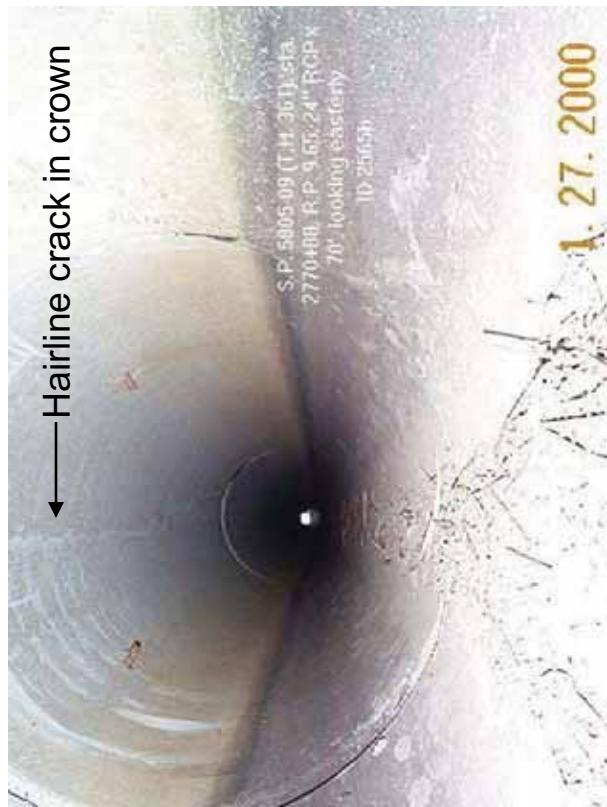


RCP – no cracks

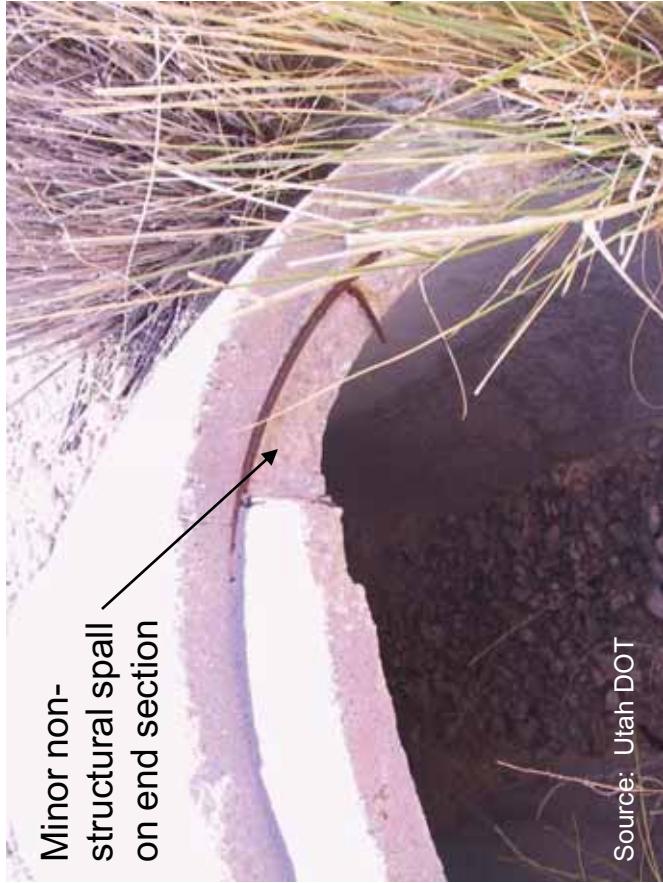
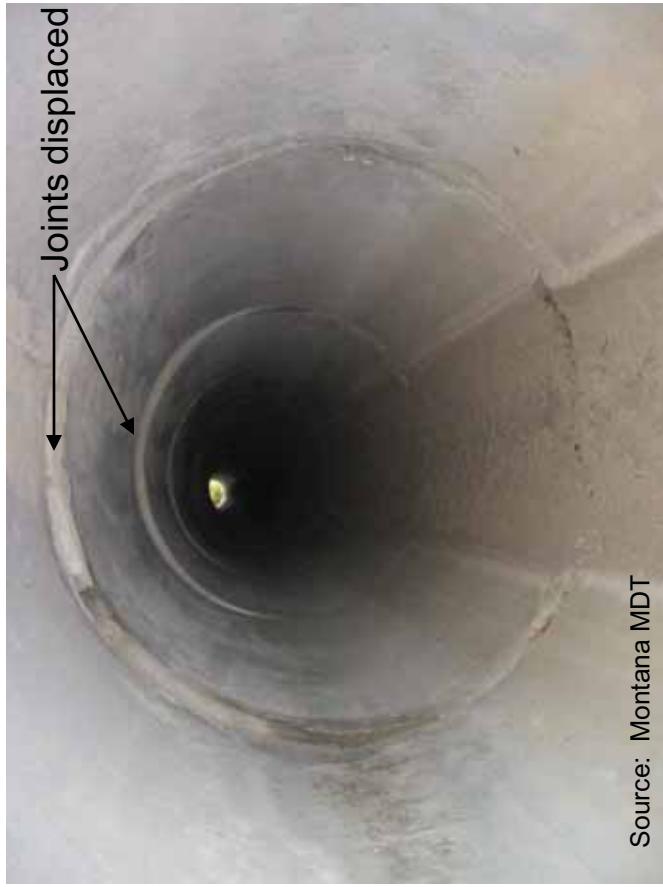


B.10

RCP – Fair



RCP – Fair

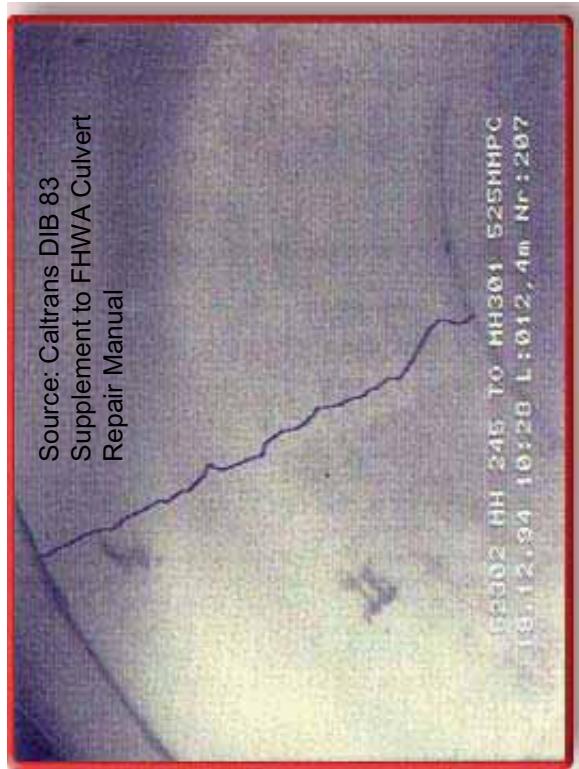
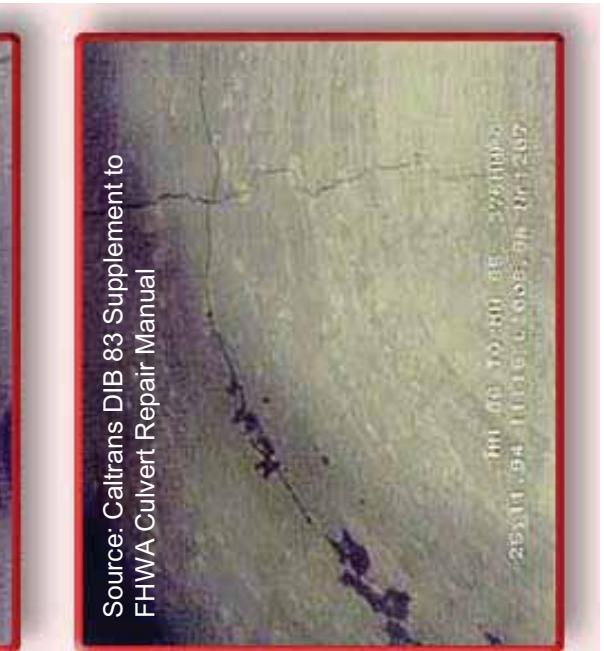
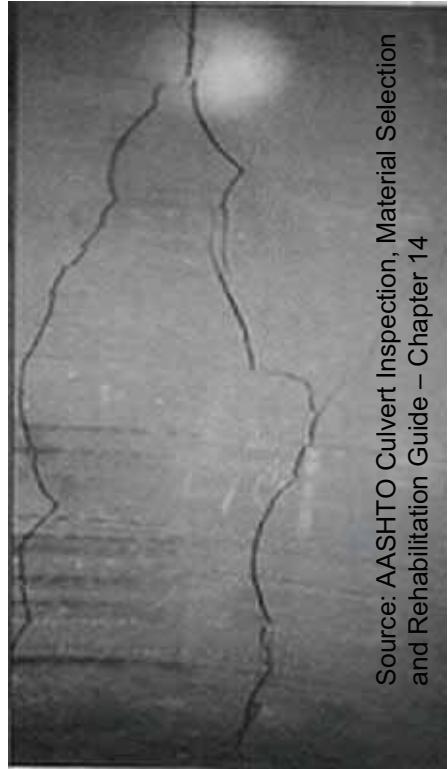


B.12



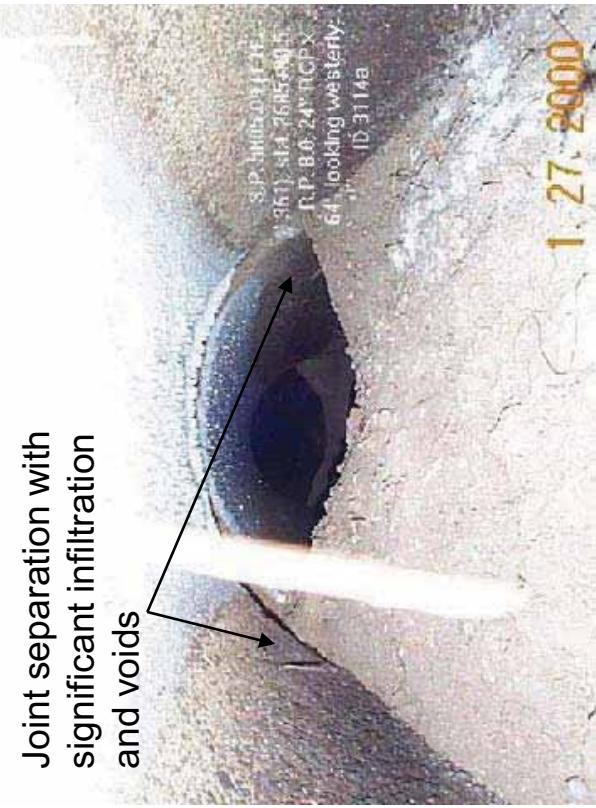
RCP – Poor

(Longitudinal and Circumferential > 1/8" Wide Cracks)

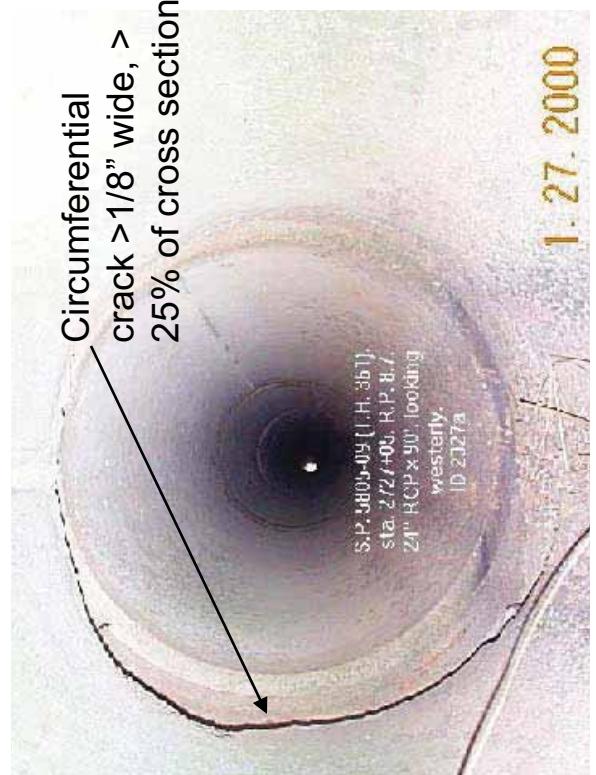


RCP – Poor

Joint separation with significant infiltration and voids

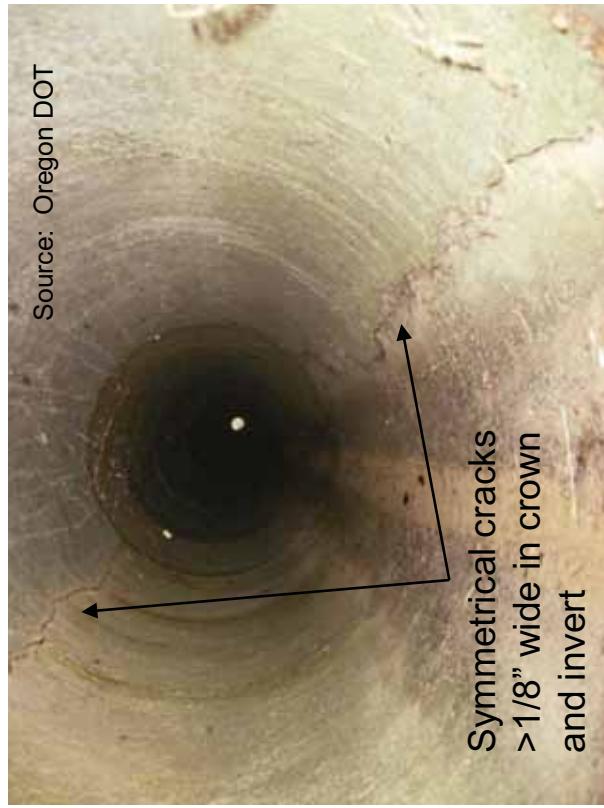


Source: Oregon DOT



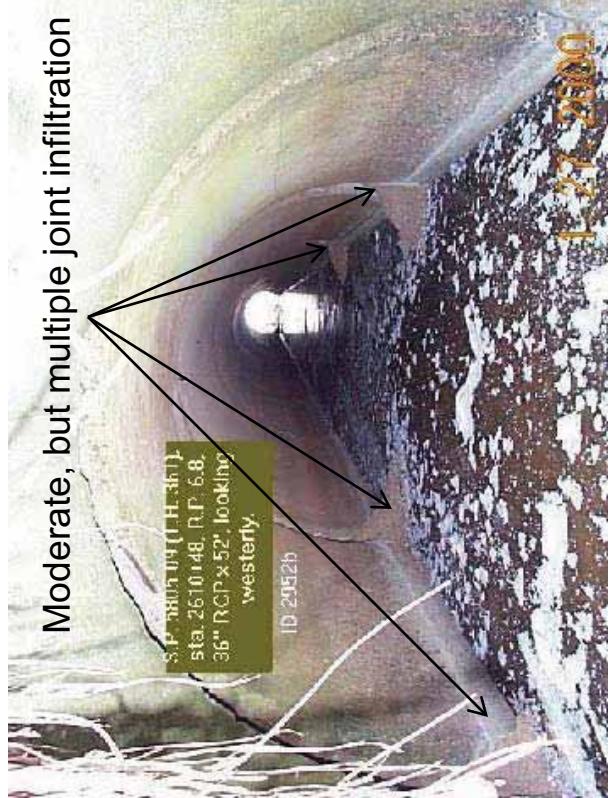
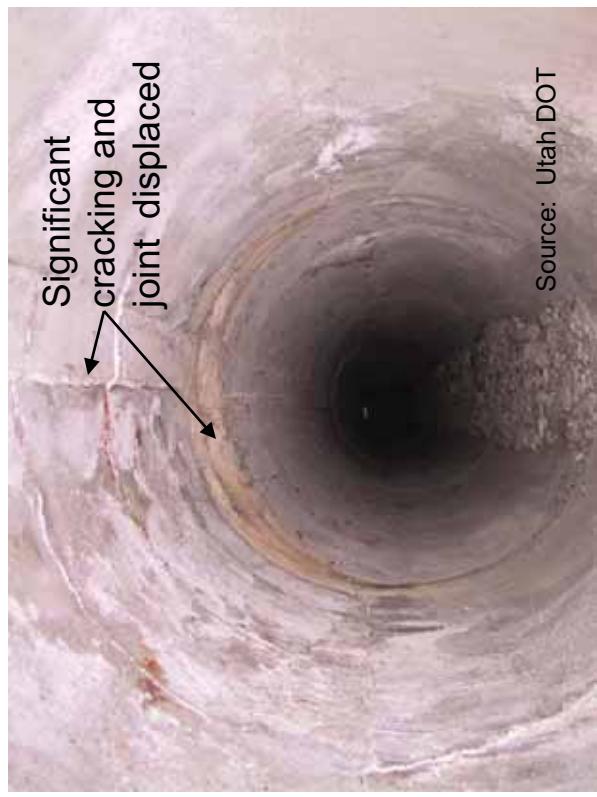
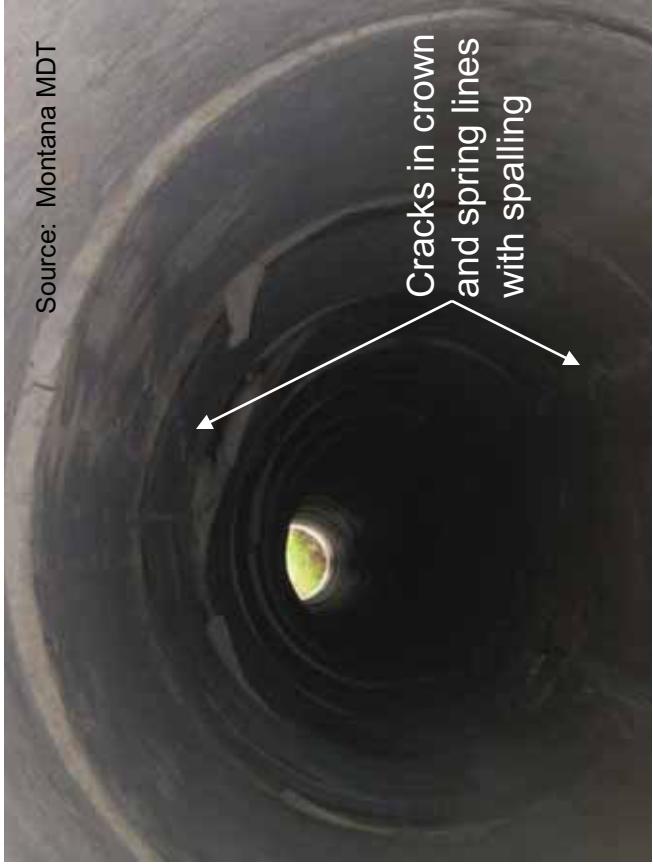
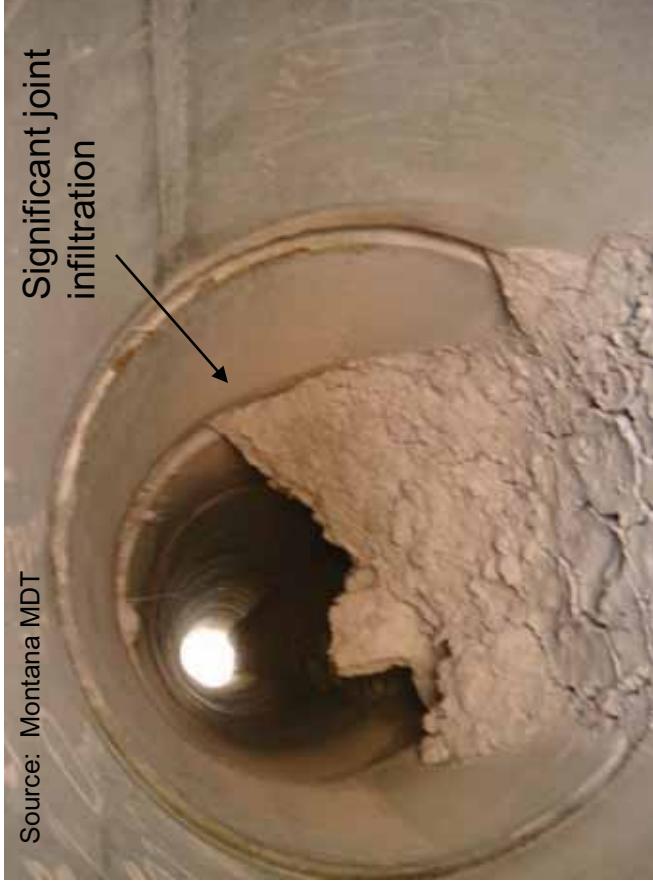
Source: Oregon DOT

