WEST BANK AND VICINITY, NEW ORLEANS, LOUISIANA
HURRICANE PROTECTION PROJECT

ENGINEERING ALTERNATIVE REPORT

WBV-39b.2: COUSINS PUMP STATION OUTFALL CANAL

JEFFERSON PARISH, LOUISIANA

DRAFT
95% Submittal

INDEX

1	INTRODUCTION	1
2	EXECUTIVE SUMMARY	2
3	PURPOSE AND SCOPE OF STUDY	3
4	DESCRIPTION OF EXISTING PROTECTION	5
5	DESCRIPTION OF PROPOSED ALTERNATIVES	6
5. A	Type of Protection	6
5. A	Alignment	11
6	DESIGN CRITERIA SUMMARY	13
6. A	Field Data Collection	13
6. B	Hydraulic Design Criteria	13
6. C	Geotechnical Design Criteria	14
6. D	Structural Design Criteria	27
6. E	Borrow Requirements	29
7	REAL ESTATE	29
8	RELOCATIONS	30
9	COST ENGINEERING	37
10	QUALITY IMPLEMENTATION	44
11	RECOMMENDATIONS	45
12	OPERATION AND MAINTENANCE	46
13	APPENDICES	47
13. A	Soils Report	
13. B	Sample Calculations	
13 C	Survey BM Listing	
13. D	Design Quality Control Plan for BKI (signed)	
14	PLATES	
C-001	LOCATION AND VICINITY MAP	
C-002	GENERAL NOTES & LEGEND	
C-003	SURVEY	

14 PLATES (Cont'd)

C-004 T-WALL ALIGNMENT – SITE PLAN

C-005 L-WALL ALIGNMENT – SITE PLAN

C-006 T-WALL PLAN AND PROFILE (N-1)

C-007 L-WALL PLAN AND PROFILE (N-1)

C-008 T-WALL ALIGNEMNT PLAN AND PROFILE (S-1 & S-3)

C-009 L-WALL ALIGNMENT PLAN AND PROFILE (S-1 & S-3)

C-010 PLAN AND PROFILE (CONCRETE CULVERT & W-1)

C-011 TYPICAL SECTION

C-011A TYPICAL T-WALL & L-WALL SECTIONS & L-WALL FOUNDATION PLAN

C-011B FOUNDATION PLANS N-1, S-1, S-3 (2 LAYOUTS) & W-1

C-012 CONCRETE CULVERT SECTION

C-013 TYPICAL DEMOLITION SECTION

C-014 DEMOLITION PLAN (N-1 & S-1)

C-015 T-WALL TEMPORARY RETAINING STRUCTURE PLAN LAYOUT (N-1)

C-016 T-WALL TEMPORARY RETAINING STRUCTURE PLAN LAYOUT (S-1 & S-3)

C-017 T-WALL TEMPORARY RETAINING STRUCTURE PLAN LAYOUT (W-1)

C-018 TEMPORARY RETAINING STRUCTURE SECTION (S-3 & W-1)

C-019 HYDROGRAPH

C-020 BORING LOG

C-021 BORING LOG

R-001 T-WALL ALIGNMENT RIGHTS-OF-WAY & CONSTRUCTION EASEMENT

14 PLATES (Cont'd)

R-002 T-WALL ALIGNMENT RIGHTS-OF-WAY & CONSTRUCTION EASEMENT

R-003 L-WALL ALIGNMENT RIGHTS-OF-WAY & CONSTRUCTION EASEMENT

R-004 L-WALL ALIGNMENT RIGHTS-OF-WAY & CONSTRUCTION EASEMENT

M-001 36" WATER LINE EXISTING PLAN

M-002 PROFILE OF EXISTING 36" WATER LINE AERIAL CROSSINGS

M-003 TYPICAL RELOCATION 36" WATER LINE RAISED LINE ALTERNATIVE

M-004 RAISED LINE ALTERNATIVE PROPOSED PIPE SUPPORT DETAILS

M-005 TYPICAL RELOCATION 36" WATER LINE THROUGH WALL ALTERNATIVE

M-006 THROUGH WALL ALTERNATIVE PROPOSED PIPE SUPPORT DETAILS

V-001 PHOTOGRAPH ORIENTATION Photos No. 1 through 35

1. INTRODUCTION.

This project is located in Jefferson Parish, Louisiana, and is part of the West Bank and Vicinity, New Orleans, LA, Hurricane Protection Project, West of Algiers Canal. The scope of this project is to investigate means of modifying the existing structural elements to accommodate raising the existing flood protection to 100-year protection design grade El. 14.0 NAVD 88 (2004.65). Drawing C-001 shows the location of the project. Drawing C-004 shows the location of the existing structures falling under the scope of this Report. The features of construction requiring retrofit or replacement: are:

1) Existing I-wall (Wall N-1) on the north side of the Cousins pump station discharge channel from the Destrehan Bridge to the tie-in at the new T-type closure walls, currently under construction.

2) Existing I-wall (Wall S-1) on the south and west side of the canal from the Destrehan Bridge to the existing capped sheet pile which transitions the channel into the float-in concrete culvert beneath Lapalco Blvd. Bridge.

3) Existing capped sheet pile wall (Wall S-3) on the west side of the discharge channel that provides the transition between S-I and the float-in concrete culvert beneath Lapalco Blvd. Bridge.

4) Existing float-in concrete culvert.

5) Existing braced concrete capped sheet pile wall (Wall W-1) on west side of the discharge channel from the concrete culvert to the tie-in at new T-walls under construction.

Pictures of the site appear after the Photograph Orientation drawing V-001.

2. EXECUTIVE SUMMARY.

The existing flood protection for the area being addressed in this report consists of I-Walls and capped sheep pile walls except for the approximate 110' area occupied by a concrete culvert. Interim measures have been taken since the Hurricane Katrina to strengthen the I-Wall areas of the project by adding grouted rip rap on the protected side of the wall. These I-, sheet pile, and culvert walls currently provide flood protection to El. 10.5. This is 3.5' lower than the authorized El. 14.0 100-year project hurricane protection. This purpose of this report is to investigate alternatives for raising the flood protection of this area to 100-year project hurricane protection in the most cost manner possible without compromising the dependability of the recommended structure during possible overtopping conditions.

The basic alternatives investigated were: T-Walls, L-Walls, combinations of both T-Walls and L-Walls, designs that incorporated as much of the existing I-Walls and sheetpile walls as possible, and the possibility of adding a parapet wall to the concrete culvert structure.

