

**APPENDIX C – PHOTOGRAPHIC GUIDE FOR CULVERT REPAIR  
AND REPLACEMENT TECHNIQUES**



FHWA FLH Culvert Assessment and Decision-Making  
Procedures Manual

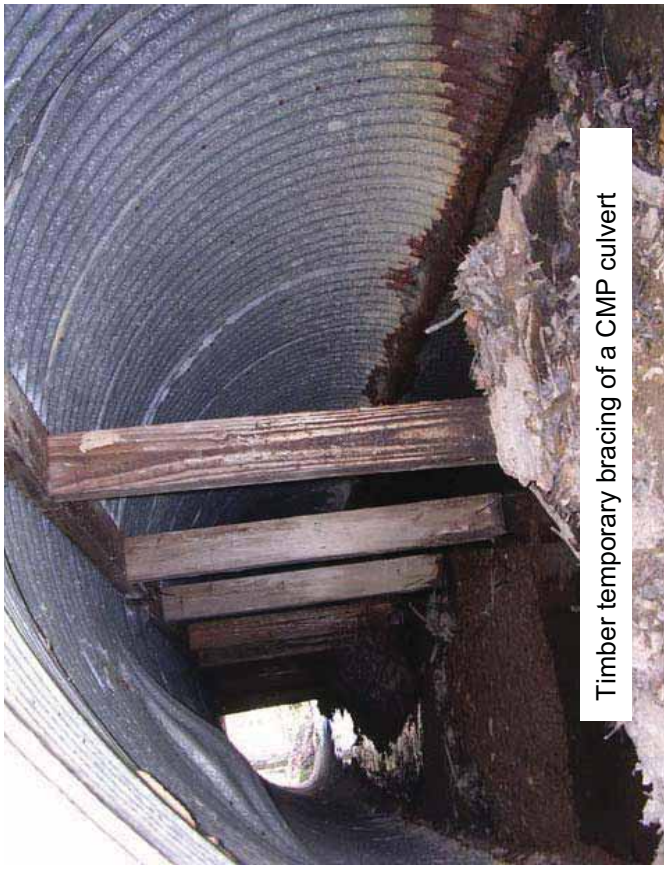
## Appendix C

# Photographic Guide of Culvert Repair and Replacement Techniques

# Temporary Bracing



Steel temporary bracing of a concrete culvert



Timber temporary bracing of a CMP culvert

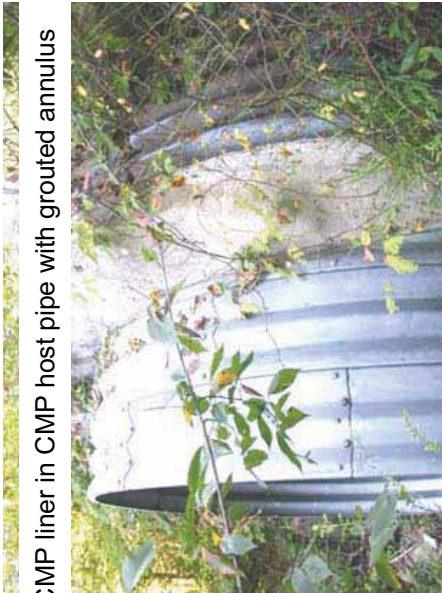
# Liner Repairs



Spiral-wound plastic liner with grouted annulus



Plastic segmental slipliner