Circumferential
crack >1/8" wide, >
25% of cross section

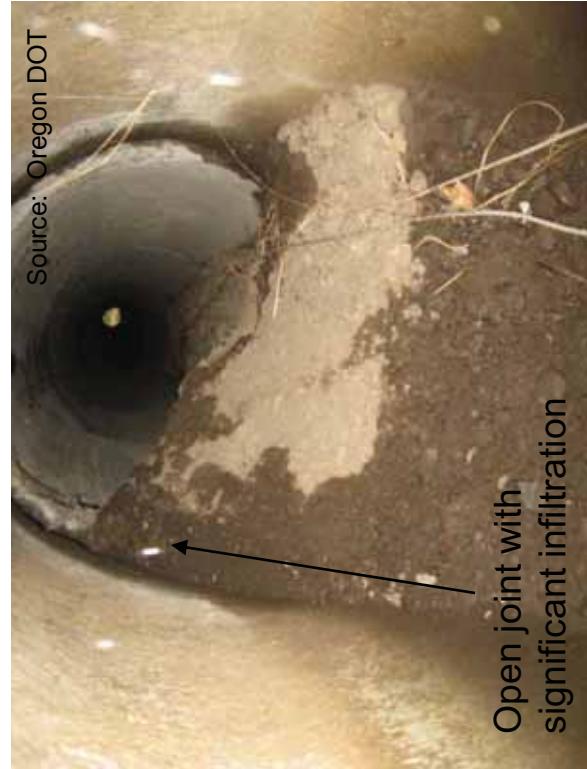
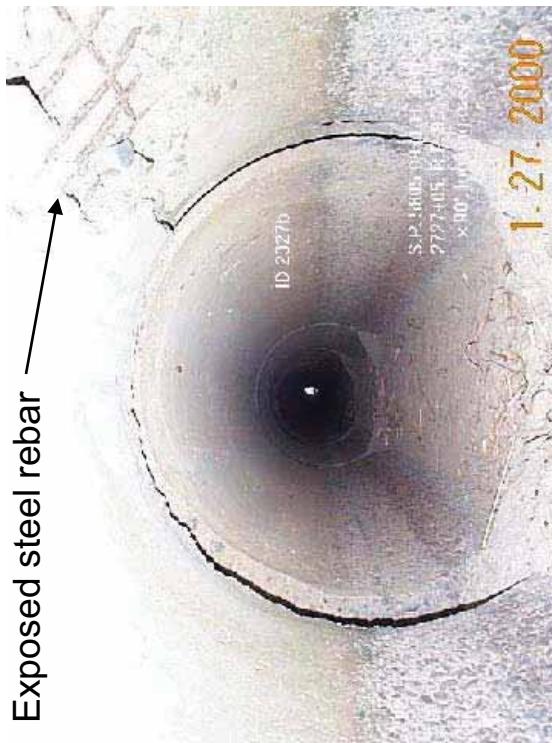


B.14

RCP – Poor



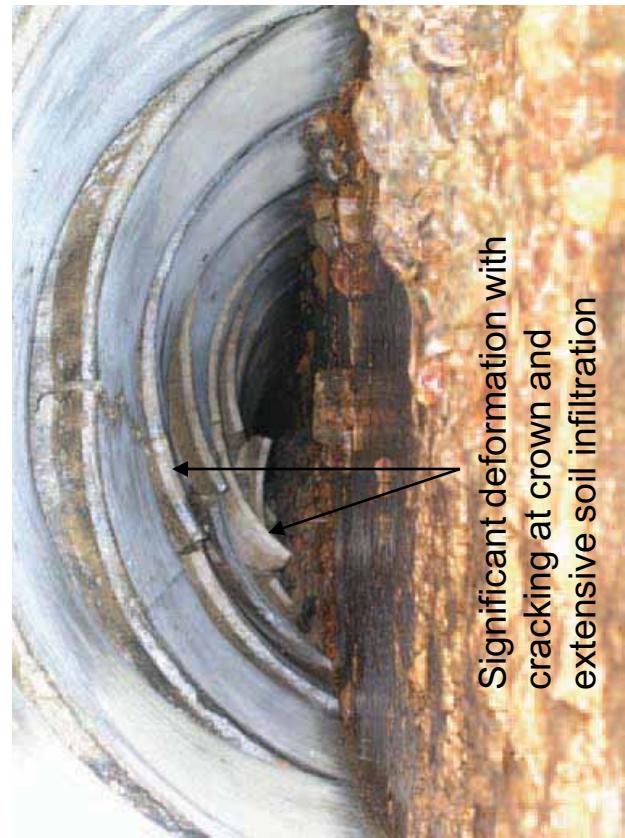
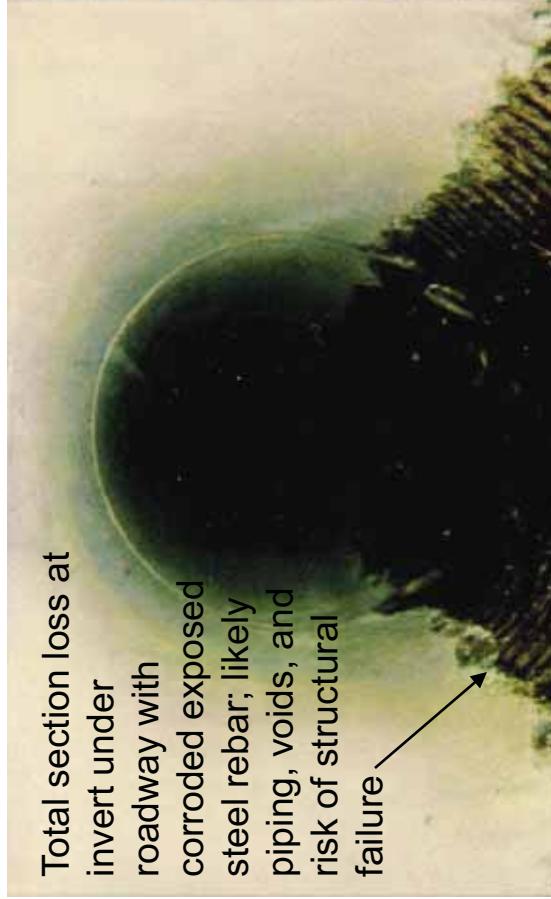
RCP – Poor



B.16

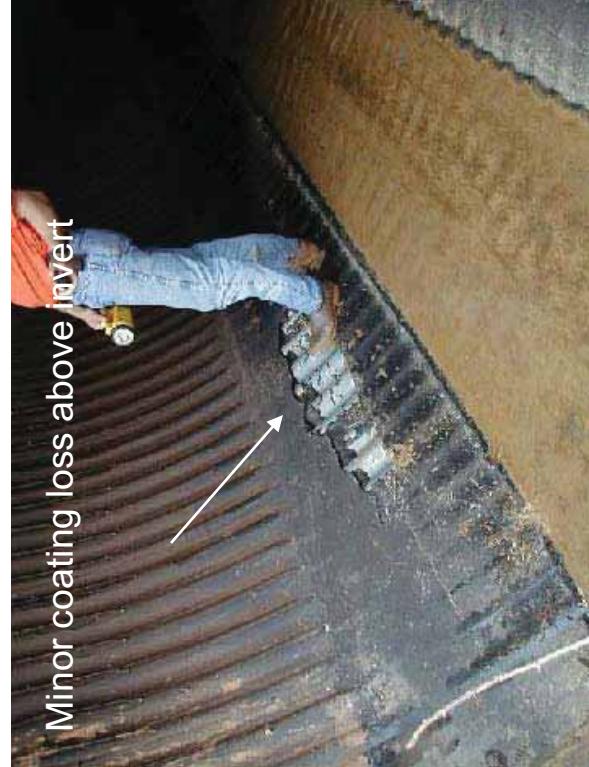
RCP – Critical

Total section loss at invert under roadway with corroded exposed steel rebar; likely piping, voids, and risk of structural failure.

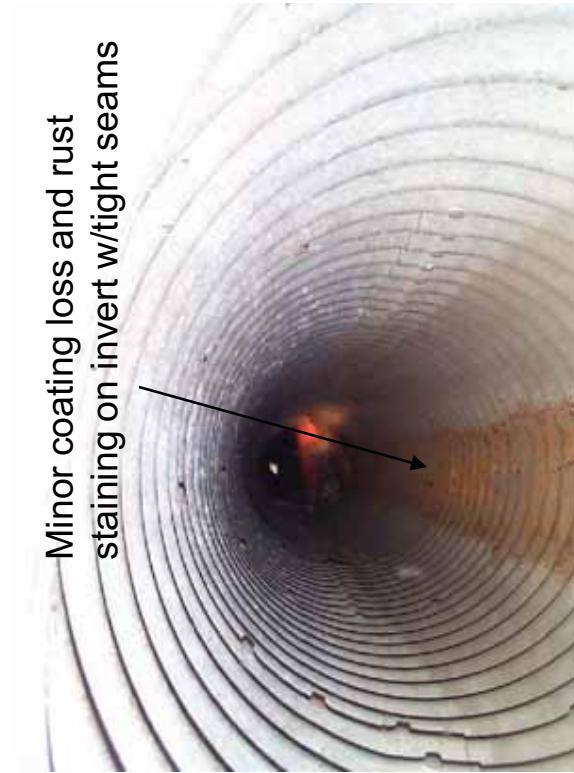


Significant deformation with cracking at crown and extensive soil infiltration

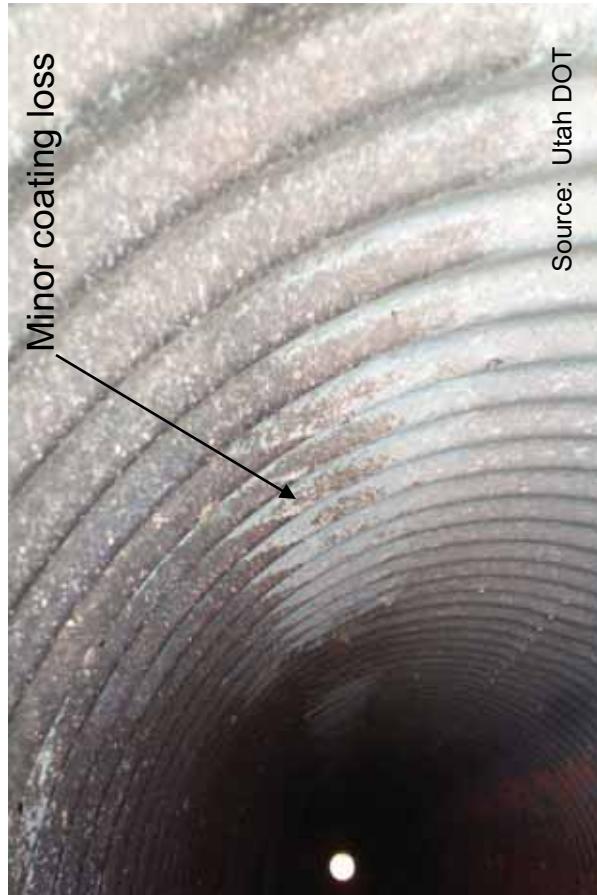
CMP – Good



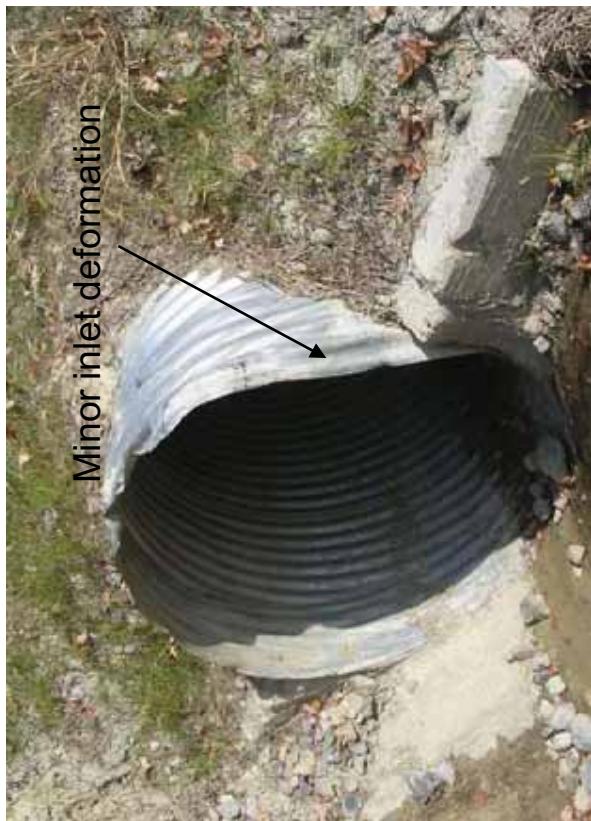
B.18



CMP – Good

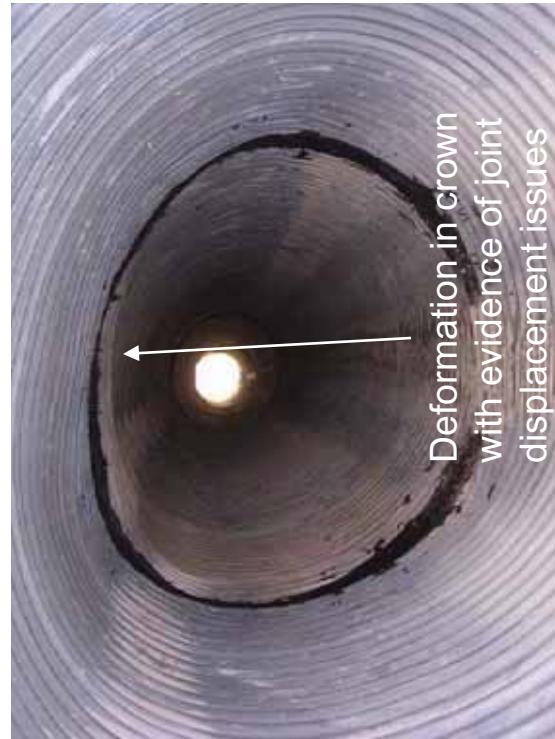
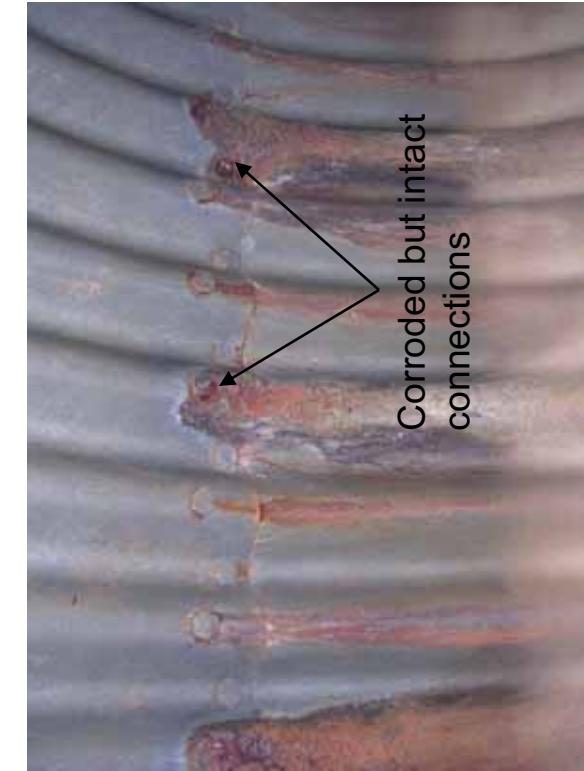