The parapet wall was found to be a viable method for raising the concrete culvert wall. It was determined that the L-Wall was $900,000 less expensive than the T-Wall on the North side of the Cousins pump station discharge canal. The L-Wall / T-Wall combination was found to be almost $1.2 Million less expensive than the pure T-Wall alternative on the South side of the discharge canal.

The apparent cost savings do not reflect the cost of purchasing a corridor in the industrial yard of Petrex on the North side of the channel (Reach N-1). The site must also be environmentally surveyed for possible contamination before pursuing the L-Wall alternative in the area. On the South side of the channel the additional rights-of-way that would be required to pursue the L-Wall in Reach S-1

belongs to Jefferson Parish and is not an industrial site therefore poses no contamination issues.

The L-Wall as designed is dependent on the presence of an earthen berm on its protected side that has to be protected by the concrete slope pavement scour protection should the wall be overtopped by a storm surge. The T-Wall is more of a stand alone design that will not be compromised during an overtopping scenario. If the Corps of Engineers determines that the L-Wall can afford the same degree of dependability during an overtopping scenario then the L-Wall plan should be pursued through Reach S-1 on the South side of the discharge canal.

3. PURPOSE AND SCOPE OF STUDY.

The Architect-Engineer (A-E) shall furnish all services, materials, supplies, plant, labor, equipment, studies, investigations, superintendence, travel and coordination with all local, State, and Federal authorities as required for the design and preparation of the Engineering Alternative Report for the 100 year hurricane stages, assisting the Government and the West Jefferson Levee District (WJLD) at public meetings, and coordinating with all local, State, and Federal authorities for the hurricane protection project. The A-E will also be required to coordinate his effort with that of NY and Associates for the tie-in to the pumping station frontal protection system for the Phase II Engineering Alternative Report and floodproofing of the Destrehan Bridge. The limits of the project on the south side extend from T-Wall "W-1" at Baseline Sta. 62+87.87 (207.82' RT Offset) to Baseline Sta. 58+80.98 (62.36' LT. Offset) (W/L sta. 16+97.20), which includes the west side of the culvert and on the north side from Baseline Sta. 61+89.83 (219.96' LT. Offset) (W/L 15+34.70 to Baseline Sta. 58+91.59 (262.57' LT. Offset) (W/L Sta. 12+31.38). Work shall also include

raising the south and west walls of the concrete culvert. The A-E shall investigate three alternatives: T-Walls, L-Walls and a design that incorporates as much of the existing I-Wall as feasible. The A-E shall also investigate the feasibility of adding a parapet wall to the concrete culvert structure. The A-E shall use all soil data completed for the Cousins Discharge and the Harvey Sector Gate which will be government furnished. The A-E is responsible for identifying utility relocations but not for Real Estate or Environmental costs. The A-E shall obtain all rights-of-entry and work permits that may be necessary for access to or for performance of services required by this task order. The A- E shall review any existing documents pertaining to the site and shall visit the site and its immediate vicinity to evaluate existing conditions. The A- E shall determine if such conditions may affect, or be affected by the proposed construction. The A-E is not responsible for environmental costs or Real Estate acquisition.

The A-E is required to investigate means of modifying the existing structural elements to accommodate raising the permanent protection design grade to El. 14.0 NAVD 88 (2004.65). The features of construction being requiring retrofit or replacement:

1) Existing I-walls on the north side of the canal from the Destrehan Bridge to the tie-in at the new T-type closure walls, currently under construction.

2) Existing I-walls on the south and west side of the canal from the Destrehan Bridge to the float-in concrete culvert beneath Lapalco Blvd. Bridge.

3) Float-in concrete culvert

4) Tie-back walls on west side of canal from concrete culvert to tie-in at new T-walls under construction.

The professional services required of the A-E include engineering and design (E&D) for the preparation of an Engineering Alternative Report. This Engineering Alternative Report shall incorporate the various design data, investigations and information including the structural analysis and design on the project's components for the various alternatives investigated and quantity take-offs to prepare cost estimates of all viable solutions investigated.

4. DESCRIPTION OF EXISTING PROTECTION.

This report addresses the North and South bank of the Cousins pump station outfall canal for a distance of approximately 290' east of the Destrehan Ave. bridge and the west bank of that outfall canal until it ties into a newly constructed T-Wall that forms the hurricane protection system on the west side of the Harvey Canal. This area can be seen on the Survey drawing C-003. The Reaches of this area are called out on drawing C-004. The existing structures provide a level of flood protection to El, 10.5 in the project area. With the exception of the existing concrete culvert these structures are to be demolished to make way for a combination of L-Walls and T-Walls to El. 14.0. Details of the existing structures to be demolished are shown on drawing c-013 and C-014.

Most of the area on which the existing structures rest is owned by Jefferson Parish. Rights-Of-Way drawings R-001 through R-004 describe the existing rights-of-way and define the required perpetual and temporary easements required to upgrade flood protection in this area from El. 10.5 to El. 14.0.

5. DESCRIPTION OF PROPOSED ALTERNATIVES.

5. A. Type of Protection.

In this report, the following alternatives were investigated:

1) L-Walls.

If no unbalanced loading exists, L-walls may be employed where I-walls are currently constructed. Wherever possible, the existing sheet piling shall be utilized. The maximum allowable distance from the finished ground to the top of wall for an L-Wall is eight feet; therefore, only walls S-1 and N-1 were evaluated for L-walls.

A geotechnical analysis was done for L-walls at S-1 and N-1 assuming the existing sheet pile would be reused in its current location. The analysis showed unbalanced forces, so a second analysis was done moving the walls back from the top of bank until the unbalanced force was eliminated. This analysis showed that the L-walls would need to be set back 22 feet from the top of bank. Based on this, a preliminary structural design was performed for a typical 40 foot L-wall monolith.

The top of proposed L-wall is Elevation 14.0 NAVD 88, and the top of the base slab is at Elevation 3.0 NAVD 88. The overall length of Wall N-1 is 286 linear feet, and the overall length of Wall S-1 is 294 linear feet. The proposed L-wall for N-1 will consist of five 40' monoliths, one 45.55' monolith and one 58.55' monolith. The proposed L-wall for S-1 will consist of six 40' monoliths and one 54.36' monolith.

