

**STRUCTURE CS-3**  
**INSPECTION DATE: 2/21/2020**



Double Barrel, 48" Diameter x 102' Long

Location:	FWMA
	Levee FWMA
Latitude:	27.8229 N
Longitude:	80.6735 W
Type:	Gated Culvert
No. Barrels:	Two
Inspection	
Start Date:	2/21/2020
End Date:	2/21/2020

TEAM MEMBERS	
Lead Engineer	Jeffrey O'Connor, P.E.
Dive Supervisor	Bo Green
Diver	Natasha Daniel
Diver – Standby	Aaron Willard
Dive Tender	Ben Harpel
Dive Tender	
Animal Control	TJ McDonagh
SJRWMD Agent	

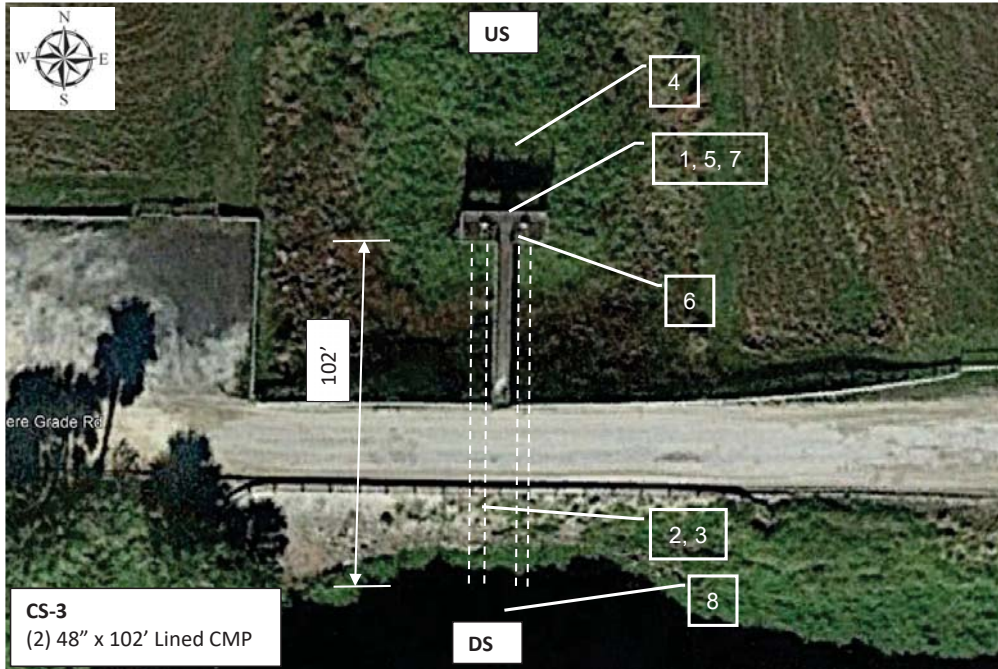
Respectfully Submitted,  
**UNDERWATER ENGINEERING SERVICES, INC.**  
3306 Enterprise Road  
Fort Pierce, FL 34982  
(772) 337-3116 Lic. No. CA3703  
Jeffrey O'Connor, P.E. (FL 50914)  
Vice President  
Project Manager



Digitally signed by  
Jeffrey H O'Connor  
Date: 2020.06.25  
11:02:03 -04'00'

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

**Aerial View of Structure**



No.	Item No.	Inspection Item	Rating	Deficiency
1	US152	Gate Guides	C-3	Moderate to major corrosion on isolated portions of the guide angles.
2	DS56	Shoaling/Scour	C-3	Up to 6" of hard mud built up in west barrel.
3	DS58	Debris	C-3	Lining construction debris buried in mud in west barrel.
4	US2	Riprap	C-2	No riprap observed within 10' of gates but may be covered in mud.
5	US114	Structural Support	C-2	Minor concrete scaling for support frame.
6	US151, DS151	Structure Gates	C-2	Coating blisters and minor corrosion on both sides of gates.
7	US153	Gate Seals	C-2	East top embedded seal plate has minor to moderate corrosion.
8	DS2	Riprap	C-2	No riprap observed beyond 10' from bank but may be covered in mud.

### Structure Description and Method of Underwater Inspection

Structure CS-3 is a gated culvert comprised of two barrels, extending north (gated end) to south under Levee FWMA. The barrels are lined CMP, 48 inches diameter by 102 feet long. The north end has an access bridge supported by a buried abutment and the concrete structure frame.

The underwater inspection was performed by a 5-person dive team on February 21, 2020 and completed on March 24, 2020. The dive team worked from a dive trailer, using surface-supplied air, and accessed the structure areas from the bank.