Source: Utah DOT



Source: Federal Lands Highway

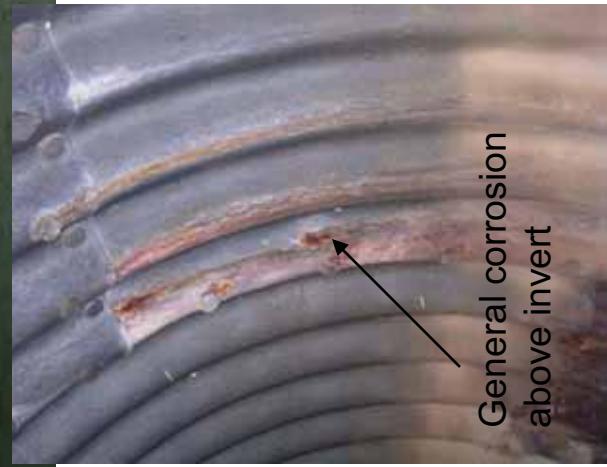
CMP – Fair



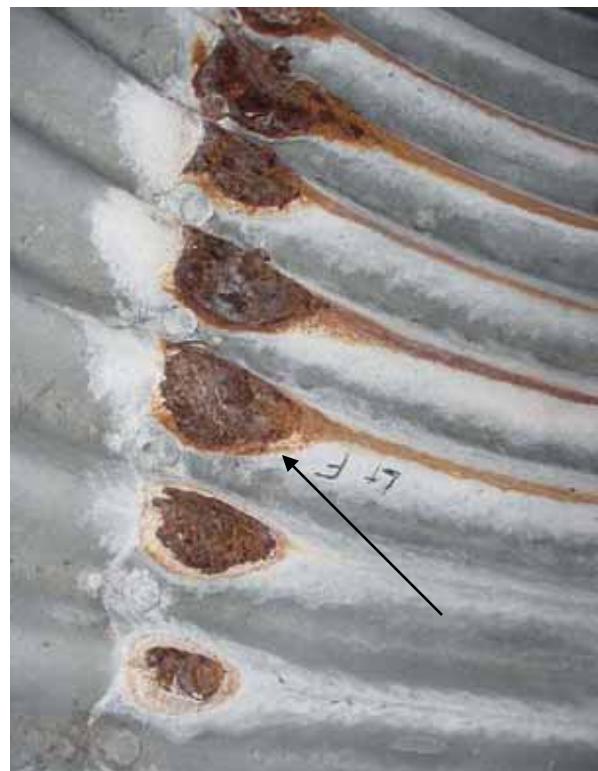
B. 20

CMP – Fair

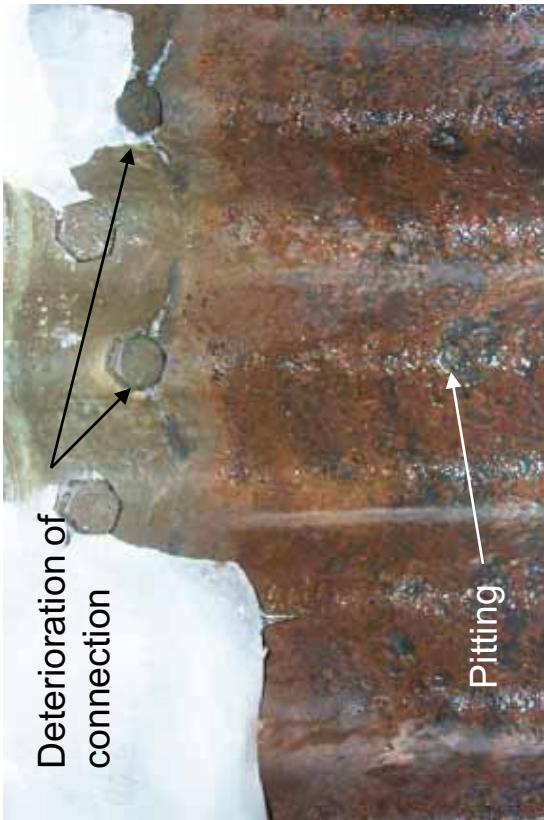
(Local corrosion at seam edges and hardware)



B. 21



CMP – Fair



B. 22

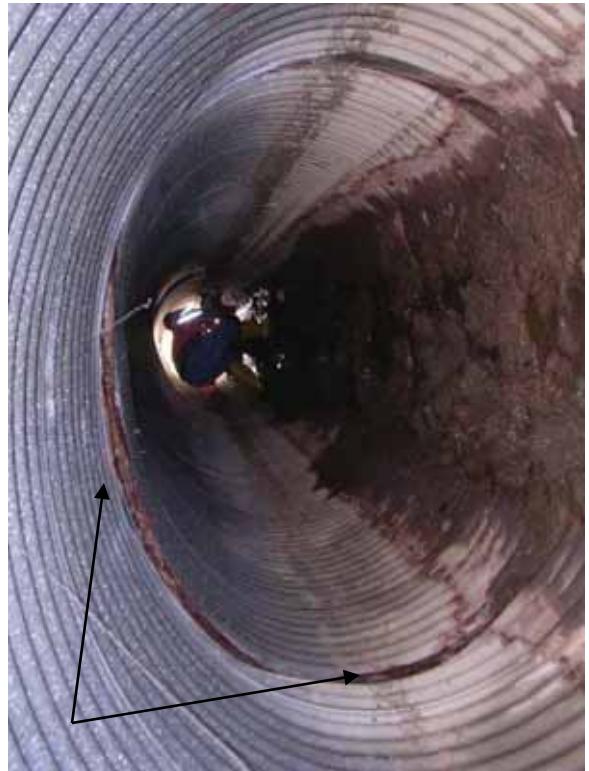
Invert coating loss with surface rust

CMP – Fair

(Open joint separation with minor infil/exfil and gasket visible)



B. 23



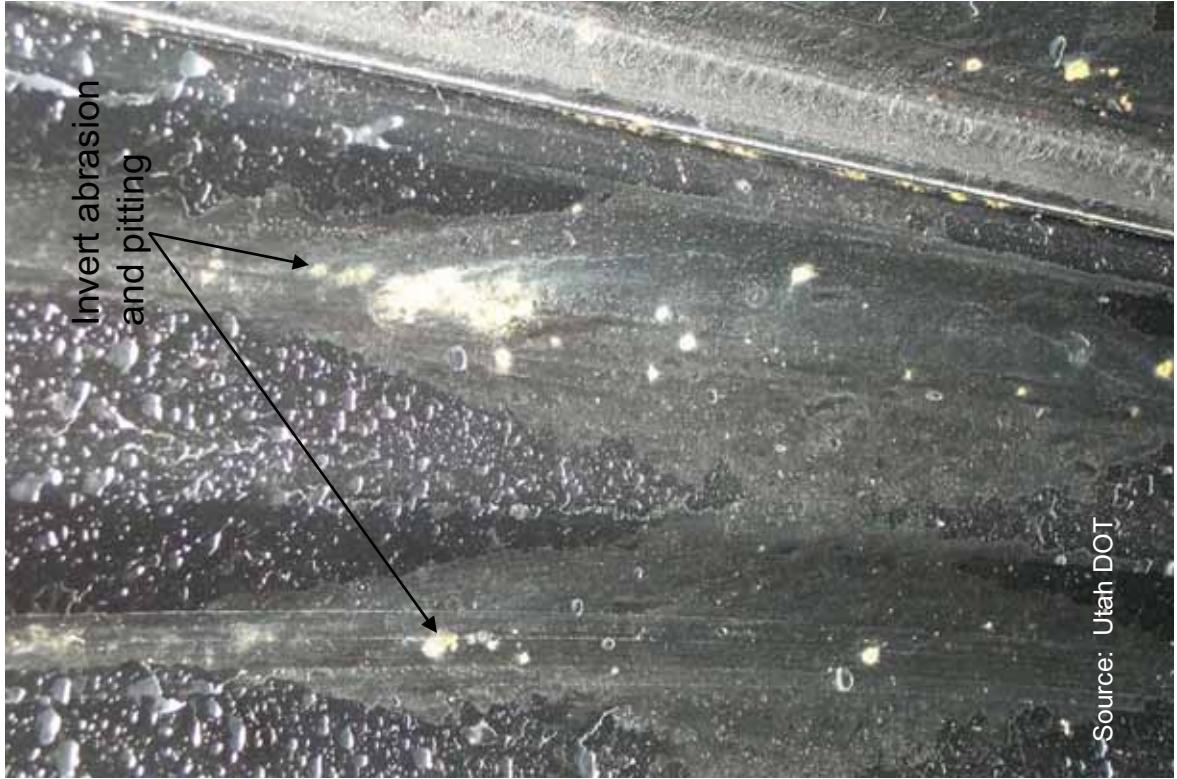
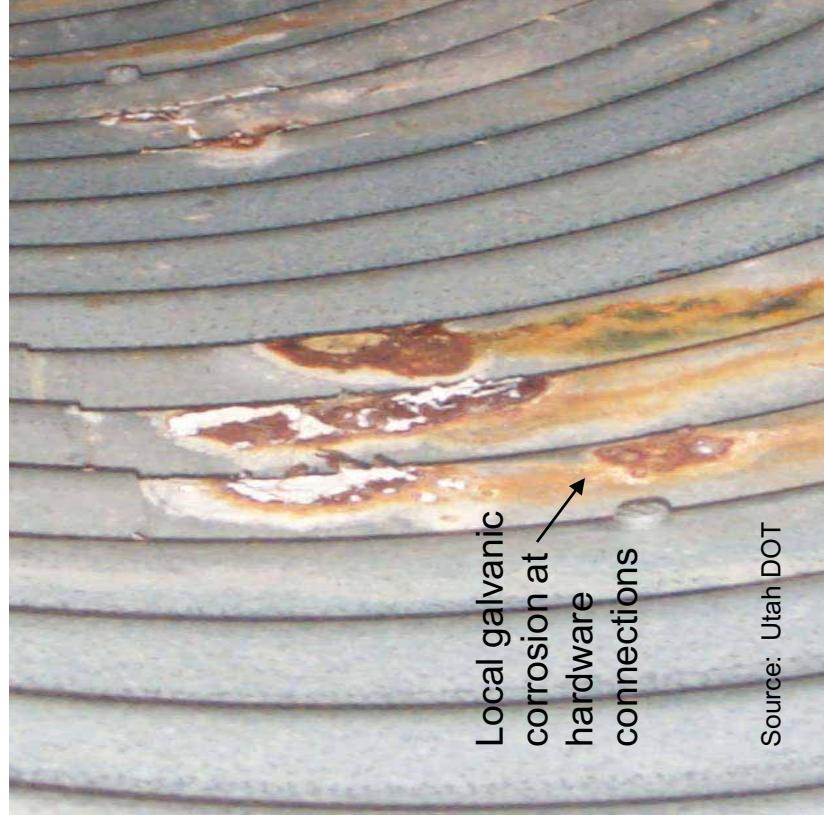
CMP – Fair



B. 24

Source: Utah DOT

CMP – Fair



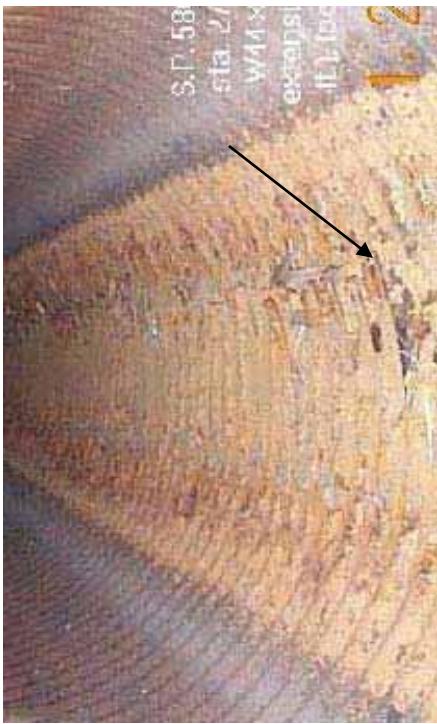
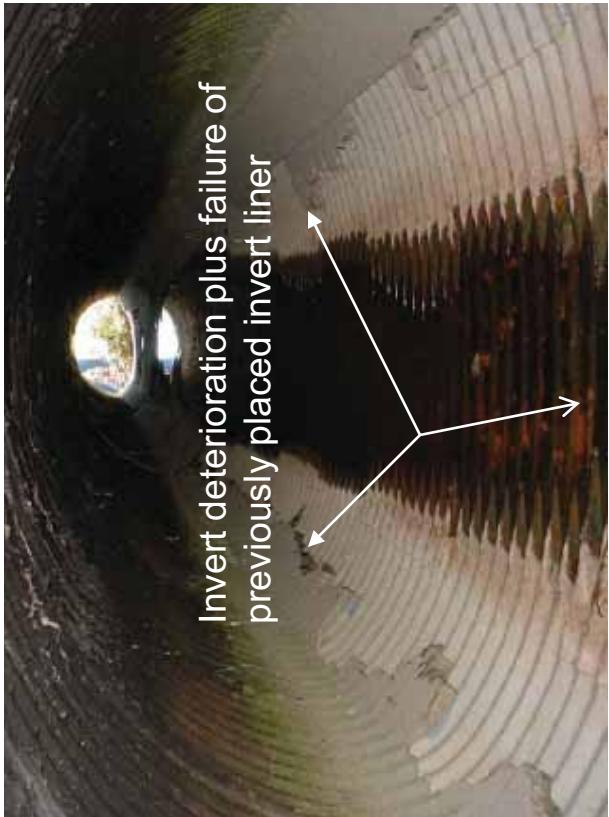
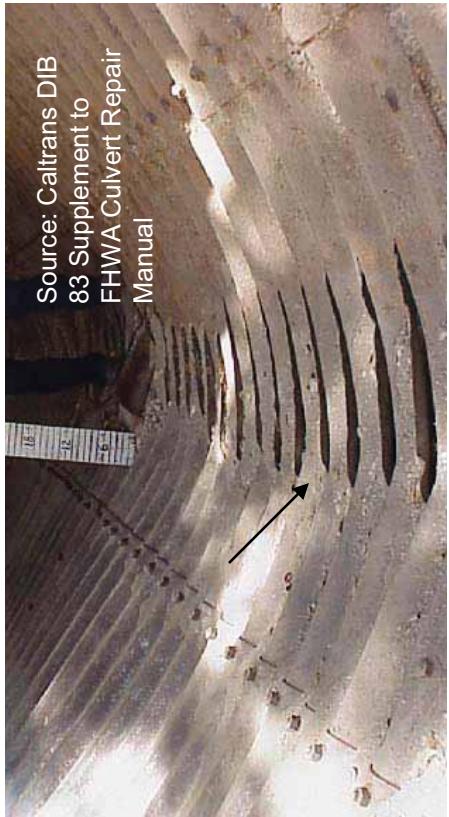
CMP – Fair



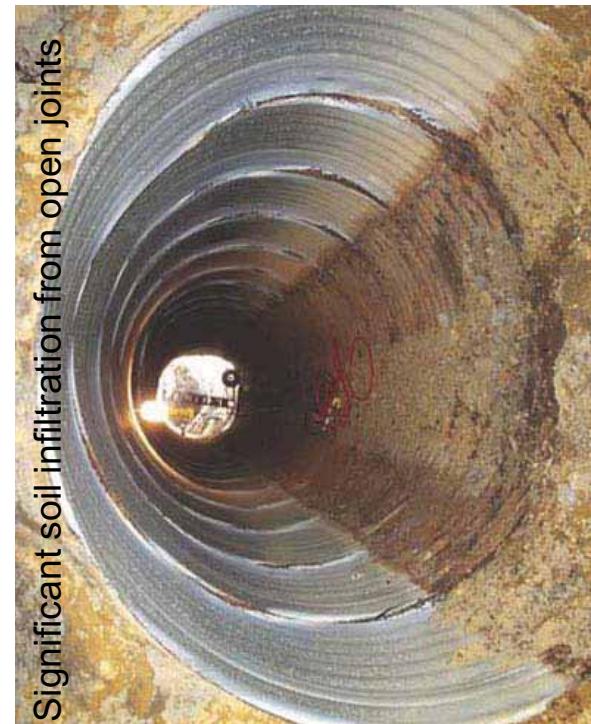
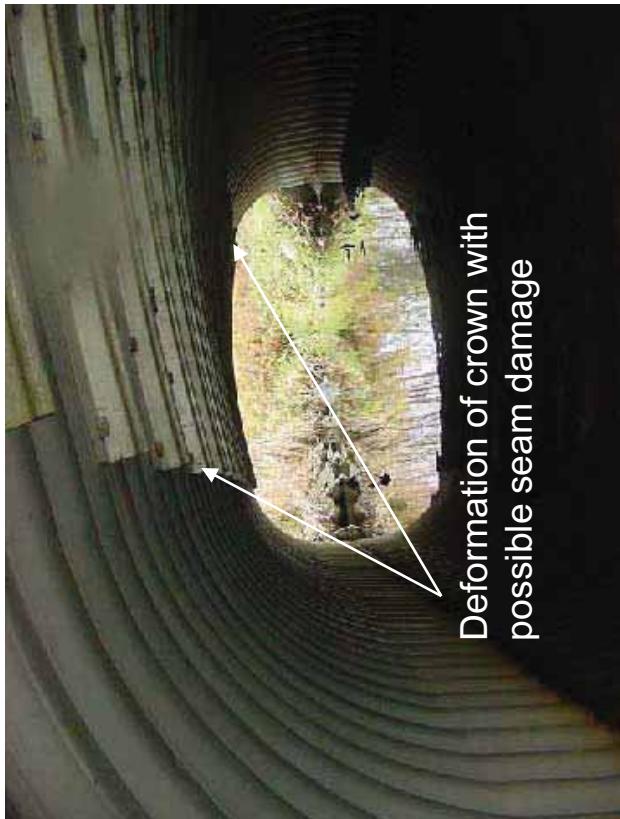
Coating loss with minor
surface corrosion