CMP liner in CMP host pipe with grouted annulus



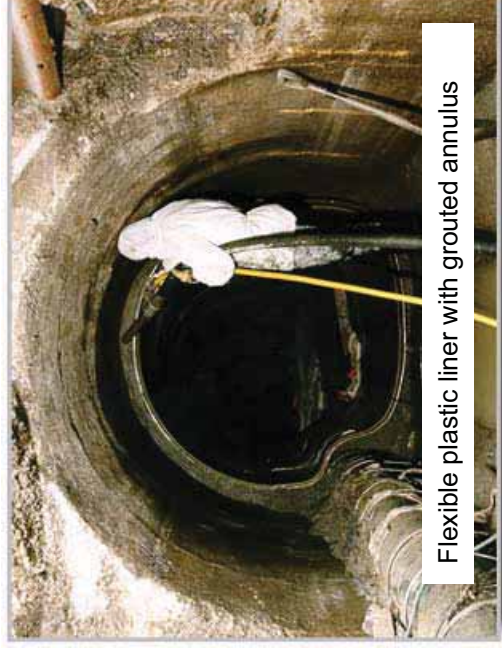
# Liner Repairs



PVC liner with annulus grout injection pipes visible



PVC liner with grouted annulus



Flexible plastic liner with grouted annulus

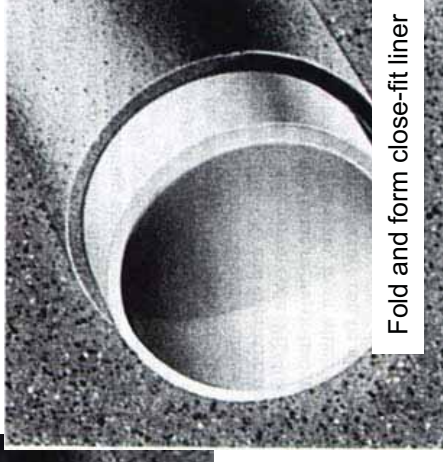
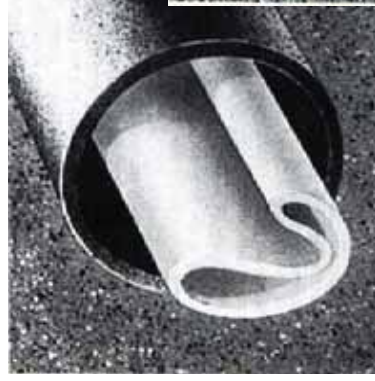
# Liner Repairs



FRC liner during installation and completed



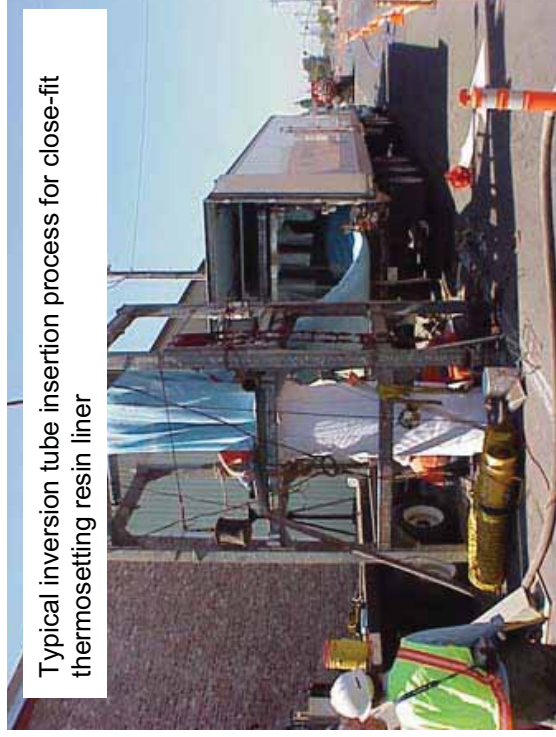
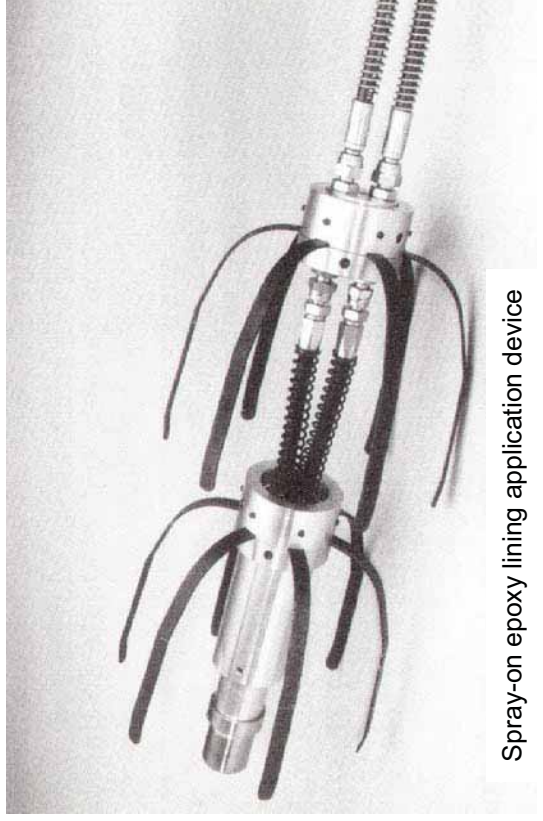
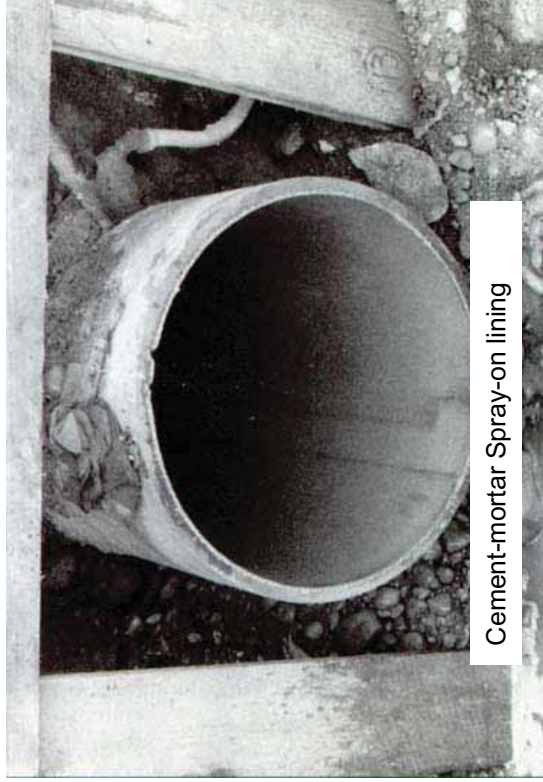
Push/pull type fusion-welded HDPE pipe slipliner