On the protected side of the L-wall, a 15-foot berm to elevation 8.0 is required. The berm is capped with eight inches of concrete slope paving. During the

construction of the L-Wall, the full berm cannot be placed until the flood side structural backfill is placed.

In order to transition to the adjacent, deeper T-wall monoliths, transition T-wall monoliths are requires. At a step down transition, the maximum difference in adjacent base slab elevations is five feet. For Wall N-1, a single T-wall transition monolith is required to tie into the Cousins Canal Closure Wall. For Wall S-1, two T-wall transition monoliths are required to tie into Wall S-3. The design of the transitions was not a part of the scope of this study, but the cost estimates for the transitions were developed using the worst case of the designed monoliths.

Each of the typical 40' monoliths is Walls N-1 and S-1 will have one row of battered piles on the protected side, with a batter of 3 vertical:1 horizontal. PZ 27 steel sheet pile will be used for cutoff and axial support on the flood side. Each monolith has five HP 14x73 to a tip elevation of -70.0 on the protected side and PZ 27 sheet pile to a tip elevation of -80.0 on the flood side. Structural calculations can be found in Appendix B, Structural Calculations and Quantity Take Offs.

2) <u>T-Walls.</u>

A T-wall alternative was evaluated for Walls N-1, S-1, S-3 and W-1. The T-wall analyses assumed the existing sheet pile in its current alignment will be reused.

<u>Walls S-1 and N-1</u>

The existing walls S-1 and N-1 are concrete capped, steel sheet pile I-walls. The top of the existing wall is Elevation 11.5, and the tip of the sheet pile is Elevation -28.0. The soil elevations for the protected and flood sides are 2.0 for Wall N-1 and 3.0 for Wall S-1.

The top of proposed T-wall is Elevation 14.0 NAVD 88, and the top of the base slab is at Elevation 3.0 NAVD 88. The overall length of Wall N-1 is 291 linear feet, and the overall length of Wall S-1 is 334.5 linear feet. The proposed T-wall for N-1 will consist of six 40' monoliths, one 26.12' monolith, and one 25.0' monolith. The proposed T-wall for S-1 will consist of seven 40' monoliths, one 34.48' monolith, and one 20' monolith.

Each of the typical 40' monoliths is Walls N-1 and S-1 will have two rows of battered piles, with a batter of 2 vertical: 1 horizontal. Each monolith has six HP 14x73 on the flood side and nine HP 14x73 on the protected side. The estimated pile tip is -64.0. The existing sheet pile will be reused with a tip elevation of -28.0. Excess sheet pile will be cut off. Structural calculations can be found in Appendix B, Structural Calculations and Quantity Take Offs.

Wall S-3

The existing wall S-3 consists of a concrete capped steel sheet pile cantilever wall. The top of the wall is at Elevation 11.5, and the tip of the sheet pile is at Elevation -71.0. The protected side soil elevation is 2.0, and the flood side soil elevation is -11.0, with a two-foot rip rap layer above the soil.

The top of the proposed Wall S-3 is Elevation 14.0, and the top of the base slab is elevation -10.0. The overall length of Wall S-3 is 195.74 linear feet. The proposed T-wall for S-3 will consist of five 31'-5 ¼" monoliths and one 38'- 6 ½" monolith. Each of the smaller monoliths has twenty HP 14x73 piles, ten each on the flood side and the protected side. The larger monolith had 12 HP 14x73 piles on the flood side and 14 HP 14x73 piles on the protected side. The estimated pile tip elevation is -99.0. The existing sheet pile will be reused. Excess sheet pile will be cut off. Structural calculations can be found in Appendix B, Structural Calculations and Quantity Take Offs.

Wall W-1

The existing wall W-1 consists of a concrete capped, steel sheet pile wall braced with steel pipe piles. The top of the wall is at Elevation 11.5, and the tip of the sheet pile is at Elevation -53.0. The protected side soil elevation is 2.0, and the flood side soil elevation is -11.0, with a two-foot rip rap layer above the soil.

The top of the proposed Wall W-1 is Elevation 14.0, and the top of the base slab is elevation -10.0. The overall length of Wall W-1 is 100.0 linear feet. The proposed T-wall for W-1 will consist of two 50' monoliths. Each of the monoliths has 28 HP 14x73 piles, fourteen each on the flood side and the protected side. The estimated pile tip elevation is -99.0. The existing sheet pile will be reused. Excess sheet pile will be cut off. Structural calculations can be found in Appendix B, Structural Calculations and Quantity Take Offs.

3) Retrofit Existing Structures.

The existing concrete culvert walls are made up of prestressed concrete panels set between cast-in-place columns. The top of the walls extend to Elevation 11.5. The top two feet of the walls consist of a solid, cast-in-place cap. The base of the culvert also used prestressed panels set between cast-in-place beams, and the invert is at Elevation -9.0. The foundation of the culvert includes 24-24" diameter steel pipe piles.

All elements of the culvert were evaluated for the increased wall height to Elevation 14.0 and the corresponding increased water load, including the foundation, the base panels and beams, the wall panels and the wall columns. The foundations, base panels and beams and the wall panels were all sufficient to support the additional loads.

The height of the culvert walls will be increased to Elevation 14.0 by the addition of 2.5 feet of concrete. The additional concrete will be anchored into the existing wall cap. The existing wall columns were not sufficient to support the additional load of water. In order to support the new loads, bracing across the culvert is required. The bracing will be made of galvanized steel piping and set at Elevation 10.50. A bracing sleeve will be anchored to each side of the culvert, and the bracing will be welded to the sleeve. Five braced are required along the length of the culvert.

Structural calculations for the culvert evaluation can be found in Appendix B, Structural Calculations and Quantity Take Offs.

4) Temporary Retaining Structures.

The T-Walls will require a Temporary Retaining Structure (TRS) to construct. A TRS was designed for Wall W-1 and applied to all T-Walls for costing purposes. Two TRS walls were analyzed. TRS Wall W-1 was assumed to be parallel to and 44 feet from the existing wall on the canal side. TRS Wall W-2 would be installed 44 feet from and parallel to the wall on the land side. Two levels of struts are necessary. Strut forces from both TRS Walls W-1 and W-2 would be supported by a system of batter and vertical piles driven on the canal side of TRS Wall W-1. Walls W-1 and W-2 will consist of PZ 27 sheet piling, with the tip of W-1 at Elevation -63.0 and the tip of Wall W-2 at Elevation -73.0. The top of the

TRS will be at Elevation 3.75. The struts will be at Elevations 1.0 and -8.0 and will be comprised of two channel sections (C15 x 33.9) each. The batter and vertical pile supports will be spaced at eight feet on center. The vertical piles will be 24" diameter steel pipe piles and will extend to Elevation -100.0. The batter piles will be HP 14x73 piles and will extend to Elevation – 78.0. Calculations for the TRS can be found in Appendix B, Structural Calculations and Quantity Take Offs.