The scope of services included the underwater inspection of the submerged structure components. The area extended 20 feet beyond the structure edges. There were no boat barriers.

The air temperature was 61 degrees F. and the weather was overcast. The underwater visibility ranged from 1 to 2 feet. The water level was unknown – there were no staff gauges present.

### Rating System

- C-1: No action needed
- C-2: Monitor condition at next dive inspection (5 years)
- C-3: Schedule repair/replacement (for routine items)
- C-4: Schedule repair/replacement (for safety or operational items)
- C-5: Repair/replace immediately (for structural items)
- C-6: Critical - Repair/replace immediately (for operational items)

### Summary of Observations

#### Items Rated C-5 and Above

There were no items rated C-5 and above.

#### Items Rated C-4

There were no items rated C-4.

#### Items Rated C-3

- Item US152: Both sides of both gates have moderate to major corrosion with minor to moderate section loss in the vertical angles located just above the top gate block. The section loss is knife edging with losses of 1/2" to 1.5" on the leg over a 3" to 12" length of angle, with associated thickness loss. The vertical angle frame outside of this area has minor coating blisters and corrosion.
  - Recommended Action: The gate frame areas with heavy corrosion and section loss should be cleaned and recoated and may need additional strength.
- Item DS56: Sediment in west barrel is hard mud approximately 4"-6" deep throughout. Some areas of mud have embedded plastic liner pieces of debris.

- Recommended Action: Remove sediment and debris from west barrel.
- Item DS58: The west barrel has pieces of plastic debris at 45'-49', 59' and 102' in from downstream end, size of debris is approximately 2' x 2'.
  - Remove pieces of plastic debris.

#### Items Rated C-2

- Item US2: No riprap found in line with gates within 10'.
  - Recommended Action: Monitor area upstream of culvert for future scour.
- Item US114: The concrete columns have minor scaling, up to 1/16" deep with exposed aggregate over 50% of the area, from the channel bottom to the construction joint at 6' above bottom. The lower concrete struts have minor scaling of 1/16" to 1/4" maximum.
  - Recommended Action: Monitor concrete column for advanced scaling.
- Item US151: (1) Both gates have coating blisters throughout and spotty minor corrosion covering 20% of the surface. Both gates have a higher concentration of pitting, up to 1/32" around the stem. (2) The middle stiffener plate that the stem passes through has been torch cut along the front edge, that exposes the stem through the hole.
  - Recommended Action: Monitor gate for coating loss and advanced corrosion and/or section loss.
- Item DS151: Both gates have coating blisters covering 20%-25% of area with minor corrosion pitting up to 1/64" deep underneath.
  - Recommended Action: Monitor gate coating for increased coating loss and/or pitting underneath.
- Item US153: The east gate seal plate along the top has minor to moderate corrosion on top edge covering 20% of area with pitting up to 1/16" deep maximum.
  - Recommended Action: Monitor corrosion of seal plate top edge for advanced corrosion and/or section loss.
- Item DS2: No riprap found beyond 10' from shore, but area had up to 4' of mud.
  - Recommended Action: Monitor area downstream of culvert for future scour.
- Item US152: Refer also to C-3 notes above. (1) The anchors for the gate frame all have minor corrosion with less than 10% section loss. (2) The block hardware for both gates have minor corrosion with less than 10% section loss on the large anchors. Some of the block set screws have loose washers and inner nuts not tight.
  - Recommended Action: Monitor areas of gate frame, gate frame hardware and block hardware for advanced corrosion and/or section loss. Monitor loose block set screws and tighten as necessary.

**PHOTOGRAPHS**

Item No.: US152 Gate Guides	Rating: C-3	Photo Description: Corrosion on angle leg edges
--------------------------------	-------------	--

Deficiency: Both sides of both gates have moderate to major corrosion with minor to moderate section loss in the vertical angles located just above the top gate block. The section loss is knife edging with losses of 1/2" to 1.5" on the leg over a 3" to 12" length of angle, with associated thickness loss. The vertical angle frame outside of this area has minor coating blisters and corrosion.

Probable Cause: The corrosion was due to chemical attack from the water and isolated areas of galvanic corrosion due to contact of dissimilar metals.

Recommendation: The gate frame areas with heavy corrosion and section loss should be cleaned and recoated and may need additional strength.



Item No.: DS56 Shoaling/Scour	Rating: C-3	Photo Description: Mud Build-up in west barrel
Deficiency: Sediment in west barrel is hard mud approximately 4"-6" deep throughout. Some areas of mud have embedded plastic liner pieces of debris.		
Probable Cause: The sediment deposit is natural with a low flow condition and may have built up due to presence of construction debris.		
Recommendation: Remove sediment and debris from west barrel.		
No image available – mud at invert. Refer to DS58 photo.		