Fold and form close-fit liner



# Liner Repairs





# Liner Repairs



Installation of large diameter deformed-reformed HDPE liner



Installation of 18in. diameter deformed-reformed liner through drainage inlet

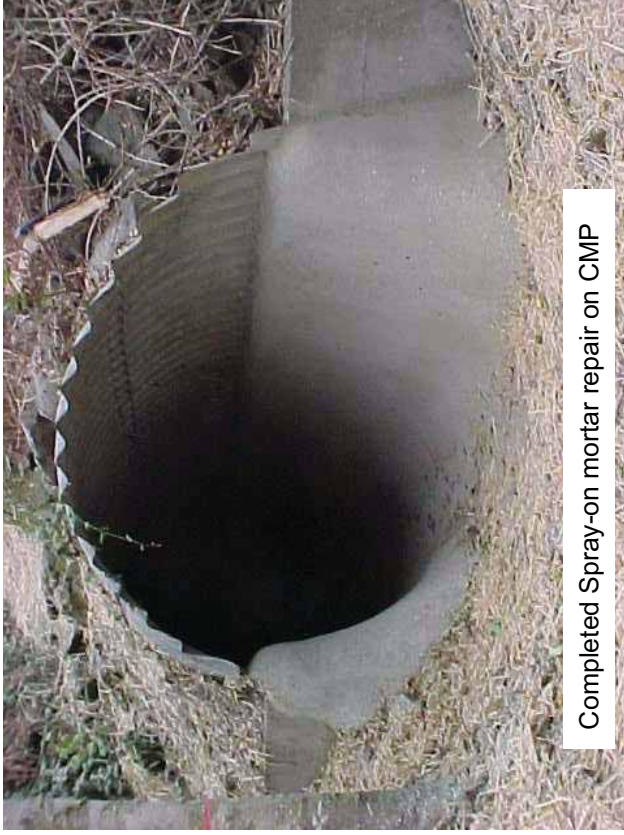


Spiral wound liner installation in masonry culvert



Spray-on mortar partial lining of CMP via man-entry

# Liner Repairs



Completed Spray-on mortar repair on CMP



A



B

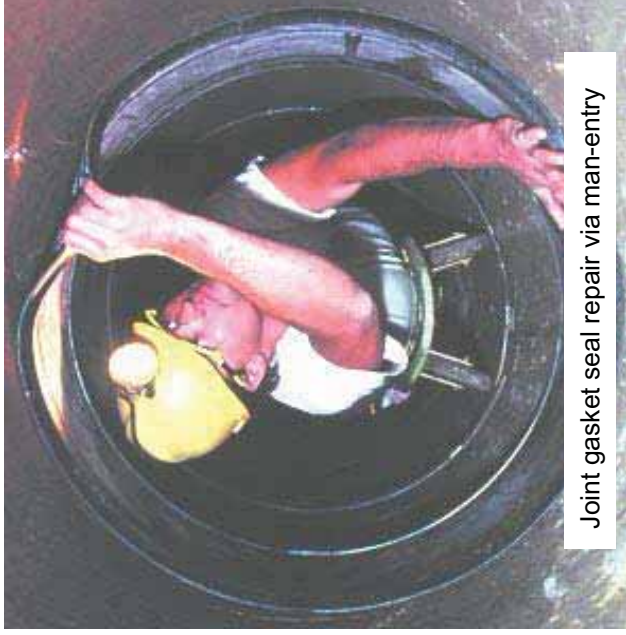
Cured-in-place Liner installation<sup>B</sup> and completed<sup>A</sup>