5. B. Alignment.

North Side of the Discharge Channel:

The project consists of an I-Wall on the North side of the Cousins pump station discharge channel (Reach N-1). This wall ties into the Destrehan Ave. bridge abutment and extends approximately 290' east until it ties into an existing T-Wall, segments of which are currently under construction. The new alignment calls for tying into a proposed floodgate to be constructed across Destrehan Ave. approximately 20' north of the bridge abutment. An alignment was developed for a T-Wall that would straddle the existing I-Wall, after demolition, utilizing the old I-Wall's sheetpile in the pedestal of the new T-Wall. The new T-Wall alignment is shown on drawing C-006.

An L-Wall alignment was developed for the same area. Because of unbalanced load conditions the L-Wall could not follow the old I-Wall alignment. The L-Wall has to be set back 22' from the top of bank and contain a 15' berm to El. 8 on the protected side of the L-Wall stem. This L-Wall ties back to new newly constructed T-Wall using a T-Wall monolith. The layout and alignment of this L-Wall is shown on drawing C-007.

South Side of the Discharge Channel:

On the South side of the Cousins pump station discharge channel The project consists of an I-Wall (Reach S-1) that ties into a concrete capped sheet pile (Reach S-3) that transitions the channel through a concrete culvert, and finally a braced concrete capped sheet pile wall (Reach W-1) that ties the concrete culvert with a newly constructed T-Wall.

A T-Wall alignment was developed for this area that straddle the existing walls, after demolition, utilizing the old walls' sheetpile in the pedestal of the new T-Wall. The new alignment calls for tying into a proposed floodgate to be constructed across Destrehan Ave. approximately 20' south of the bridge abutment. This alignment is shown on drawing C-008 and C-010.

An L-Wall alignment was developed for the same area. As discussed the L-Wall has to be set back 22' from the top of the channel sloping (1V:3.5H) bank. It should be noted that Reaches S-3 and W-1 have no sloping bank but rather a vertical drop on the channel side of the sheet pile wall to the channel bottom (El. -9.0). The L-Wall can therefore only be considered for Reach S-1 application. T-Walls are used to transition the L-Wall base slab step down from El. +3.0 to the S-3 T-Wall base slab El. -10.0. This alignment is shown on drawing C-009. Reach W-1 remains unchanged. It uses the T-Wall alignment cited above and shown on drawing C-010.

Typical sections of the wall geometry are shown on drawing C-011.

6. DESIGN CRITERIA SUMMARY.

6. A. Field Data Collection.

Site Reconnaissance:

A site visit was made on 13 December 2007. Pictures of the site appear after the Photograph Orientation drawing V-001. Potential relocations are identified on the Rights-Of-Way map drawings R-001 through R-004 with disposition recommendations.

Surveys:

Existing surveys were used to develop the alternatives investigated in this report. These existing surveys consist of the use of an existing topographic survey of the area that was updated with cross, soundings, and spot elevations taken in December 2006.

Soil Borings:

New soil borings were not performed for this study. Borings drilled in 1996 and 1999 for West Jefferson Engineering Services, L.L.C., were used. Boring data were taken from two reports. The first report is entitled "Geotechnical Investigation, West Jefferson Levee District, Cousins Pumping Station to First Avenue Canal, Harvey, Louisiana," dated 7 October 1997 (Eustis Project No. 14149). The second report is entitled "Supplemental Geotechnical Investigation, West Jefferson Levee District, Cousins Pump Station to First Avenue Canal" dated 17 December 1999 (Eustis Project No. 15845).

6. B. Hydraulic Design Criteria.

Hydraulic design criteria for this project is provided by the U.S. Army Corps of Engineers. The Still Water Level = El. 11.0 NAVD88 (2004.65), and the Top of

Structure = El. 14.0. The wave load shall be taken as a point load of 4.08 kips per foot of wall acting at El. 3.41. Extreme Water Level (EWL) is at top of wall El. +14.0. Low Water Level (LWL) is El. -1.5.

6. C. Geotechnical Design Criteria.

INTRODUCTION

Geotechnical recommendations and analyses were performed to develop an engineering alternative plan for Phase 2, (100-year design storm) flood protection at the discharge of Cousins Pump Station.

For this engineering alternative study, the walls were evaluated with flood protection to el 14 (NAVD 88). For conditions with storm water at el 14 and low water at el -1.5, Spencer's Method of Analysis was used to determine if a minimum factor of safety of 1.4 (Hurricane and Storm Damage Reduction System Design Guidelines dated 23 October 2007) was achievable by converting the walls to L-walls by adding fill. In summary, analyses revealed safety factors less than 1.4. The walls were then analyzed as T-walls using the Method of Planes. The design of L-wall with a safety factor of 1.4 is discussed later.

Analyses for this study included Spencer's Method of Stability Analyses of L-walls, T-wall stability analyses using Method of Planes, sheetpile analyses, piping analyses, pile capacity estimates, horizontal subgrade moduli estimates, and lateral earth pressure estimates.

References

Computer Programs. The following computer programs were used to evaluate L-walls, T-walls, and sheet pile walls.

(1) UTEXAS4, Version 2006, Shinoak Software, Austin, Texas

(2) Analysis of Slope Stability, Method of Planes, April 1988, SSW028 (UPLIFT)

(3) Design/Analysis of Sheet Pile Walls by Classical Methods (CWALSHT), 2001

Design Criteria

The project design criteria used in the geotechnical analyses are shown in the following table.