Item No.: DS58 Debris	Rating: C-3	Photo Description: Plastic debris from lining install
Deficiency: The west barrel has pieces of plastic debris at 45'-49', 59' and 102' in from downstream end, size of debris is approximately 2' x 2'.		
Probable Cause: The most likely probable cause would be from not removing scrap pieces during liner install.		
Recommendation: Remove pieces of plastic debris in west barrel.		



# **APPENDIX**

# **CHECKLISTS**



## Structure No. CS-3

### UPSTREAM EROSION CONTROL

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
US1	Slope/Banks of Channel	1	No deficiencies noted		
US2	Rip Rap	2	No riprap found in line with gates within 10'.	Monitor area upstream of culvert for future scour.	Riprap may not have been placed properly during construction.
US3	Exposed erosion-Control Fabric	1	No deficiencies noted		
US4	Evidence of stone displacement (bedding stone)	1	No deficiencies noted		
US5	Channel Stabilization and erosion control	1	No deficiencies noted		

### UPSTREAM GENERAL

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
US50	Structural - General Concrete Condition	2	Refer to US114		
US51	Structural - General Metal Condition	3	Refer to US152		
US52	Structural - General Timber Condition	NA	No deficiencies noted		
US53	Construction Joints (Bolts, Welds)	1	No deficiencies noted		
US54	Channels for Stoplogs or Flashboards	NA	Item not present		
US55	Settlement	1	No deficiencies noted		
US56	Shoaling/Scour	1	No deficiencies noted		
US57	Fouling/Marine Growth	1	No deficiencies noted		
US58	Debris	NA	Item not present		
US59	Stilling Wells	NA	Item not present		
US60	Underwater Controls/Instruments	NA	Item not present		
US61	Fenders	NA	Item not present		

### UPSTREAM STRUCTURE

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
US100	Wingwalls	NA	Item not present		
US101	Buttresses (support arms for wall)	NA	Item not present		
US102	Abutments	NA	Item not present		
US103	Retention Walls	NA	Item not present		
US104	Headwall	NA	Item not present		
US105	Expansion/Construction Joints	1	No deficiencies noted		
US106	Sheetpiles and Bulkheads	NA	Item not present		
US107	Wales/Tiebacks	NA	Item not present		
US108	Intake Bays	NA	Item not present		
US109	Piers	NA	Item not present		
US110	Foundation	NA	Item not present		
US111	Weir/Weir crest	NA	Item not present		
US112	Baffles	NA	Item not present		
US113	Underwater Apron Slabs	NA	Item not present		
US114	Structural Support, Bracing or Frames	2	The concrete columns have minor scaling, up to 1/16" deep with exposed aggregate over 50% of the area, from the channel bottom to the construction joint at 6' above bottom. The lower concrete struts have minor scaling of 1/16" to 1/4" maximum [13:45, 14:23].	Monitor concrete column for advanced scaling.	The concrete scaling is due to chemical attack from the water and possible long-term abrasion from flowing water.
US115	Culverts	NA	Item not present		
US116	Risers	NA	Item not present		

**Structure No. CS-3**

**UPSTREAM GATES**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
US151	Structure Gate(s)	2	(1) Both gates have coating blisters throughout and spotty minor corrosion covering 20% of the surface. Both gates have a higher concentration of pitting, up to 1/32" around the stem [14:08, 14:37, 14:46]. (2) The middle stiffener plate that the stem passes through has been torch cut along the front edge, that exposes the stem through the hole [14:37].	Monitor gate for coating loss and advanced corrosion and/or section loss.	The corrosion was due to chemical attack from the water and isolated areas of galvanic corrosion due to contact of dissimilar metals. The cut area of the west gate middle stiffener appears to be intentional.
US152	Gate Guides and Gate Control	3	(1) C-3: Both sides of both gates have moderate to major corrosion with minor to moderate section loss in the vertical angles located just above the top gate block. The section loss is knife edging with losses of 1/2" to 1.5" on the leg over a 3" to 12" length of angle, with associated thickness loss. The vertical angle frame outside of this area has minor coating blisters and corrosion [13:50, 14:16, 14:25, 14:47]. (2) C-2: The anchors for the gate frame all have minor corrosion with less than 10% section loss. (3) C-2: The block hardware for both gates have minor corrosion with less than 10% section loss on the large anchors. Some of the block set screws have loose washers and inner nuts not tight [13:53, 14:19, 14:27, 14:50].	The gate frame areas with heavy corrosion and section loss should be cleaned and recoated, and may need additional strength. Monitor areas of gate frame, gate frame hardware and block hardware for advanced corrosion and/or section loss. Monitor loose block set screws and tighten as necessary.	The corrosion was due to chemical attack from the water and isolated areas of galvanic corrosion due to contact of dissimilar metals. The loose set screw washers and inner nuts were not tightened properly during adjustment.
US153	Gate Seals & Mating Surface	2	The east gate seal plate along the top has minor to moderate corrosion on top edge covering 20% of area with pitting up to 1/16" deep maximum [14:05].	Monitor corrosion of seal plate top edge for advanced corrosion and/or section loss.	The corrosion was due to chemical attack from the water and possible isolated areas of galvanic corrosion due to contact of dissimilar metals.
US154	Cathodic Protection (entire structure)	NA	Item not present		
US155	Operator/Actuator Components	1	No deficiencies noted.		
US156	Emergency Closure Gates	NA	Item not present		
US306	Navigation Lock Miter Gates	NA	Item not present		