CMP – Poor

(Invert deterioration and perforation, and deformation with cracking)



CMP – Poor

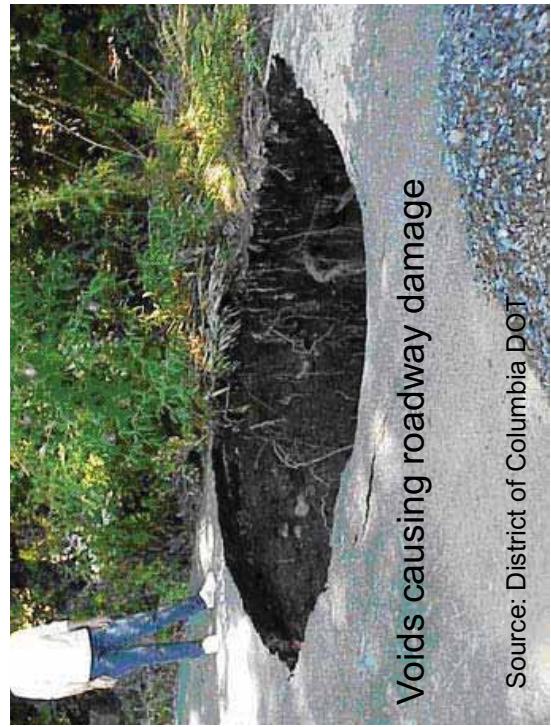


B. 28

11/7/2001

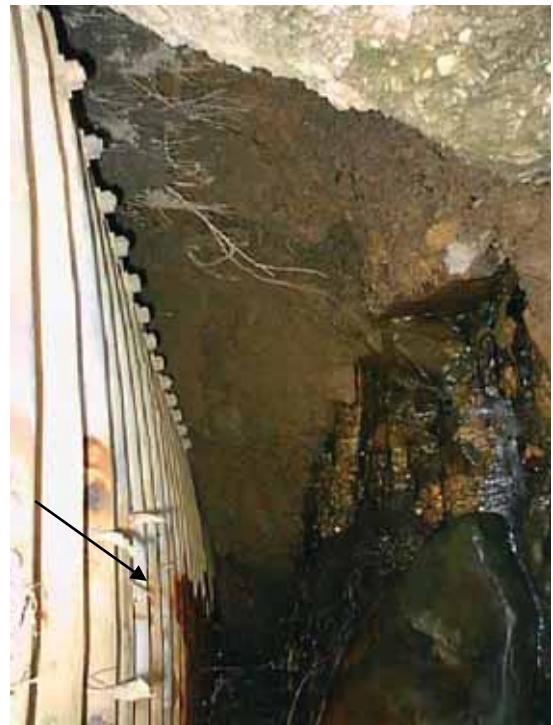
CMP – Critical

(Significant Invert section loss, voids and roadway damage)

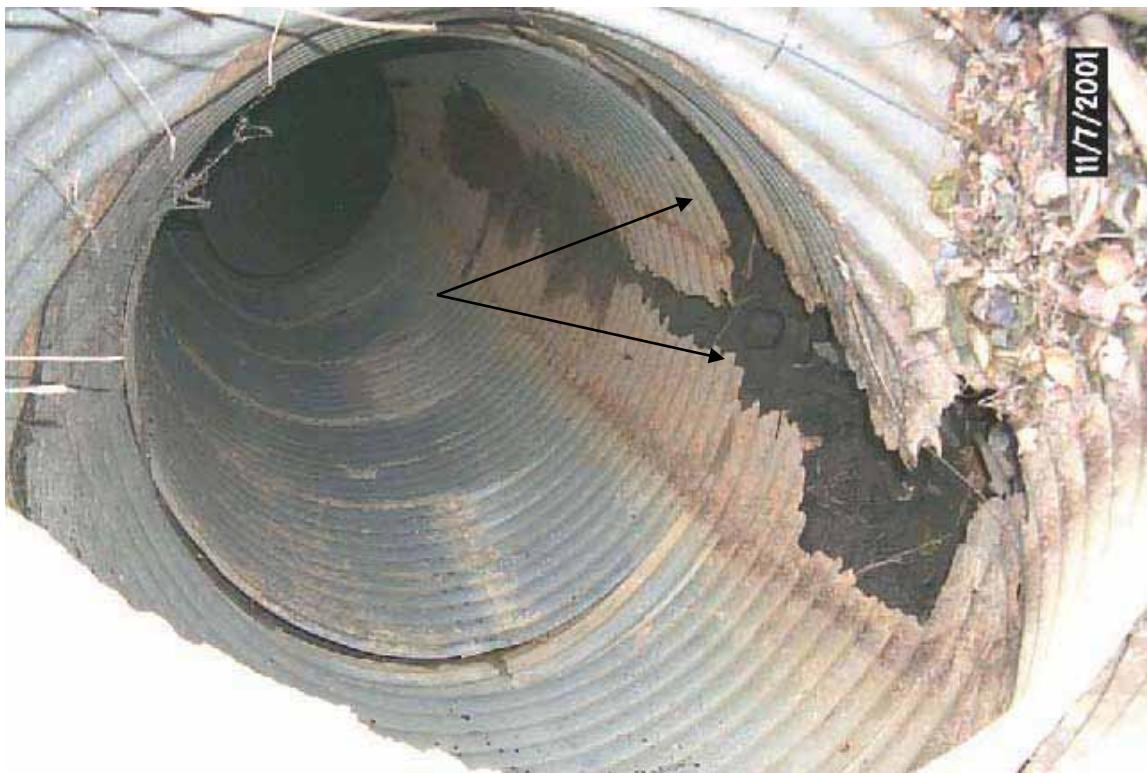


CMP – Critical

(Significant Invert section, soil infiltration and voids)

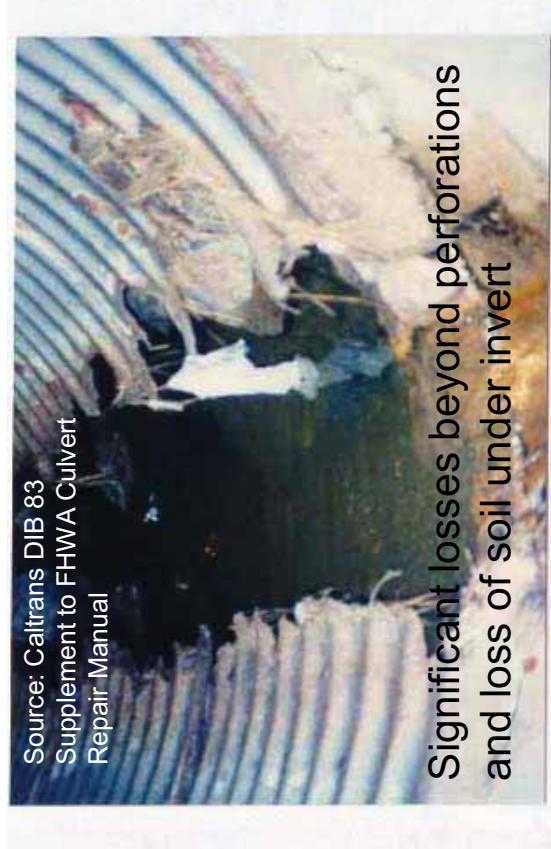
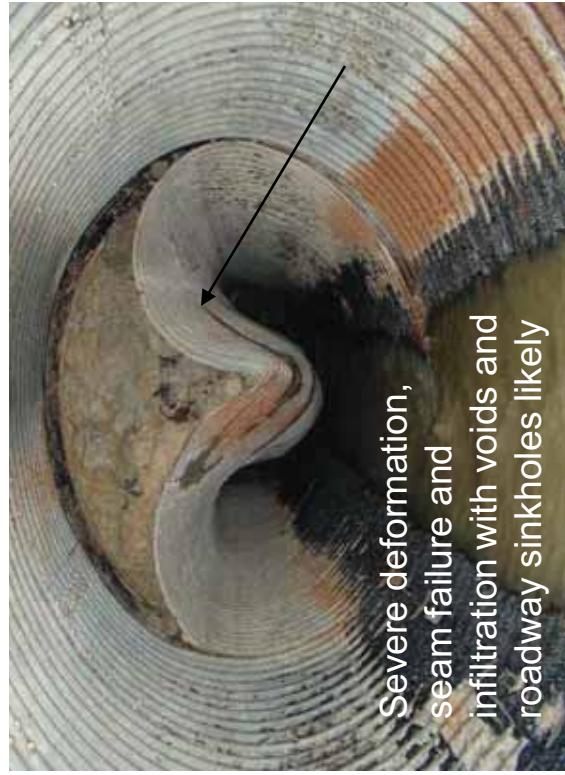


B. 30



11/7/2001

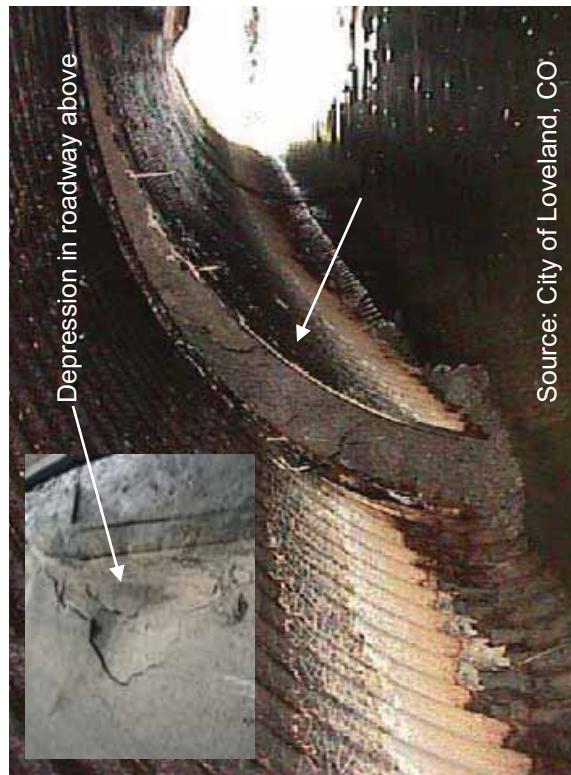
CMP – Critical



Source: Caltrans DIB 83
Supplement to FHWA Culvert
Repair Manual

CMP – Critical

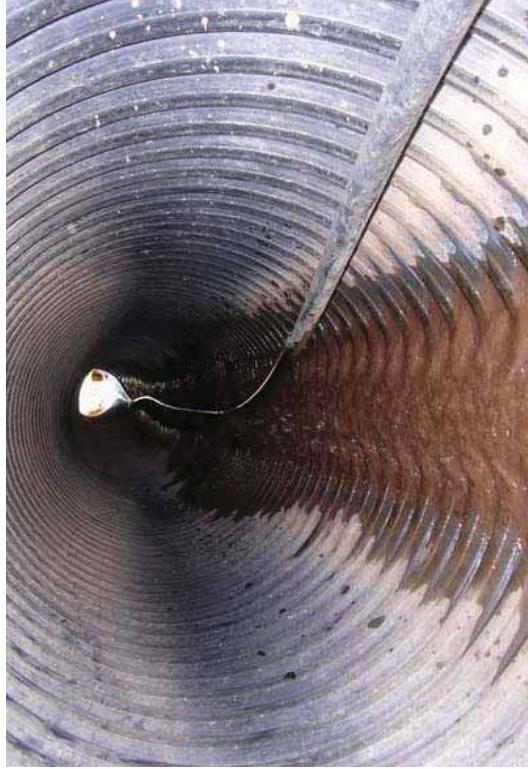
(Significant deformation, joint displacement, voids and sinkholes, with risk of embankment and roadway failure)



Source: City of Loveland, CO.



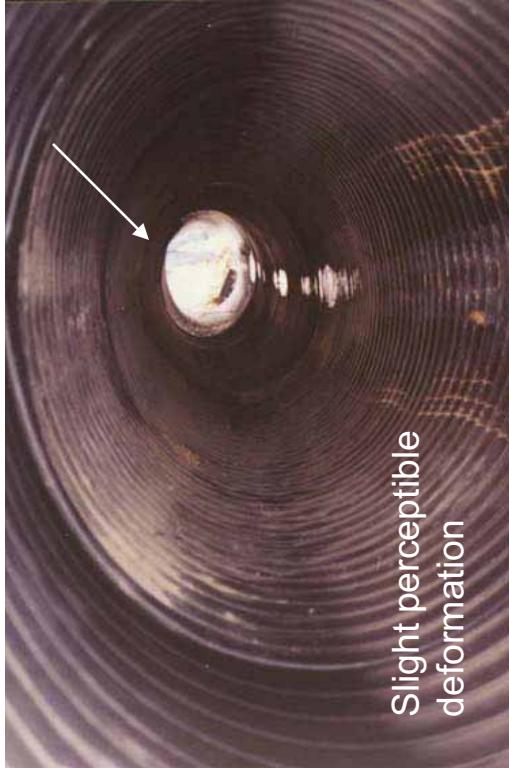
Plastic – Good



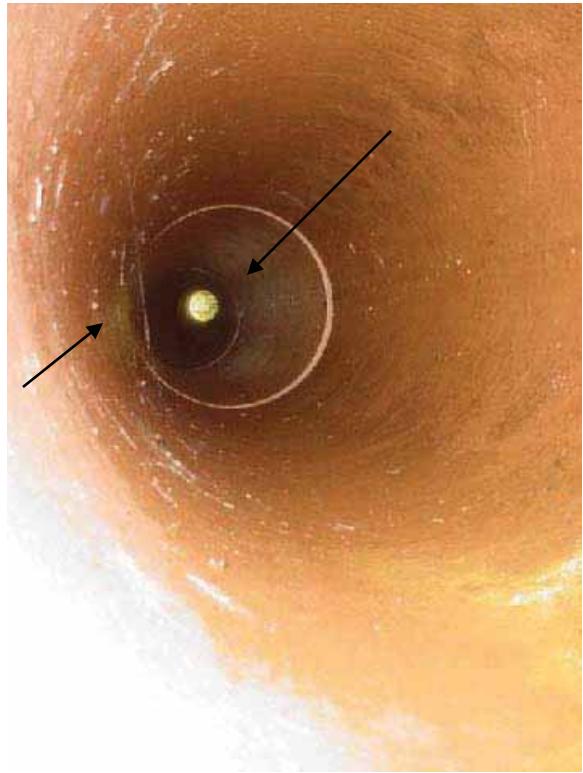
B. 33

PlastiC – Fair

(Slight perceptible deformations and bulging)

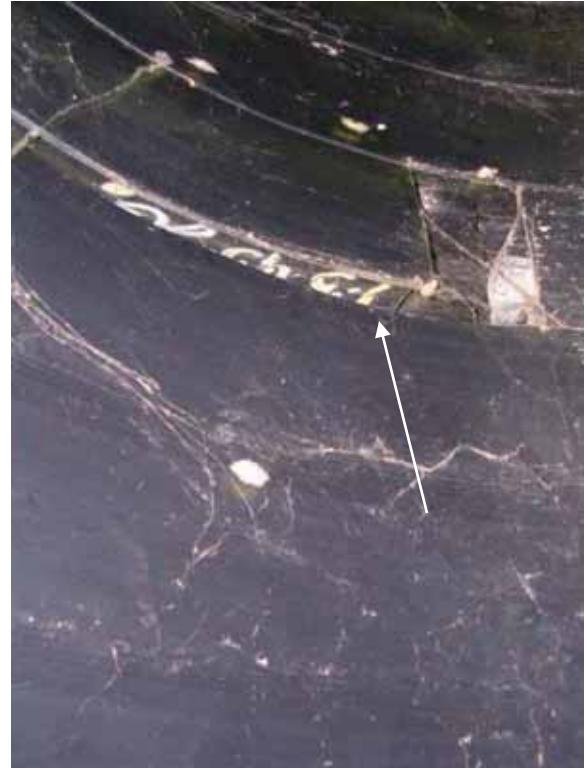
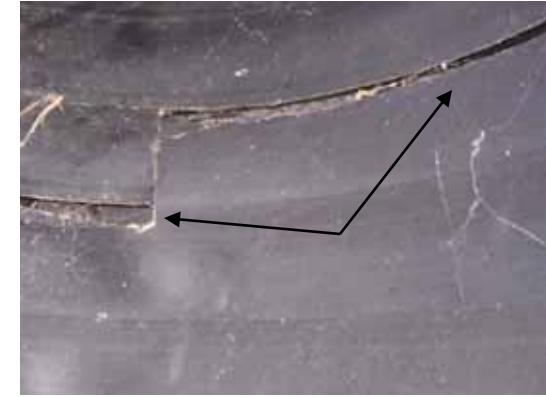