ITEM	LOADING CONDITIONS		DESIGN FEATURE OF CONSIDERATION	FACTOR OF SAFETY
	WATER LEVEL	SHEAR STRENGTH PARAMETERS		
Pile Capacity	N/A	Q	With Load Test	2.0
	N/A	Q	Without Load Test	3.0
	N/A	Q	With Dynamic Pile Test	2.5
	N/A	S	With or Without Load Test	1.5
L-wall Stability	EWL and LWL	Q	If Unbalanced Load Exists with Spencer's Method using UTEXAS4, analyze as T-wall using UPLIFT	1.4
T-wall Stability	EWL and LWL	Q	Determine if Unbalanced Load Exists to be Supported by Cutoff Sheet pile (UPLIFT)	1.3
Cutoff Sheet pile Beneath T-wall	EWL and LWL	Q	Sheet pile Penetration and Bending Moment (CWALSHT)	1.5
	EWL and LWL	Q	Anchor Force at Base of T-wall to be Carried by Batter Piles (CWALSHT)	1.0
Temporary Retaining Structure	3.75	Q	Anchor/Strut Loads	1.0
	3.75	Q	Sheet pile Penetration and Bending Moment (CWALSHT)	1.5
	1.0	S	Sheet pile Penetration Bending Moment, and Anchor/Strut Load (CWALSHT)	1.2

EWL = Extreme Water Level; LWL = Low Water Level

The above outlined criteria were provided to Eustis Engineering Company, Inc., by the U.S. Army Corps of Engineers. Additionally, hydraulic design criteria were provided as presented in the following table. The application of factors is discussed in detail in this report.

DESIGN WATER CONDITIONS	ELEVATION (NAVD 88)
EWL (Top of Wall)	14.0
LWL (Flood Side)	-1.5

Elevation Datum

All elevations discussed in this report are NAVD 88 Datum.

SOIL BORING DATA

Referenced Soil Borings

New soil borings were not performed for this study. Borings drilled in 1996 and 1999 for West Jefferson Engineering Services, L.L.C., were used. Boring data were taken from two reports. The first report is entitled "Geotechnical Investigation, West Jefferson Levee District, Cousins Pumping Station to First Avenue Canal, Harvey, Louisiana," dated 7 October 1997 (Eustis Project No. 14149). The second report is entitled "Supplemental Geotechnical Investigation, West Jefferson Levee District, Cousins Pump Station to First Avenue Canal" dated 17 December 1999 (Eustis Project No. 15845). The borings drilled and shown in these reports along the discharge channel were used as a basis for design parameters. These borings were sampled with 5-in. diameter fixed piston samplers to approximate el -100 (NAVD 88). Copies of a site plan showing the boring locations and the boring logs are provided in Appendix I of the Appendix 13. A. Soils Report.

SUBSOIL CONDITIONS

Geology

Approximately 2 to 20 feet of fill were encountered in the referenced borings. Beneath this fill, the site is characterized by Holocene Epoch deposits that overlie Pleistocene Epoch soils. The Holocene Epoch soils consist of swamp/marsh, deltaic plain, and nearshore Gulf deposits. Subsoil profiles from the referenced reports are reproduced and provided in Appendix I of the Soils Report. The subsoil profiles delineate the various deposits.

Ground Water

The previous investigation shows ground water approximately 5 feet beneath the existing ground surface at the time of the investigation. The depth to ground water will fluctuate with changes in climatic conditions, site drainage, and other factors. For this reason, the depth to ground water should be determined by those persons responsible for construction immediately prior to beginning work.

Soil Design Parameters

The soil design parameters selected for this Engineering Alternative Plan (Phase 2) are provided on Plates 2 and 3 (Walls S-1 and N-1, and Walls S-3 and W-1), respectively. These parameters are identical to those used from these same walls in the interim report of March 2007. The graphical presentations of the parameters used from the referenced reports are reproduced in Appendix I of the Soils Report. Recall that Plate 1 shows the locations of these floodwalls in plan view.

FOUNDATION ANALYSES

Furnished Information

The project includes evaluation of the S-1, N-1, S-3, and W-1 floodwalls and determination of appropriate changes to the floodwalls to meet the criteria for Phase 2 presented in the "Introduction" section of the Soils Report. Floodwalls between the Destrehan Avenue Bridge and the Harvey Canal (N-1 and S-1) are currently I-walls that are being upgraded to interim protection. Going south from the east-west discharge channel to the Lapalco Boulevard Bridge, Wall S-3 is a cantilevered wall also being upgraded to interim protection. A braced sheet pile wall (W-1) extends south of the Lapalco Boulevard Bridge on the west bank of the Harvey Canal. This wall is also currently being upgraded to interim protection. Interim protection primarily includes erosion protection on the protected side of these walls and over excavating at Wall S-3 on the protected side of the wall to improve the factor of safety for low water conditions.

Geotechnical engineering analyses were performed to determine which walls among S-1, N-1, S-3, and W-1 fulfill the design requirements for Phase 2 protection. Copies of the engineering calculations are provided in Appendix II of the Soils Report.

Lateral Earth Pressures

At-Rest Pressures. Lateral pressures on buried structures should be determined using at-rest lateral earth pressure coefficients. The lateral earth pressure coefficients for various materials are shown in the following table.

LATERAL	AT-REST LATERAL EARTH PRESSURE COEFFICIENT (K_o)
In Situ Clay or Clay Fill Soils	0.80
Select Structural Fill	0.55

Active and Passive Pressures. Methodology to determine active and passive pressures of in situ soils and granular backfill is described in this section. Recommended values for undrained shear strength and effective unit weights are shown below for in situ soils. Recommended values are also provided for both sand and clay backfill.

P_A = ('HK_A - $2S_U/K_A$

P_P = ('HK_P + $2S_U/K_P$

Where:

P_A = Active Pressure in psf.

P_P = Passive Pressure in psf.

S_U = Undrained Shear Strength (short term), For in situ clay soils, use: 200 psf. For clay fill soils, use 500 psf. For select fill and long term (drained) analyses, undrained shear strength = 0 psf.

(' = Effective Unit Weight, For in situ clay soils, use: 90 pcf above the water table and 27.5 pcf beneath the water table to el -10. For clay fill soils, use: 110 pcf above the water table and 48 pcf below the water table. For select backfill, use: 120 pcf above the water table and 58 pcf below the water table.

K_A = Active Pressure Coefficient.

K_P = Passive Pressure Coefficient.

H = Depth Below the Ground Surface in Feet.