# Joint Repairs



Hand-applied epoxy joint patch seal



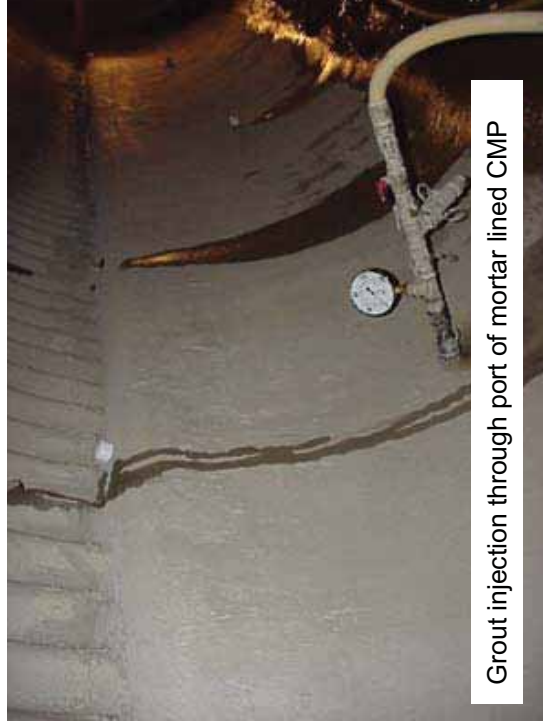
Joint gasket seal repair via man-entry



Joint gasket seal repair via man-entry



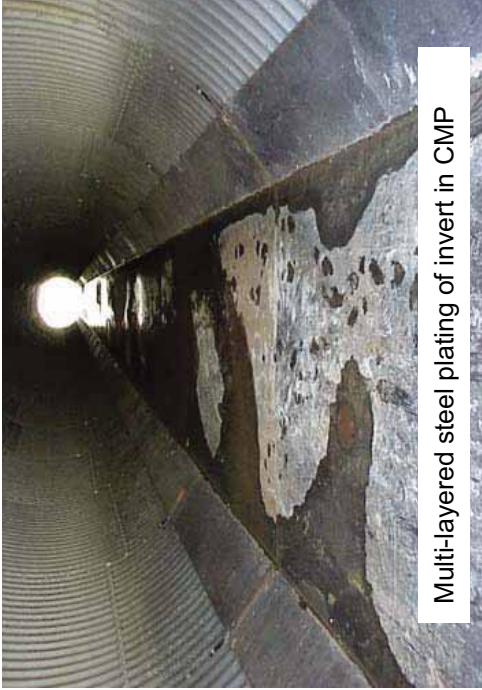
# Void Repairs



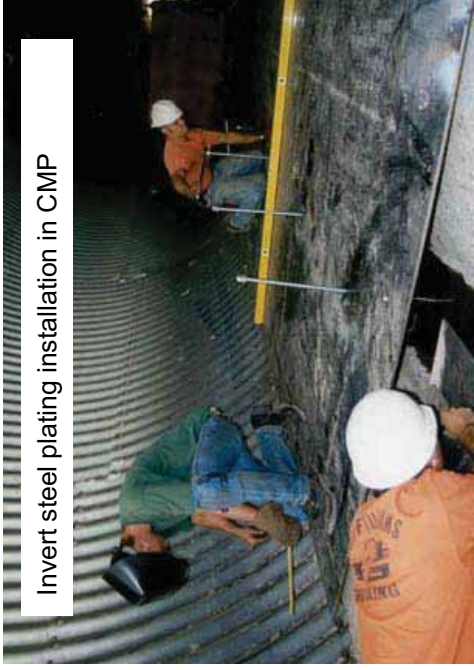
Grout injection through port of mortar lined CMP