B. 34



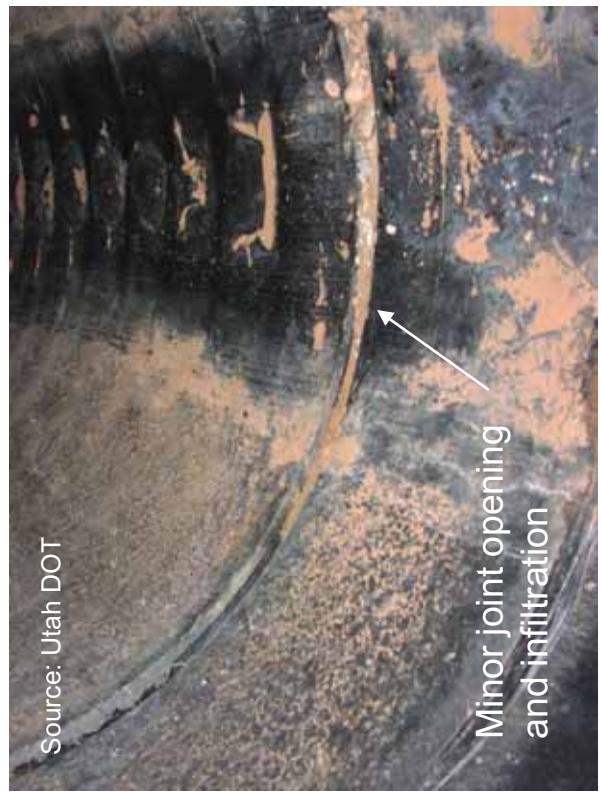
PlastiC – Fair

(Joint separations with minor infil/exfil)



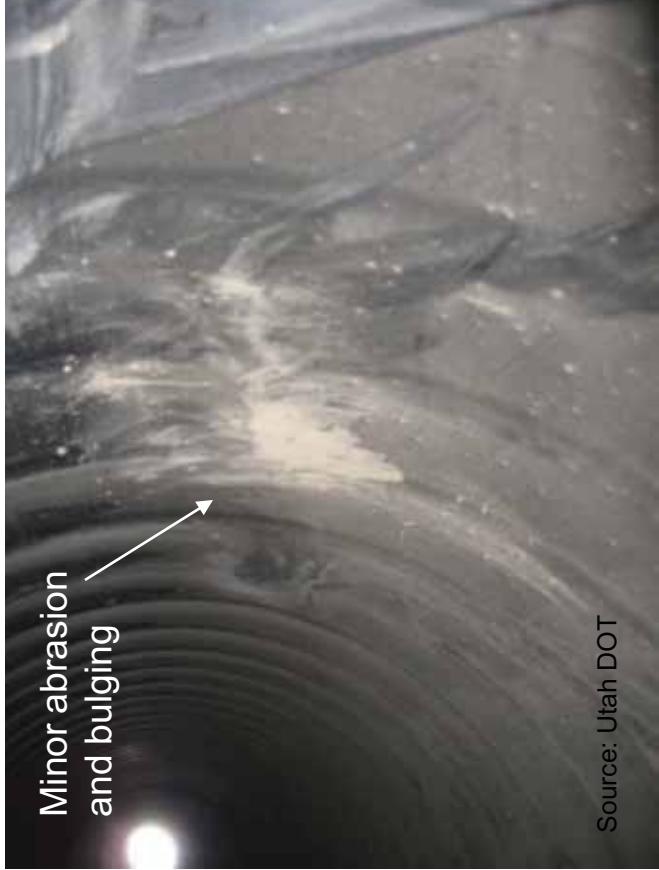
B. 35

PlastiC – Fair

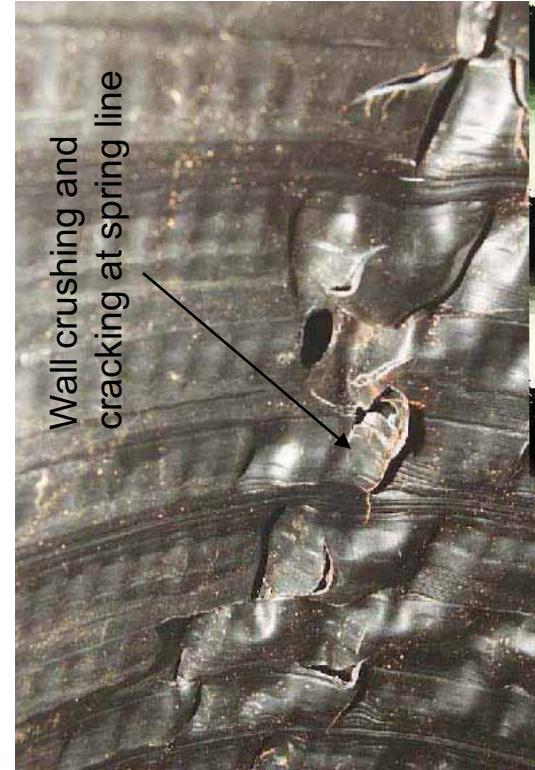


B. 36

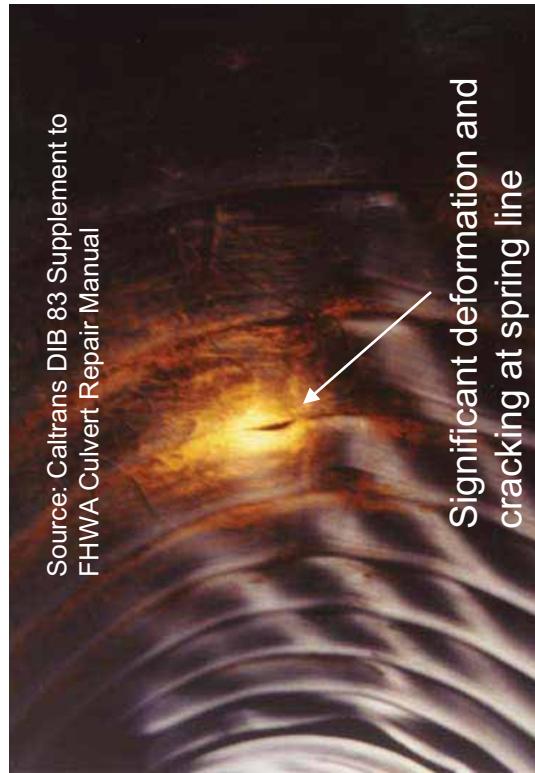
PlastiC – Fair



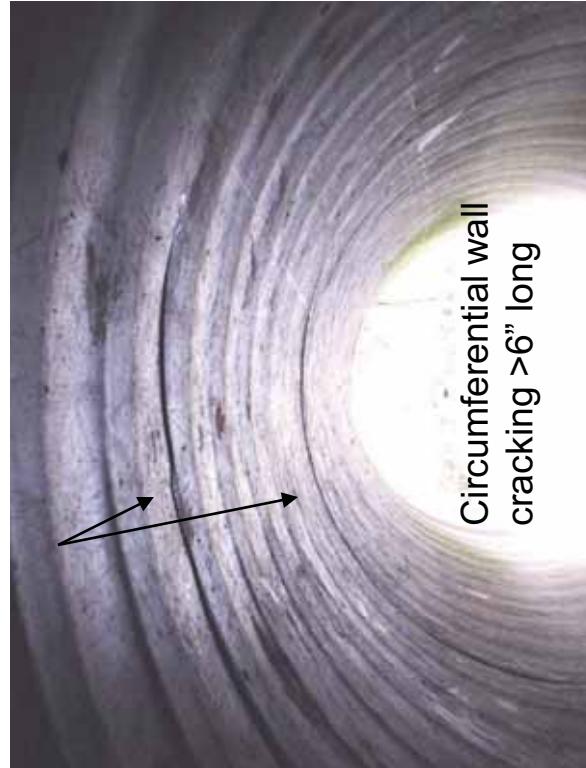
Plastic – Poor



Source: Caltrans DIB 83 Supplement to
FHWA Culvert Repair Manual



Significant deformation and
cracking at spring line



Circumferential wall
cracking >6" long



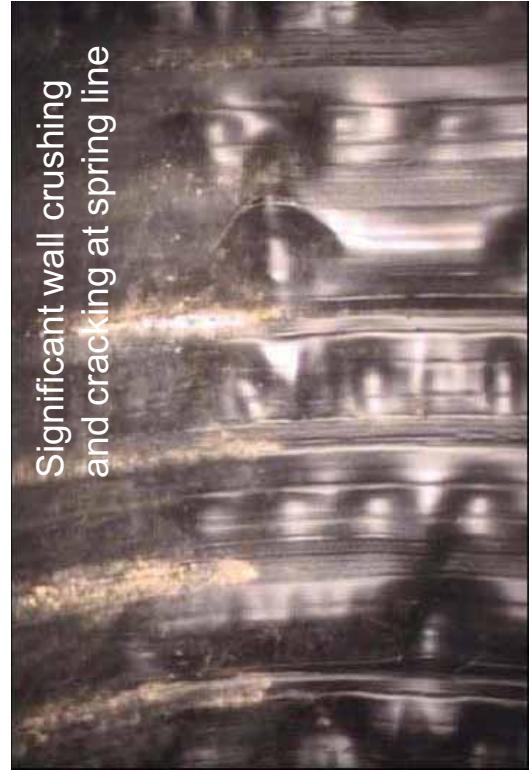
Source: Caltrans DIB 83 Supplement to
FHWA Culvert Repair Manual

Wall buckling and cracking

B. 38

Plastic – Poor

(Excessive cross-sectional deformation and wall damage)



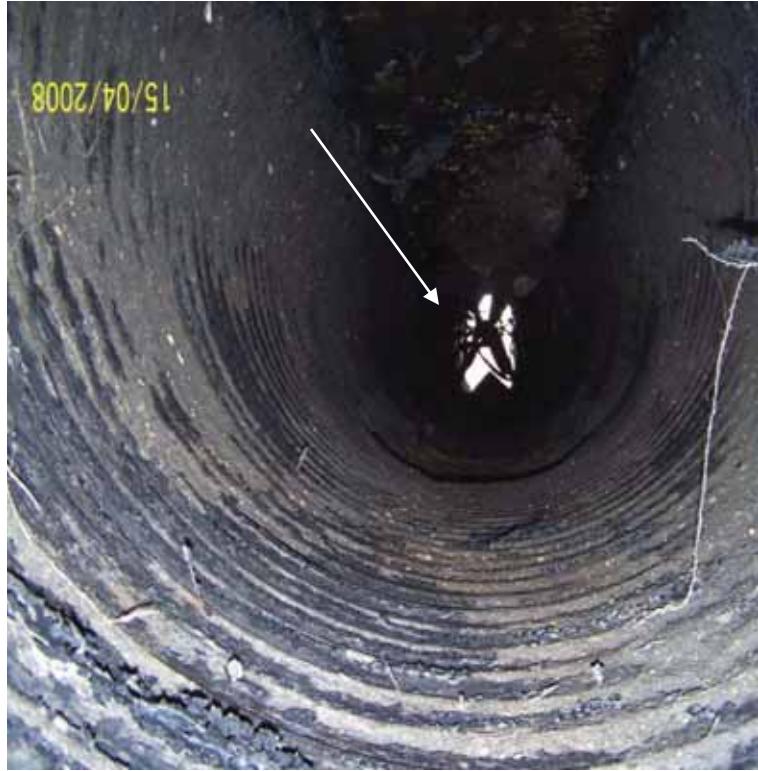
Plastic – Poor



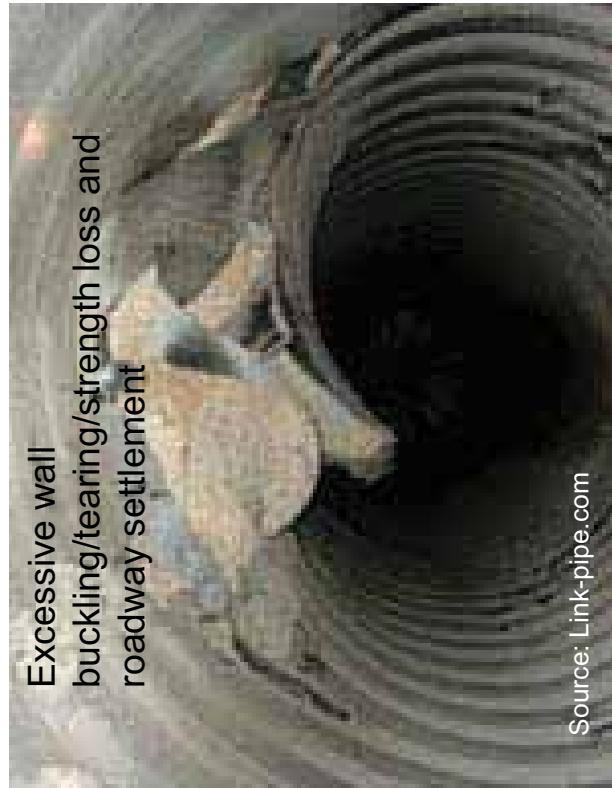
B. 40

Plastic – Poor

(Fire damage and resultant severe deformations at ends)