MATERIAL	ACTIVE PRESSURE COEFFICIENT (K_A)		PASSIVE PRESSURE COEFFICIENT (K_P)	
	LONG TERM	SHORT TERM	LONG TERM	SHORT TERM
Select Structural Fill	0.33	0.33	3.00	3.00

In Situ Clay Soils and Clay Fill	0.44	1.00	2.28	1.00

Stability Analyses of the Floodwalls

L-wall Evaluation. Walls S-1, N-1, S-3, and W-1 were analyzed at EWL and LWL water levels using the Spencer's Method of Analysis. Various fill types were considered including lightweight fill in order to achieve a factor of safety of at least 1.4 with no unbalanced loads by the Spencer's Method. Unbalanced loads were required to achieve this target safety factor, thus eliminating L-walls along the existing flood protection alignment and requiring T-walls. Note that the analyses for Walls N-1 and S-1 show minimal unbalanced load. Considering the intent is to build the base top of the concrete wall at S-1 and N-1 near existing grade regardless of what it will be, L-wall or T-wall, the additional costs of a T-wall will likely not be significant. Various configurations were considered using the Spencer's Method. Calculations are provided in Appendix II of the Soils Report.

T-wall Evaluation. Considering an EWL of el 14 and an LWL of el -1.5, deep seated stability analyses were performed for T-walls S-1, N-1, S-3, and W-1. The stability analyses utilized the Lower Mississippi Valley Division (LMVD) Method of Planes Stability with UPLIFT computer program. Results of T-wall analyses are shown on Plates 4 through 9 of the Soils Report. Using the LMVD Method, our analyses incorporated shear strengths factored by 1.3 in order to determine any unbalanced soil forces when evaluating T-walls. Unbalanced soil forces were computed by summing all horizontal driving forces minus the resisting forces, and minus the free water horizontal force.

All T-wall analyses were performed using the methodologies outlined in the 20 April 2006 criteria for T-walls provided by the USACE, New Orleans District. R_b (i.e., base shear) was ignored along the central block for the width of the base slab for the slip surface underlying the T-wall base. This assumption considers

that settlement may occur below the base slab, and contact between the base and the underlying soil may not exist. Water on the flood side of the wall was assumed to be sea water with a unit weight of 64 pcf under storm conditions. Fresh water with a unit of weight of 62.5 pcf was assumed within the canal during low water conditions.

Piping Analyses

Piping potential was evaluated using the Lane's Weighted Creep Ratio (LWCR) method for the T-walls. The sheetpiles primarily penetrate clay. Sheetpile tip penetrations provide a minimum LWCR greater than 3, which is considered suitable in clay. Horizontal contacts were neglected.

Pile Foundations

Axial Capacity. Computations were made to determine the estimated allowable single pile load capacities for 12, 14, and 16-in. square, prestressed, precast concrete piles, and 12 and 14-in. steel H-Piles. The pile capacities were computed for Q-case and S-case soil parameters.

The allowable pile load capacities are provided on Plates 10 through 17 of the Soils Report. Q-case analyses are presented on Plates 10, 11, 14, and 15; and S-case analyses are summarized on Plates 12, 13, 16, and 17. The Q-case governs the design. The pile capacities provided should be reduced by 33% (67% of indicated capacities) if a static pile load test is not performed (i.e., safety factor equal to 3.0), and 20% (80% of indicated capacities) if a dynamic pile test is performed (i.e., safety factor equal to 2.5). All Q and S-case computations were made considering a static pile load test will be performed and include factors of safety of 2 and 1.5, respectively, against failure of a single pile. Where batter piles are supporting the unbalanced "anchor" load of the cutoff sheetpile for T-walls, the axial capacity above the pressure crossover level of the sheetpile must be ignored. The crossover level is indicated in the notes of the T-wall

stability plates. A method to determine allowable pile load capacity where a reduction is required, due to the presence of unbalanced loads, is shown on Plate 18.

Pile Group Capacity and Spacing. Piles will derive a majority of their supporting capacity from skin friction. Therefore, it will be necessary to consider the effect of group action. In this regard, the supporting value of the piles driven in groups should be investigated on the basis of group perimeter shear by the formula shown on Plate 19 of the Soils Report. The minimum spacing between piles should be evaluated using the second formula shown on Plate 19.

Lateral Loads. Horizontal and axial components of batter piles should be determined from geometry using the formula shown on Plate 20 of the Soils Report. The modulus of horizontal subgrade reaction (K_h) necessary for evaluating lateral support of batter piles of Walls S-1 and N-1, and S-3 and W-1 should be estimated using the tables presented on Plates 21 and 22, respectively.

Pile Driving

Close field supervision should be maintained by experienced personnel to ensure proper procedures are followed and accurate records are kept during all pile driving operations. The driving record should include the pile type, overall length, tip and butt diameters or side dimensions, embedment below finished grade, and number of blows per foot of penetration. An accurate driving record is especially important to verify all piles are installed to the required tip embedment and to give an indication of any unusual driving characteristics which may indicate pile breakage.

Square precast concrete piles and steel H-Piles should be driven with a single acting air hammer delivering a manufacturer's rated energy of at least 24,000 ft-lbs per blow.

Test Piles

Test piles should be installed along the project site of the four walls. The number and location of the test piles will depend on the type and location of the selected piles. The test pile program will be developed once the project features are finalized.

Static Pile Load Tests

At least one static pile load test should be performed on piles considered for the project. The number of load tests will depend on the selected pile types and depths and should be provided during preparation of the plans and specifications. In general, load tests should be performed in compression in accordance with ASTM D 1143. Project specifications should require load tests to failure or 300% of design load, whichever is achieved first. Static load tests should be performed no earlier than 21 days after initial pile installation.

Dynamic Pile Tests

As a minimum, precast concrete test piles should be monitored and evaluated by a DPT using a Pile Driving Analyzer® during the pile's installation. The PDA will monitor driving stresses during installation and evaluate pile integrity during installation. The PDA will also evaluate installation efficiency by monitoring the energy transferred to the pile by the hammer.

In lieu of static load tests, consideration can be given to performing DPT to evaluate capacity of steel H-Piles and precast concrete piles. If this is the case, the pile should be evaluated by restrike DPT and subsequent CAPWAP®

analyses. The restrikes should be performed no earlier than 21 days after initial installation.

Preconstruction and Monitoring Considerations

Surveys of Existing Conditions. The existing conditions of the surrounding structures at the project site should be assessed. This study should include any residences and business structures within a 500-ft distance of the construction site. The assessment should consist of videotaped surveys of the inside and outside of the structures and should be made by a registered professional engineer.