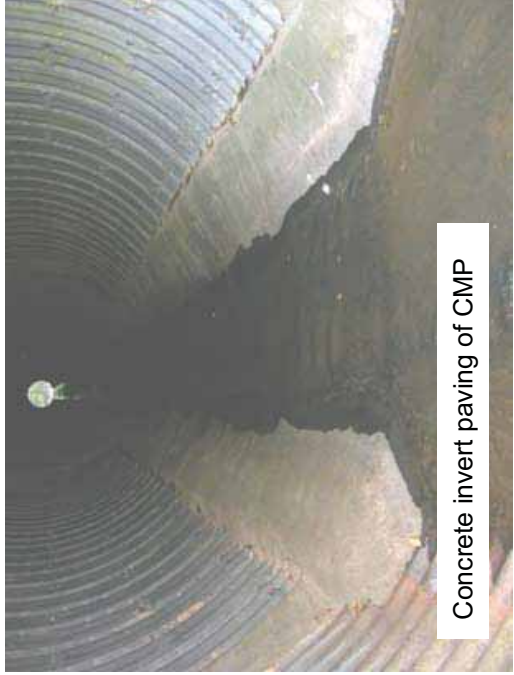
# Invert Paving and Plating



Multi-layered steel plating of invert in CMP



Invert steel plating installation in CMP

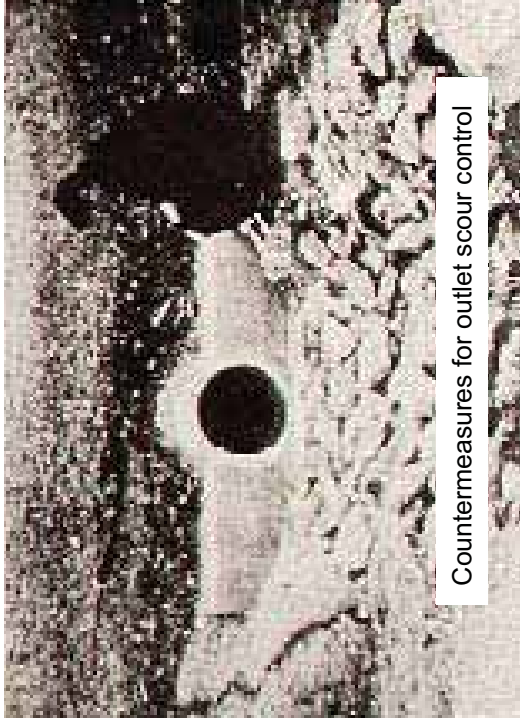


Concrete invert paving of CMP



Concrete or mortar-lined invert in CMP

# Scour Countermeasures



Countermeasures for outlet scour control

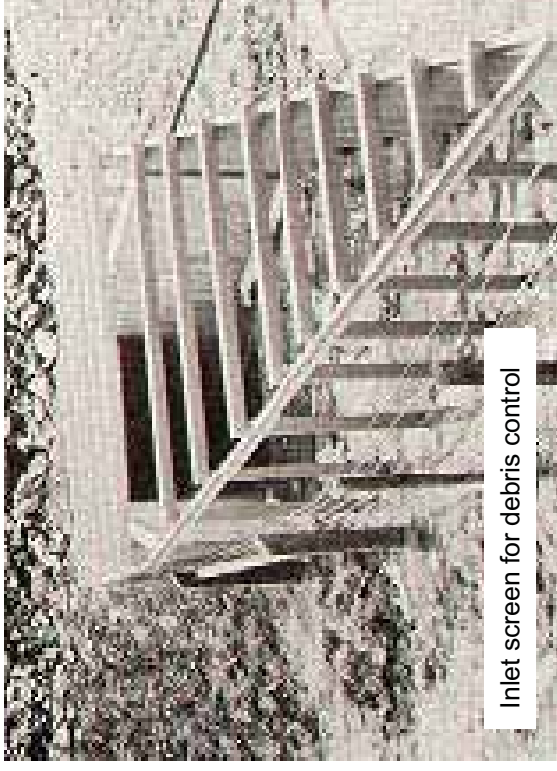


Energy dissipater for outlet scour control



Outlet apron repair

# Debris Countermeasures





# Pipe Jacking/Ramming/Auguring/Replacement



Large scale (10ft. Diameter CMP) ramming operation



Small scale (24in. Diameter CMP) ramming operation



Horizontal auger boring of 24in. CMP



Typical jacking pit



# Sources

- Caltrans Supplement to FHWA Culvert Repair practices Manual, DIB No. 83-01; October 2, 2006.
- Culvert Pipe Liner Guide and Specifications; Publication No. FHWA-CFL/TD-05-003; FHWA Central Federal Lands Highway Division; Colorado State University ERC; July 2005.
- FHWA FLH Field Photo Archives.
- Oregon DOT Hydraulics Manual, Chapter 16 – Trenchless Technology; 2005.
- Summary of Trenchless Technology for Use With USDA Forest Service Culverts; USDA Forest Service; Rob Piehl, P.E.; September 2005.
- Understanding the Environmental Implications of Cured-in-Place Pipe Rehabilitation Technology; Virginia Transportation Research Council Research Report VTRC 08-R16; Donaldson and Baker, P.E.; May 2008.
- Otherwise noted on individual photographs.