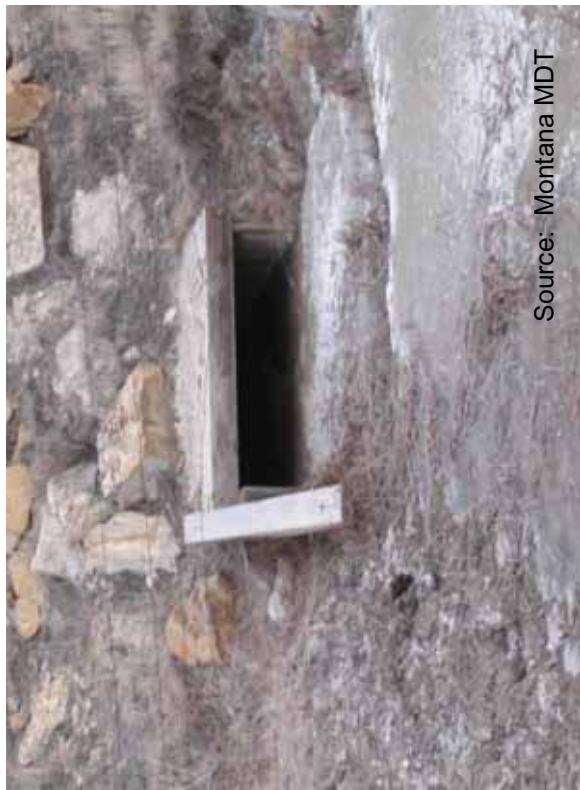
Plastic – Critical



Source: Link-pipe.com



Timber – Good



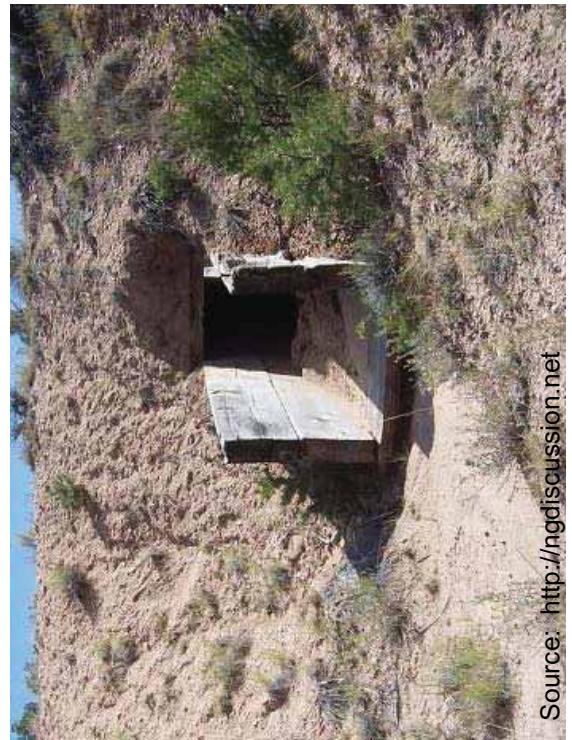
Source: Montana MDT



Source: USFWS Alpeno NFWCO, MI



Source: National Park Service



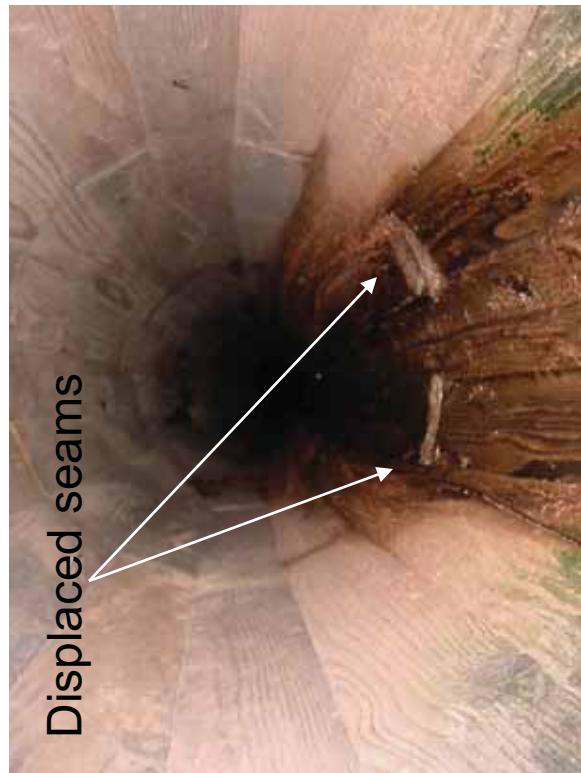
Source: <http://ngdiscussion.net>

B. 4.3

Timber – Fair



Source: University of California Berkley, ITS



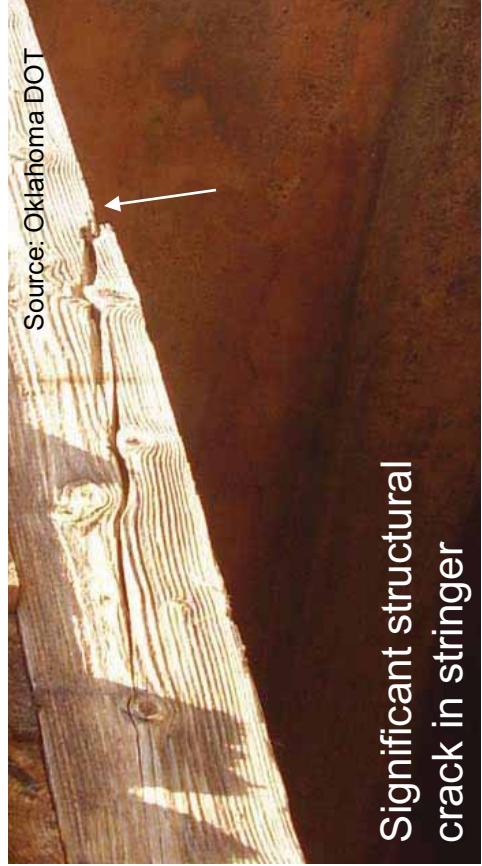
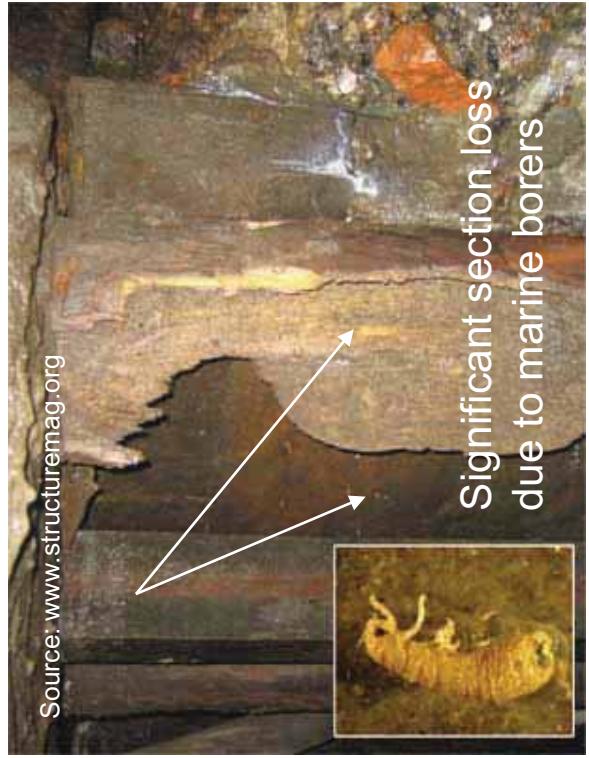
Source: www.fao.org

Surface marine borer damage



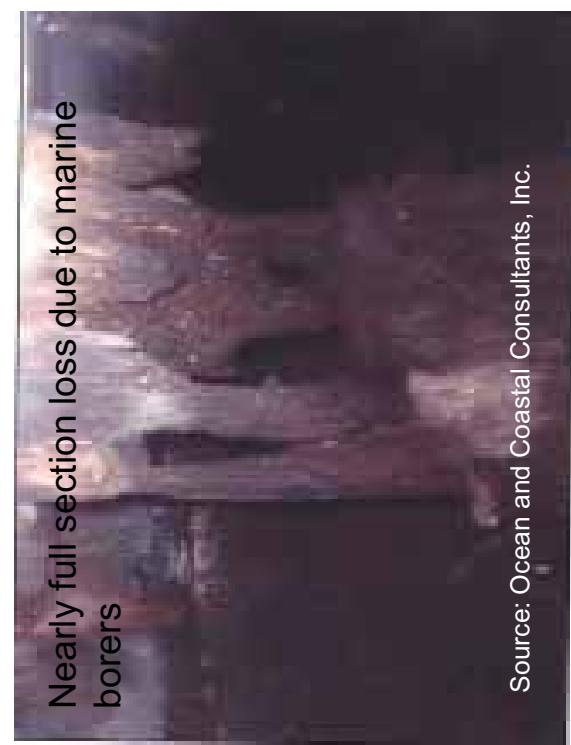
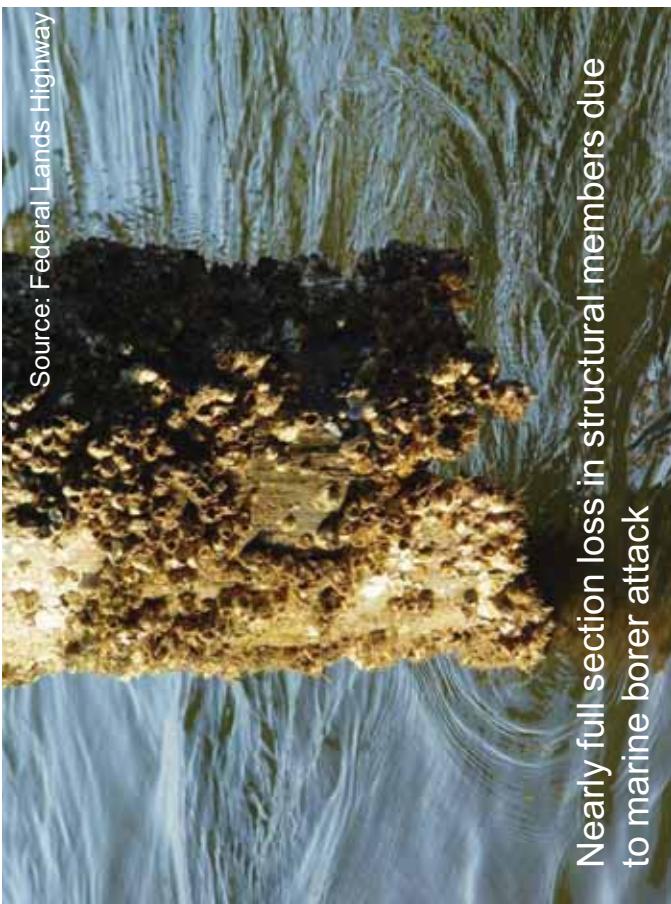
B. 44

Timber – Poor

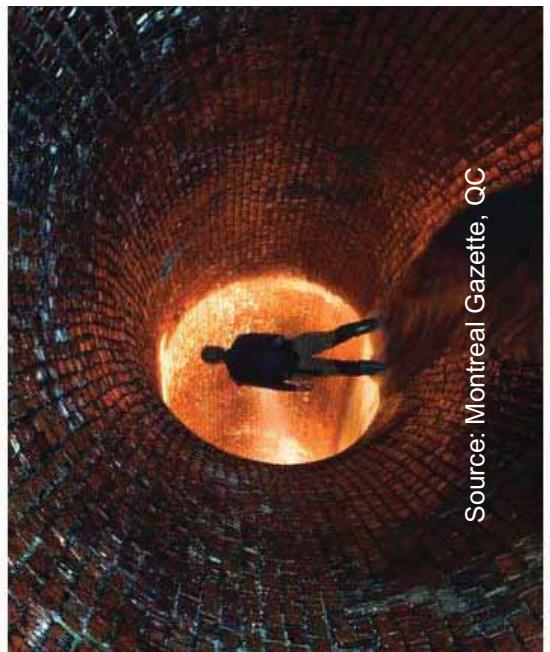
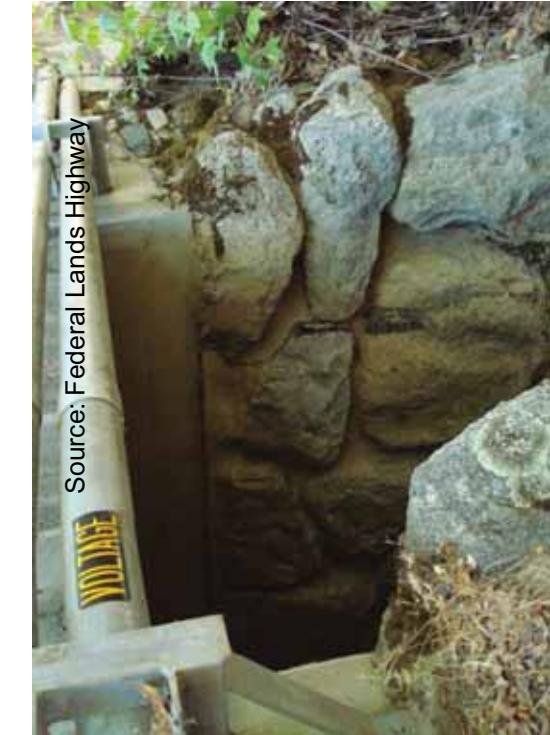
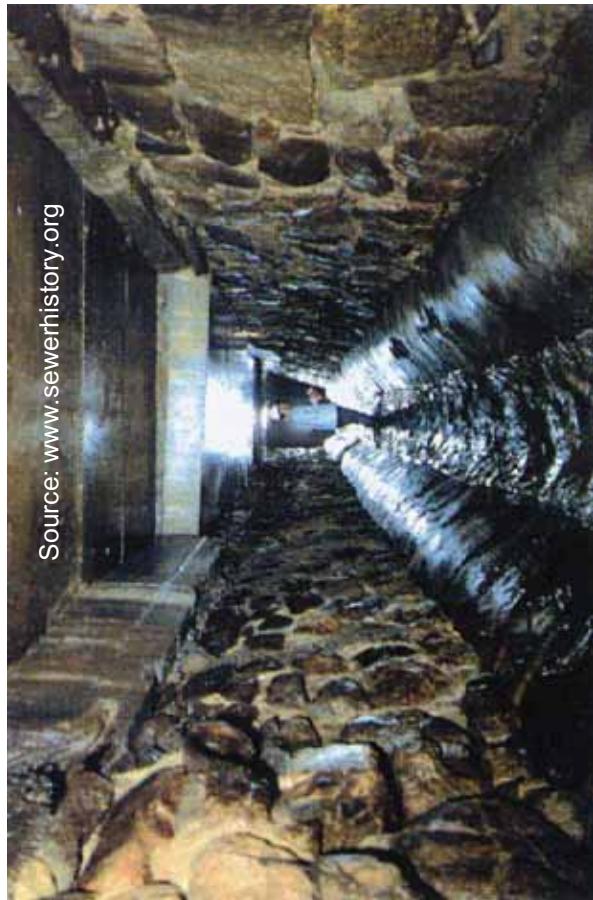


B. 45

Timber – Critical



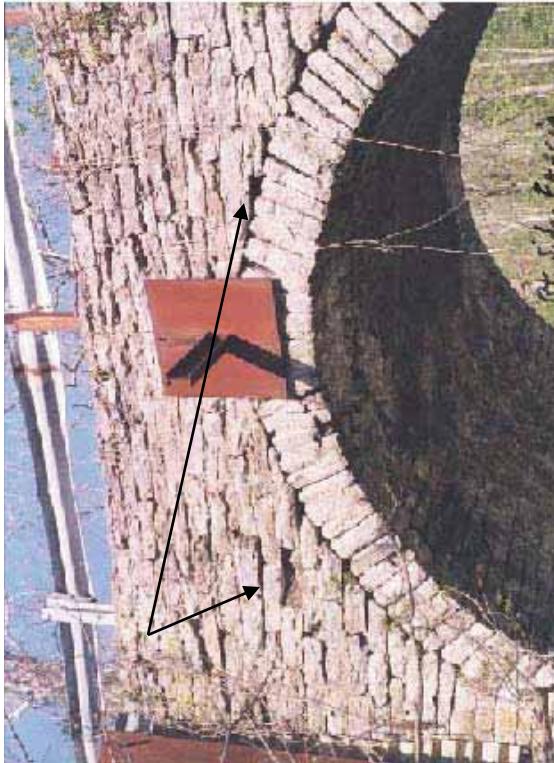
Masonry – Good



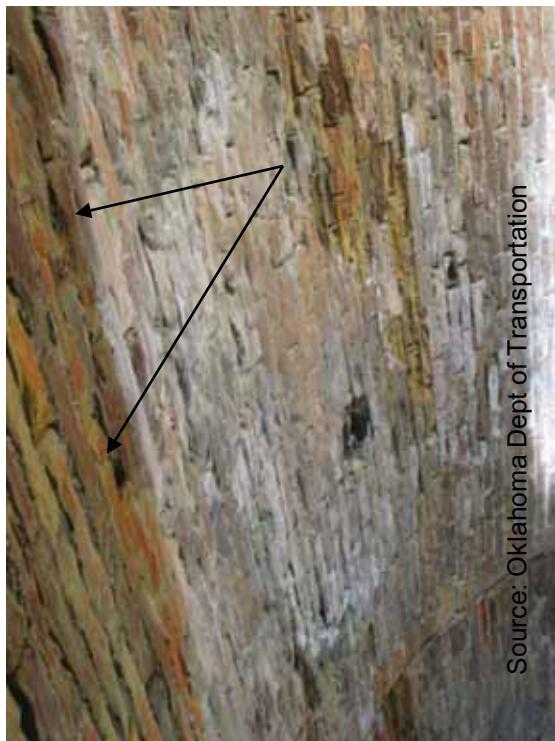
B. 47

Masonry – Fair

(Minor cracks, mortar/section loss, loose blocks and infil)