**Structure Name/No.: CS-3**

**DOWNSTREAM EROSION CONTROL**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
DS1	Slope/Banks of Channel	1	No deficiencies noted		
DS2	Rip Rap	2	No riprap found beyond 10' from shore, but area had up to 4' of mud.	Monitor area downstream of culvert for future scour.	Unknow if riprap was to be placed in area, or if it is present and just covered by mud.
DS3	Exposed erosion-Control Fabric	1	No deficiencies noted		
DS4	Evidence of stone displacement (bedding stone)	1	No deficiencies noted		
DS5	Channel Stabilization and erosion control	1	No deficiencies noted		

**DOWNSTREAM GENERAL**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
DS50	Structural - General Concrete Condition	NA	Item not present		
DS51	Structural - General Metal Condition	2	See DS151		
DS52	Structural - General Timber Condition	NA	Item not present		
DS53	Construction Joints (Bolts, Welds)	NA	Item not present		
DS54	Channels for Stoplogs or Flashboards	NA	Item not present		
DS55	Settlement	NA	No deficiencies noted		
DS56	Shoaling/Scour	3	Sediment in west barrel is hard mud approximately 4"-6" deep throughout. Some areas of mud have embedded plastic liner pieces of debris [10:34].	Remove sediment and debris from west barrel.	The sediment deposit is natural with a low flow condition and may have built up due to presence of construction debris.
DS57	Fouling/Marine Growth	1	No deficiencies noted		
DS58	Debris	3	The west barrel has pieces of plastic debris at 45'-49', 59' and 102' in from downstream end, size of debris is approximately 2' x 2' [10:36, 10:41, 10:45].	Remove pieces of plastic debris.	The most likely probable cause would be from not removing scrap pieces during liner install.
DS59	Stilling Wells	NA	Item not present		
DS60	Underwater Controls/Instruments	NA	Item not present		
DS61	Fenders	NA	Item not present		

**DOWNSTREAM STRUCTURE**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
DS100	Wingwalls	NA	Item not present		
DS101	Buttresses (support arms for wall)	NA	Item not present		
DS102	Abutments	NA	Item not present		
DS103	Retention Walls	NA	Item not present		
DS104	Headwall	NA	Item not present		
DS105	Expansion/Construction Joints	NA	Item not present		
DS106	Sheetpiles and Bulkheads	NA	Item not present		
DS107	Wales/Tiebacks	NA	Item not present		
DS108	Intake Bays	NA	Item not present		
DS109	Piers	NA	Item not present		
DS110	Foundation	NA	Item not present		
DS111	Weir/Weir crest	NA	Item not present		
DS112	Baffles	NA	Item not present		
DS113	Underwater Apron Slabs	NA	Item not present		
DS114	Structural Support, Bracing or Frames	NA	Item not present		

**Structure Name/No.: CS-3**

DS115	Culverts	1	Exterior of downstream side culvert has corrosion; however, culvert has been lined.	None	
-------	----------	---	---	------	--

**DOWNSTREAM GATES**

Finding #	Inspection Item	Rating	Comments	Recommended action	Probable cause
DS151	Structure Gate(s)	2	Both gates have coating blisters covering 20%-25% of area with minor corrosion pitting up to 1/64" deep underneath [10:59] [11:42].	Monitor gate coating for increased coating loss and/or pitting underneath.	The coating damage is from possible improper preparation or application, or age deterioration. The metal corrosion is due to chemical attack from the water.
DS152	Gate Guides and Gate Control	NA	Item not present		
DS153	Gate Seals & Mating Surface	1	No deficiencies noted.		
DS154	Cathodic Protection (entire structure)	NA	Item not present		
DS155	Operator/Actuator Components	NA	Item not present		
DS156	Emergency Closure Gates	NA	Item not present		
DS157	Navigation Lock Miter Gates	NA	Item not present		
DS1000	Additional Items and Comments				