Vibrations

Installation of piles may affect nearby structures. Vibrations should be monitored during the test pile program and during installation of job piles. The monitoring should be performed with a seismograph to evaluate peak particle velocities and frequency at critical structures during pile driving. The record of peak particle velocities will provide information in assessing potential damage and the need for changes in driving operations.

Temporary Retaining Structures

The scope of work included preliminary design of a temporary retaining structure (TRS) for construction of a T-wall at Wall W-1. A sketch of the assumed TRS wall locations and steps in their installation are shown on Plate 23 of the Soils Report and on Drawing C-014A of this report. Two TRS walls were analyzed. Wall W-1 was assumed to be parallel to and 44 feet from the existing wall on the canal side. TRS Wall W-2 would be installed 44 feet from and parallel to the wall on the land side. We have assumed that two levels of struts will be necessary. Strut forces from both TRS Walls W-1 and W-2 would be supported by a system of batter and vertical piles driven on the canal side of TRS Wall W-1. The TRS analyses were performed using the CWALSHT program and following criteria

provided in this report. The high water level was assumed to be el 3.75 (high tide). A temporary levee west of the Harvey Canal would be used to protect adjacent areas from higher flood waters.

Pressure Relief

The silt/sand stratum from el -17 to el -32 at walls W-1 and S-3 will require pressure relief. The piezometric surface should be maintained 2 to 5 feet below the excavation base.

Considering this stratum should be cut off by the TRS sheet piles, recharge of this stratum will be primarily through the sheet pile interlocks. Modest pumping should be required to maintain the necessary piezometric surface. At least two piezometers in the excavation away from pump withdrawal should be in place to monitor the piezometric surface.

Heave

Calculations for heave potential show the sand below el -73 will not require pressure relief. Assuming a piezometric surface of el 0 in the sand, the factor of safety against heave considering total vertical stresses for an excavation to el -15 is 1.38 which is considered adequate (i.e., greater than 1.20).

L-Wall

The L-Wall was revisited and analyzed / designed to eliminate unbalanced load condition without the constraint of locating it along the existing flood protection alignment. The L-wall was analyzed using Spencer's Method and computer program SLOPE/W 2004. Results of the analyses are presented in the Appendix 13. A. Soils Report. To maintain at least a minimum factor of safety (FS) of 1.4 without unbalanced loads, the analyses show the L-Wall base slab would need to be relocated toward the protected side, approximately 22' from the break in the 1V:3.5H canal slope (top of bank) at El. 3. In addition, a stability berm at El. 8 on

the protected side must extend 18' from the flood side edge of the base slab. A slope of 1V:3H was assumed for the slope of the berm back to existing grade near El. 3. The fill of the stability berm was assumed to consist of clay with cohesion of 400 psf. The clay fill was also assumed covered with an 8" concrete scour protection pavement.

The Interim Hurricane and Storm Damage Reduction System Design Guidelines, dated October 2007, requires penetration of the L-Wall cutoff wall (sheet pile) to be at least to a depth that the penetration of the sheet pile is three times the wall height. For Walls N-1 and S-1, that requires a minimum penetration of El. -33. This tip penetration will provide a minimum Lane's Weighted Creep Ratio of 3.5 with Storm water at El. 14. This is considered acceptable.

If the walls are to be constructed as L-Walls, the sheet pile will carry axial load. The Q-case allowable axial compression and tension capacities for the sheet pile were computed and are included in the Soils Report. A FS = 3.5 has been incorporated into the curves as required by the referenced Interim Guidelines for sheet pile installed by vibratory methods. In addition, the adhesion/friction of the top 10' of the sheet pile has been ignored on the flood side as required by the Guidelines.

The stability berm will induce stresses in the subgrade and induce settlement. The fill above the L-Wall foundation will be supported by the L-Wall. The fill beyond the L-Wall foundation will settle as consolidation in the subsurface clays and organic soils occurs due to the fill load. The potential settlement was analyzed. The ultimate settlement is estimated to be 8.5 to 10 inches for the berm. The settlement will occur to approximately El. -22. Because of the relative shallow depth of ground settlement, there should be minimal negative impact regarding potential downdrag on batter piles supporting the L-Wall provided the

batter piles are at least driven to El. -66. If the tips of the batter piles are shallower than El. -66, potential downdrag should be evaluated.

The fill settlement away from the L-Wall foundation will be differential with respect to the structure area which will likely induce cracking and distress in the slope pavement. A time-rate of settlement evaluation shows approximately 70% of the settlement will occur in one year and 90% in two years. To minimize the potential differential settlement after construction, consideration should be given to preloading the alignment of the proposed berm with a compacted clay embankment. Most of the embankment could be left in place when the L-Wall is constructed.

6. D. Structural Design Criteria

The permanent and temporary features of the various alternatives shall be designed in accordance with applicable portions of COE engineering manuals for civil works construction and applicable portions of industry codes referenced below. All designs shall be based on established engineering practices, incorporating advanced technology when it has been demonstrated that such technology gives safe and efficient designs.

6.D.1. Corps of Engineers Design Criteria.

EM 385-1-1	Safety and Health Requirements Manual, ENG Form 5044-R (Nov. 03)
EM 1110-2-2000	Standard Practice for Concrete for Civil Works Structures, Change 2 (Mar 01), (Feb 94)
EM 1110-2-2007	Structural Design of Concrete Lined Flood Control Channels (Apr 95)

EM 1110-2-2100	Stability Analysis of Concrete Hydraulic Structures (Dec 05)
EM 1110-2-2102	Waterstops and Other Preformed Joint Materials for Civil Works Structures (Sep 95)
EM 1110-2-2104	Strength Design for Reinforced Concrete Hydraulic Structures (Jan 92, Aug 03)
EM 1110-2-2105	Design of Hydraulic Steel Structures, Change 1 (May 94)
EM 1110-2-2502	Retaining and Flood Walls (Sep 89)
EM 1110-2-2503	Design of Sheet Pile Cellular Structures Cofferdams & Retaining Structures (Sep 89)
EM 1110-2-2504	Design of Sheet Pile Walls (Mar 94)
EM 1110-2-2701	Vertical Lift Gates (Nov 97)
EM 1110-2-2705	Structural Design of Closure Structures for Local Flood Protection Projects (Mar 94)
EM 1110-2-2902	Conduits, Culverts and Pipes, Changes 1-3 (Oct 97)
EM 1110-2-2906	Design of Pile Foundations (Jan 91)
EM 1110-2-322	Retaining and Flood Walls (Oct 90)

6.D.2 American Concrete Institute (ACI).