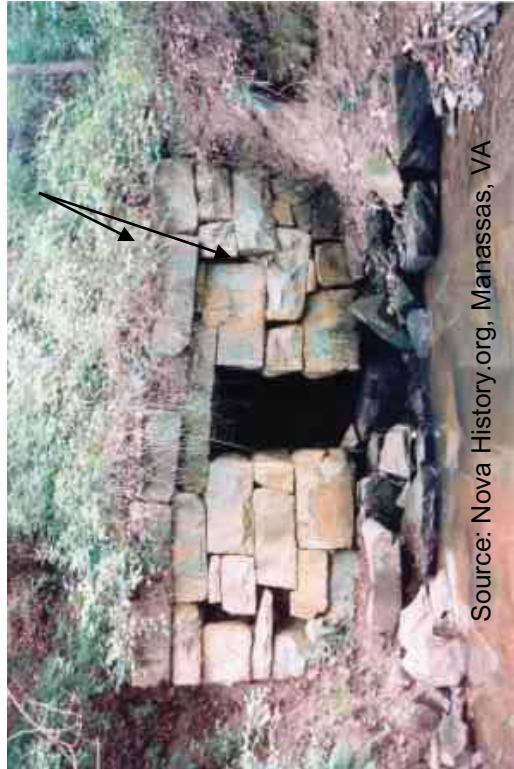


Source: Indiana University of Pennsylvania

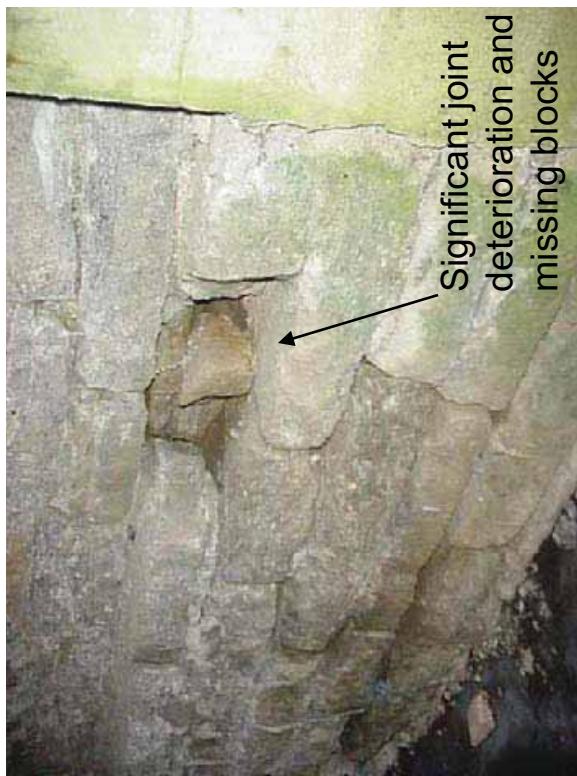


Source: Oklahoma Dept of Transportation

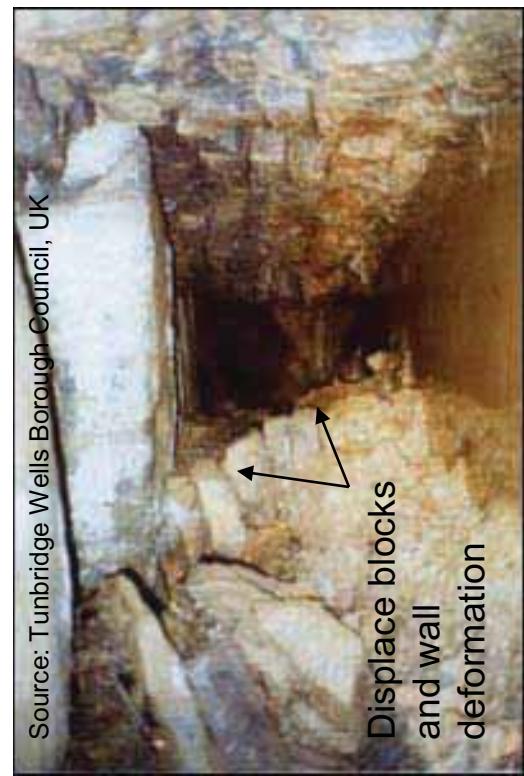
Masonry – Poor



Source: Nova History.org, Manassas, VA



Source: Tunbridge Wells Borough Council, UK



Displace blocks
and wall
deformation

Masonry – Critical

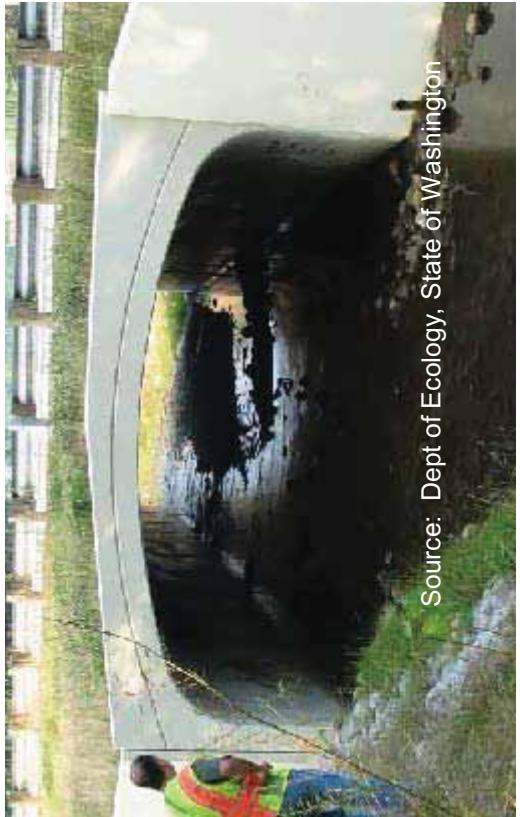
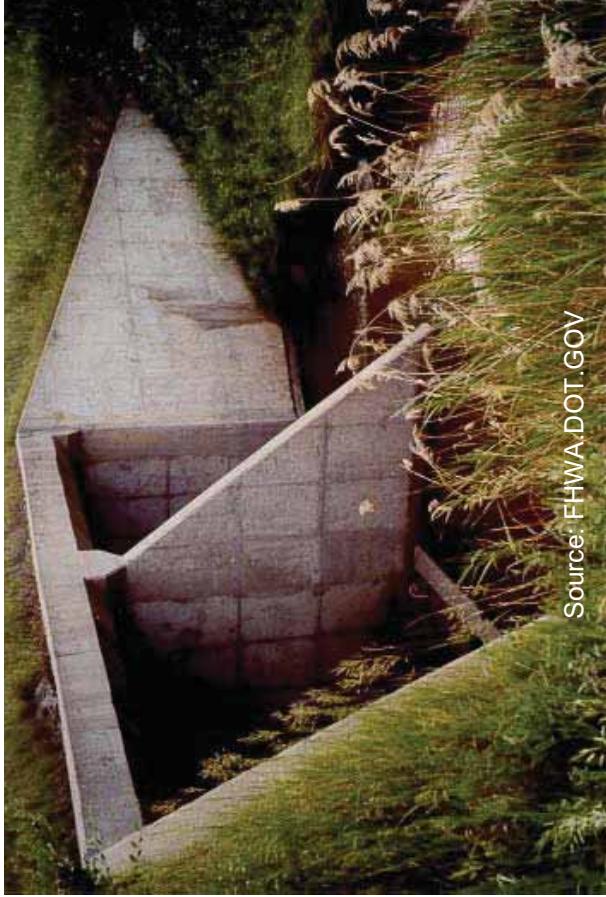


Severe section loss with significant infiltration, voids, and roadway settlement likely



Source: Town of Kennebunk, ME

Appurtenances - Good



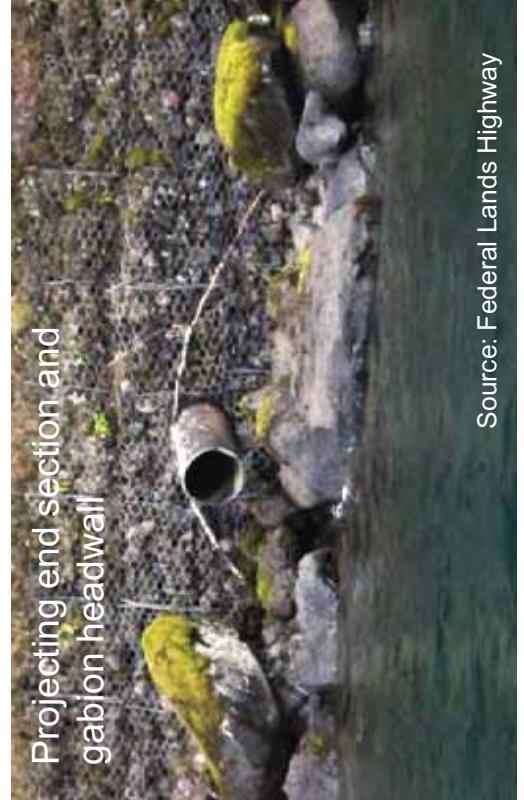
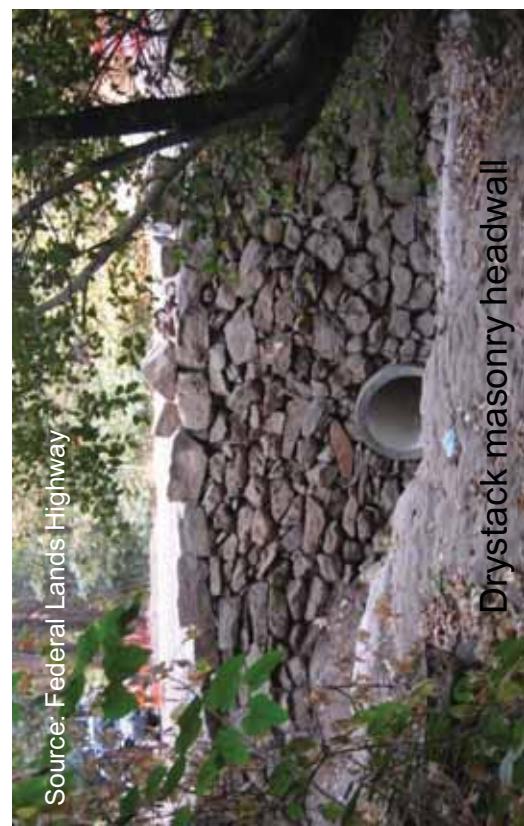
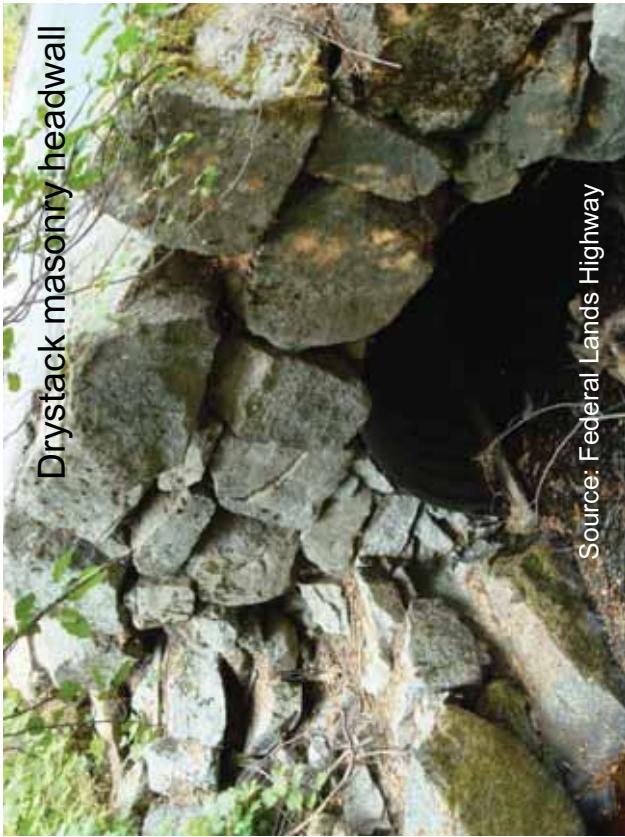
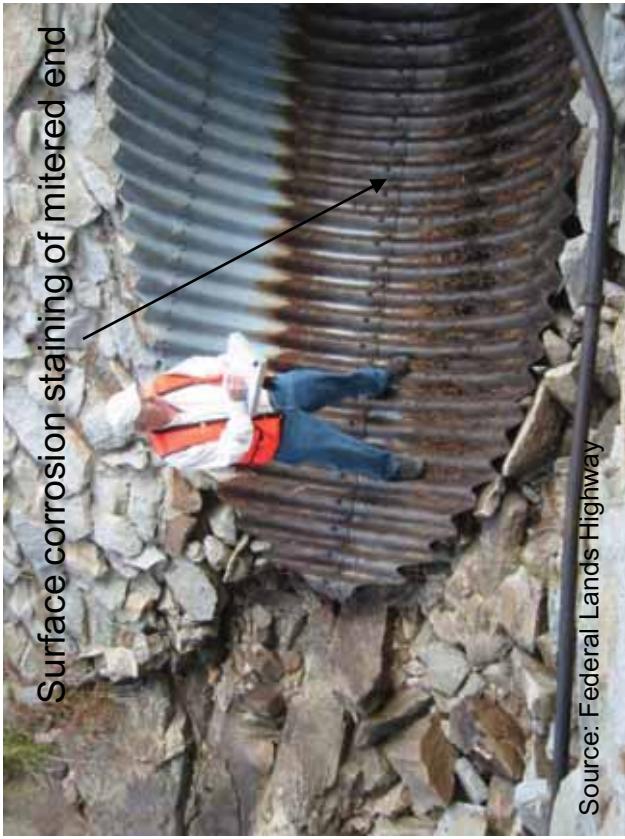
Appurtenances - Good



Source: California State Parks

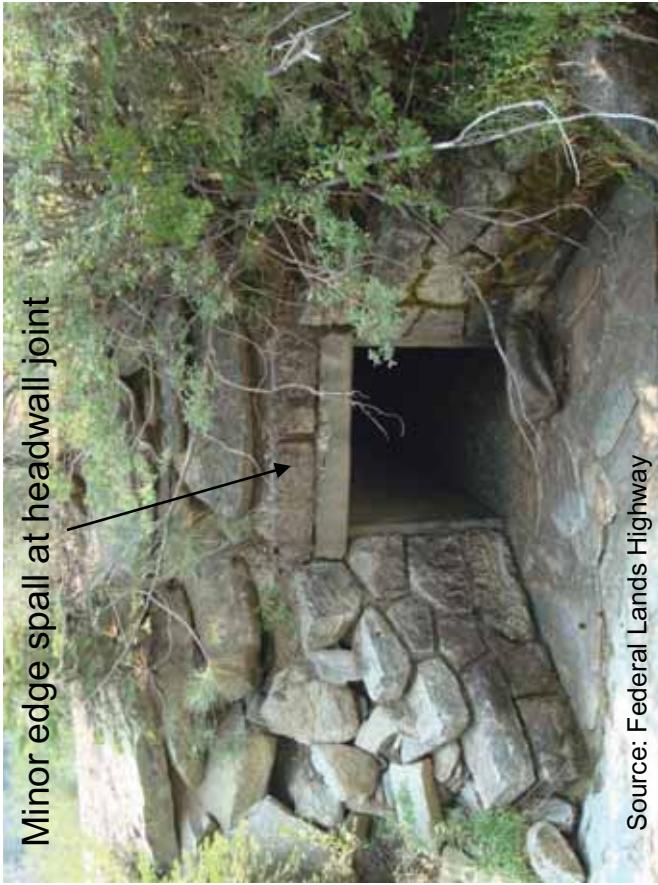


Appurtenances - Good



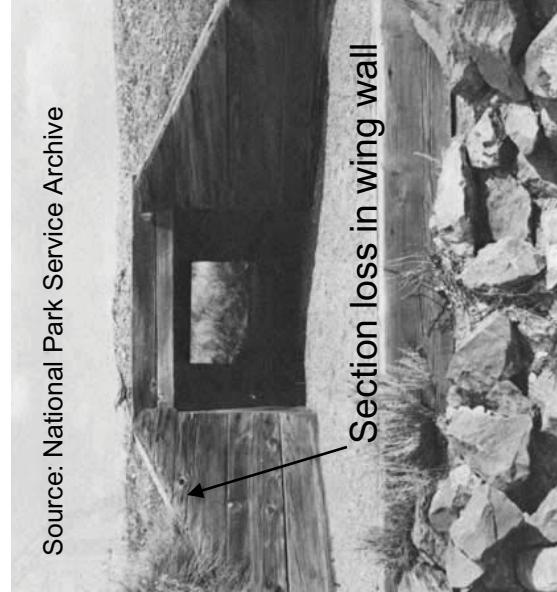
B. 53

Appurtenances - Good



B. 54

Appurtenances - Fair



B. 55

Source: Vernondepot.com, CT

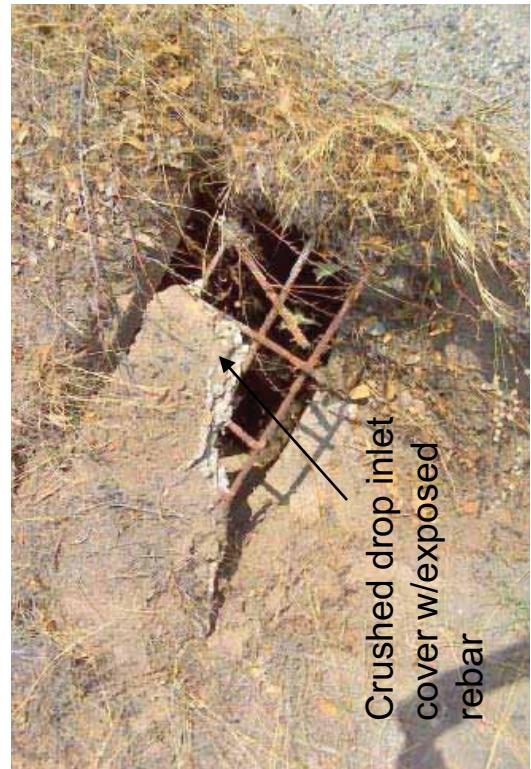
Apertures – Fair



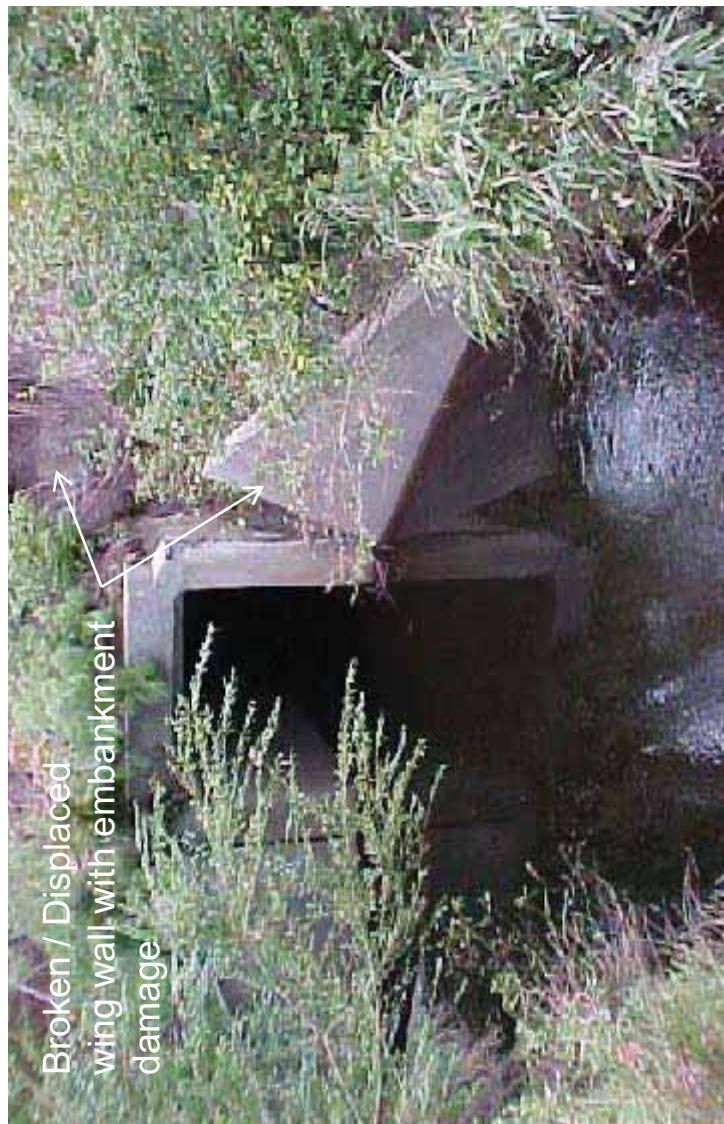
Source: Utah DOT

Source: Utah DOT

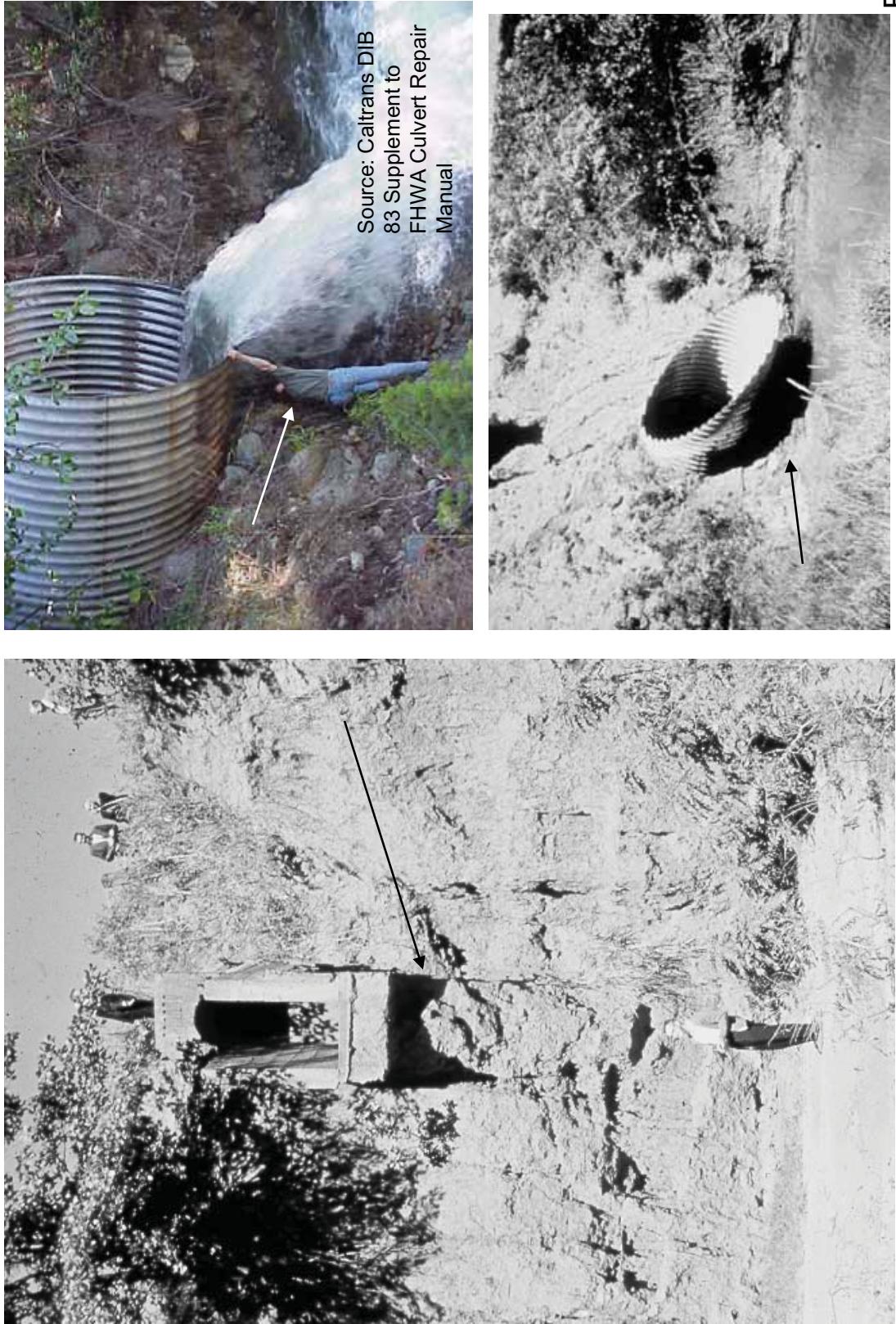
Appurtenances - Poor



Appurtenances - Critical

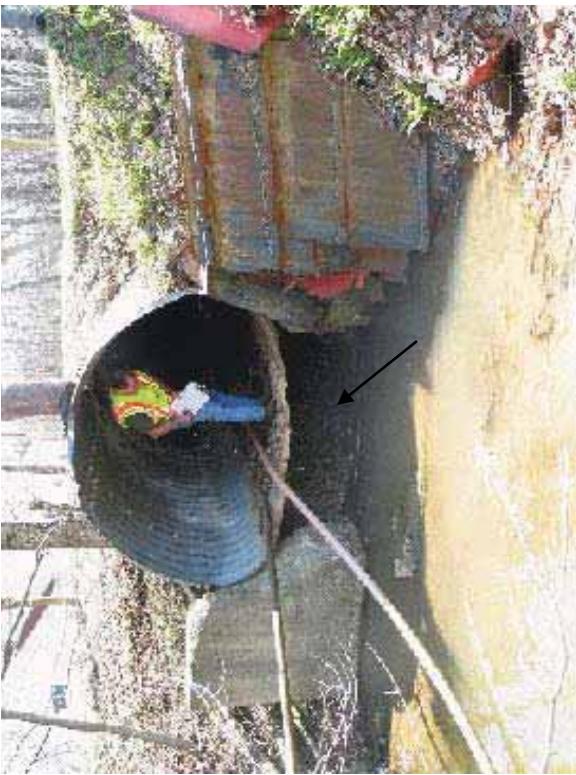
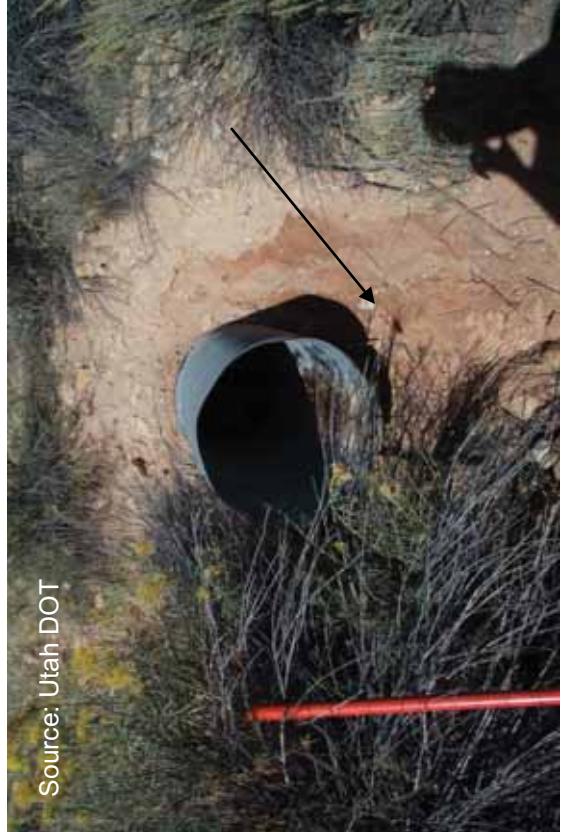


Performance – Perched Outlet



B. 59

Performance – Outlet Scour or Degradation



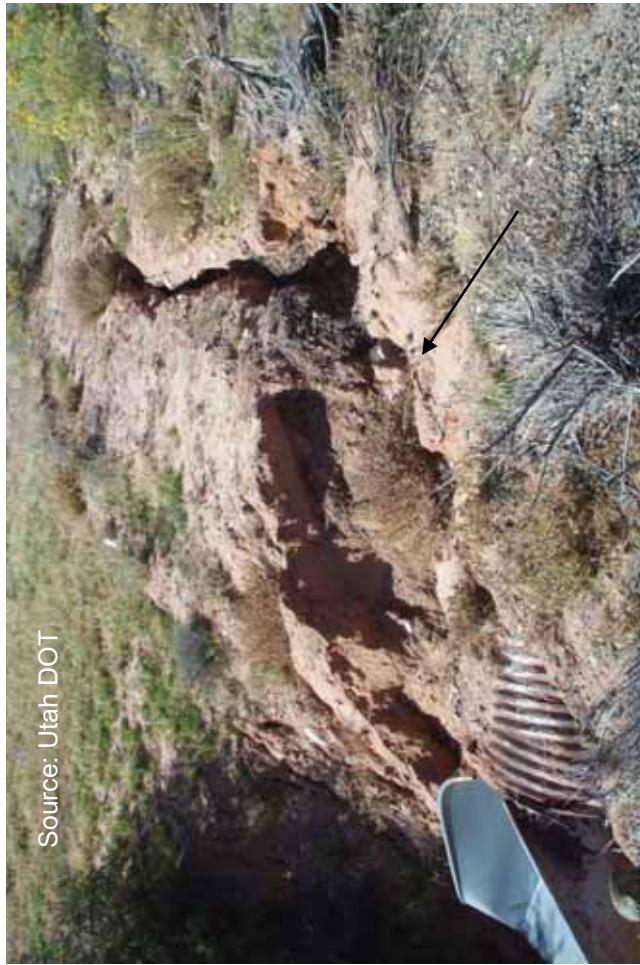
B. 60

Performance – Embankment Erosion



Performance – Embankment Erosion

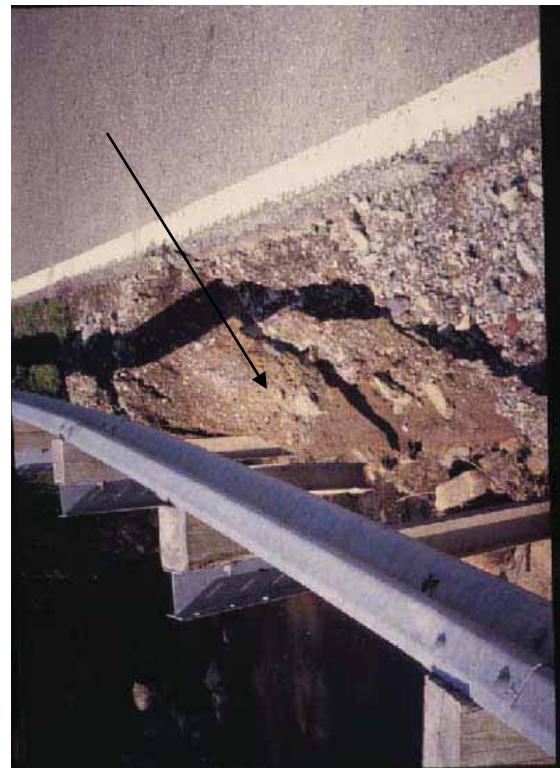
Source: Utah DOT



Source: Utah DOT



B. 62



Performance – Chronic Sediment



Source: Utah DOT



Source: Utah DOT



Source: Utah DOT



B. 63

Performance – Debris and Vegetation



B. 64

Performance – Piping/Settlement/Holes



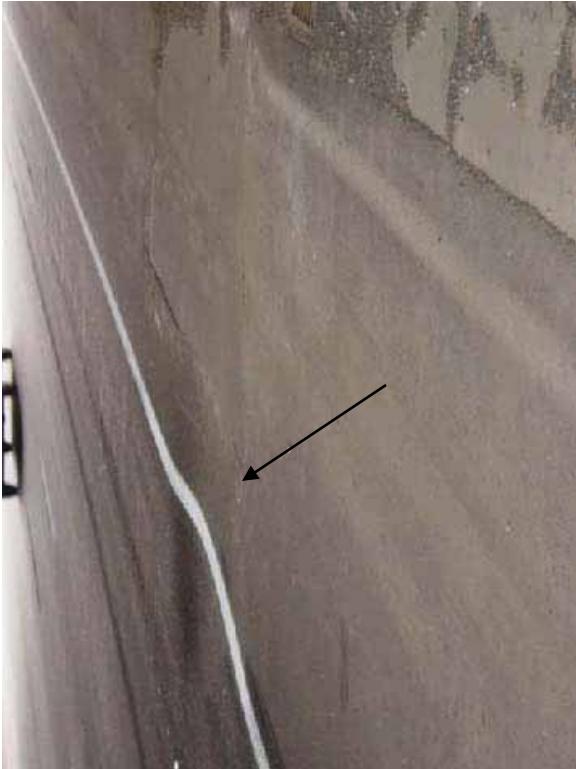
Source: Utah DOT



Source: Caltrans DIB 83 Supplement to
FHWA Culvert Repair Manual

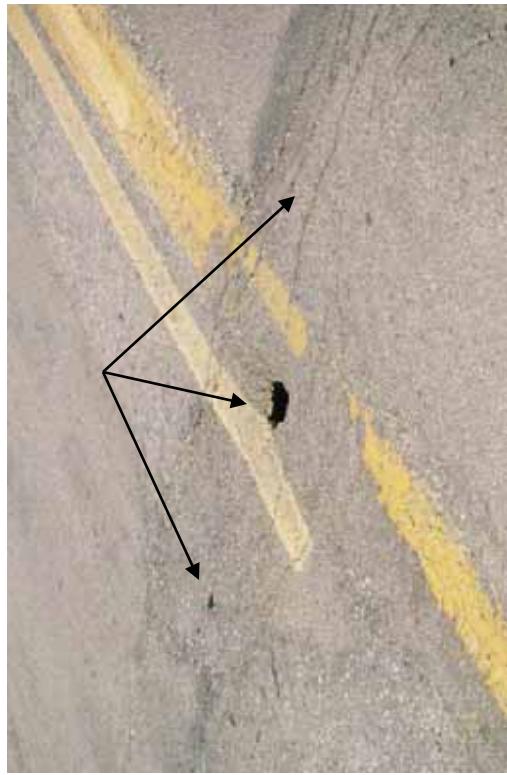
B. 65

Performance – Piping/Settlement/Holes



B. 66

Performance – Piping/Settlement/Holes



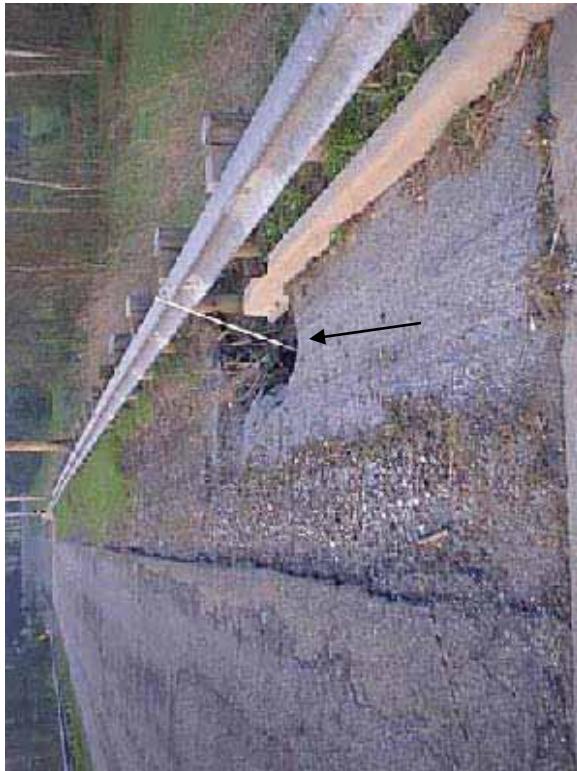
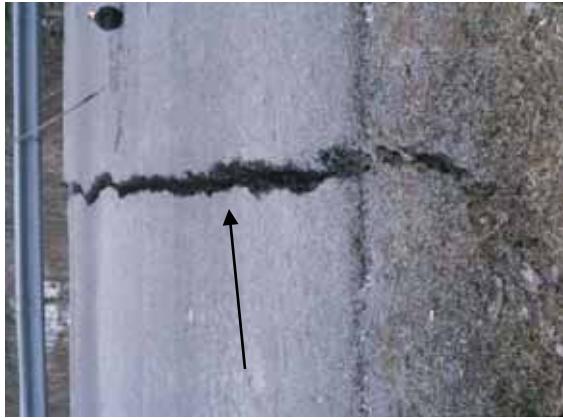
B. 67

Performance – Piping/Settlement/Holes



B. 68

Performance – Piping/Settlement/Holes



Source: Muskegon Chronicle, MI

B. 69

Performance – Piping/Invert Buckling



Source: Utah DOT

Performance – Channel Degradation



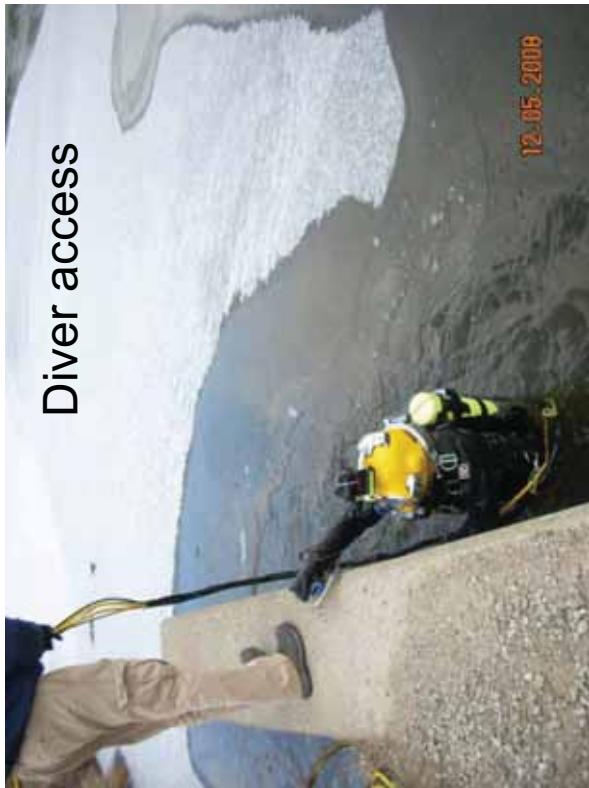
Source: City of Bellingham, WA

Performance – Approaching Headcut



B. 72

Level 2 – No Access or Specialized Equipment Necessary



Diver access



ROV/robotic crawler access



Swift water conditions



Rope access and confined space

Sources

- AASHTO Culvert Inspection, Material Selection, and Rehabilitation Guideline (Chapter 14); 2007.
- Caltrans Supplement to FHWA Culvert Repair Practices Manual; 2003.
- FHWA FLH Field Photo Archives.
- FHWA HDS5 Hydraulic Design of Highway Culverts; Rev 2005.
- MnDOT HYDINFRA website <http://www.dot.state.mn.us/bridge/Hydraulics/HydInfra.html>
- Ohio/ORITE Risk Assessment and Update of Inspection Procedures for Culverts; 2005.
- USDA Forest Service Summary of Trenchless Technology for Use With USDA Forest Service Culverts; 2005.
- Otherwise noted on the individual photograph.