ACI 318	Building Code Requirements for Structural Concrete

6.D.3 American Institute of Steel Construction (AISC)

Allowable Stress Design Manual of Steel Construction

6.D.4 Steel Sheet Pile

Steel sheet pile stress shall be limited to 0.5Fy except for unusual or extreme cases where an overstress will be permitted. The sheet pile shall have a minimum thickness of 0.335 inches.

6.D.5 Miscellaneous Design Criteria

Cast-in-place concrete design strength shall be 4,000 psi. Prestressed concrete design strength shall be a minimum of 5,000 psi.

Computer programs provided by the Corps of Engineers include the following:

CWALSHT	WES Program No. X0031
Pile Group Analysis (CPGA)	WES Program X0080
Pile Group Graphics Display (CPGG)	WES Program No. X0081
C-Frame	WES Program No. X0030
A Three Dimensional Stability Analysis Design Program (3DSAD)	WES Program No. X8100

6. E. Borrow Requirements.

Clay fill required for L-Wall beam construction shall be Contractor furnished borrow from a Government approved pit. 1,310 cubic yards of in place compacted fill are required for the L-Wall alternative in Reach N-1. 1,350 cubic yards of in place compacted fill are required for the L-Wall alternative in Reach S-1 for a total in place required fill of 2,660 cubic yards (provided the L-Wall alternative is constructed in both N-1 and S-1).

7. REAL ESTATE.

Right-Of-Way (ROW) maps R-001 and R-002 define the real estate requirements for the T-Wall alternative. ROW maps R-003 and R-004 define the real estate requirements for t3e L-Wall alternative. These maps define the Perpetual Flood Protection Easement, Perpetual Underground Piling Easement, Temporary Work Area Easement, and Temporary Lay Down Area Easement. The maps also define the Levee Board and / or U.S. Government ROW. Acreages, offsets from the baseline and (X, Y) coordinates are given for each area. Also included on the ROW maps are the locations of existing facilities and the disposition of each

facility as affected by the T-Wall & L-Wall alternative. Contact points with phone numbers and addresses are provided for the various utilities.

Real Estate costs are not a part of the scope of Burk-Kleinpeter, Inc. in preparing this Engineering Alternative Report. The cost for additional Perpetual Flood Protection Easement and easements will have to be added to the selected plan to determine its complete cost. It should be pointed out that most of the non-Levee Board / U.S. Government required area belong to Jefferson Parish. Only the area North of the 80 Arpent Line, East of Destrehan Avenue belongs to Petrex (industrial yard).

8. RELOCATIONS.

The 2 alternative floodwall types of protection evaluated by this report consist of an all T-Wall Alternative and an L-Wall / T-Wall alternative. Included with each of these alternatives is the enlargement of the existing concrete culvert parapet wall to Elevation +14. The enlargement of this parapet wall does not impact existing utilities or facilities. The footprint of each of the two alternatives has differing impact to the existing facilities in the area. This is shown in plan view on the Rights-Of-Way drawings R-001 (T-Wall alternative) and R003 (L-Wall / T-Wall alternative. The ownership and disposition of all existing facilities is defined on drawings R-002 (T-Wall alternative) and R-004 (L-Wall / T-Wall alternative).

There are 2 – 36" water lines that cross Reach W-1. Two alternatives were designed and priced for passing the new El. 14 T-Wall across these lines:

1) Raising the lines over the new T-Wall;
2) passing the lines through the new T-Wall and eventually through the T-Wall on the opposite side of the pump station discharge channel when it is raised to El. 14.

It was found that raising the pipelines saves almost $51,300 as compared to passing the lines through the floodwall. Details of cost evaluation of the alternatives are presented later in this section.

Both L- and T-Wall alternatives impact the Petrex industrial complex located adjacent to Reach N-1. Because the L-Wall alignment is set back from the edge of the discharge channel whereas the T-Wall is located at top of bank, the L-Wall alternative significantly impacts more of the Petrex complex. This is reflected in the table of relocation costs presented below.

On the South side of the pump station discharge canal are 2 – 16" high pressure gas pipelines. These lines have been directionally drilled under the Harvey Canal. The Koch-Gateway 16" high pressure pipeline is the line closest to the South bank of the discharge channel. It parallels the channel through the S-1 reach. The T-Wall alignment is located at the top of bank of the discharge channel and on the channel side of the pipeline. The L-Wall is set back 22' from the channel bank and has a 30' berm associated with its design on the protected side. The L-Wall section falls over the 16" Koch-Gateway pipeline. With the L-Wall alternative it will be necessary to relocate the Koch-Gateway line because of the S-1 L-Wall alignment. In the next paragraph you will note that the line will have to be relocated in Reach S-3 because of conflicts with the T-Wall batter piles.

Both lines pass under the segment of Reach S-3 which calls for a T-Wall with batter pile tip El. -99 for both the T- and L-Wall alignments. Permit drawings show the Koch Gateway pipeline to be at El. -80 in this area. The pipeline will have to be relocated. The Louisiana Gas pipeline permit drawings show that line to be at E. -90 as it passes under Reach S-3. It will have to be relocated also. Since these lines are directionally drilled under the Harvey Canal they would

have to be abandoned and new directional drilled pipelines installed. The cost of this relocation is estimated to be $2.5 Million for each pipeline.

The relocation cost for the T-Wall and L-Wall alternatives are summarized in the following table. The Item No. represents the same numbering system presented in plan view and in table form on Right-Of-Way drawings R-001 through R-004.

RELOCATION COST FOR THE T-WALL AND L-WALL ALTERNATIVES

Item No.	Description	Cost	
		T-Wall Alignment	L-Wall Alignment
Reach N-1			
E-3	Power Line	$10,000	$10,000
E-5	Underground Power Cables	$50,000	$50,000
PP-8	Power Pole	$5,800	$5,800
PP-9	Power Pole	$3,300	$3,300
C-2	Petrex-slabs, piling, piping, etc.	$75,000	$150,000
C-2	Petrex-Compressor Bldg.	-	$200,000
Subtotal		$144,100	$419,100
Reach S-1			
E-4	Power Line	-	$5,000
PP-3	Power Pole	-	$5,800
PP-4	Power Pole	$5,800	$5,800
PP-5	Power Pole	-	$3.300
G-2	Koch 16" H.P. Gas Line	-	$2,500,000
Subtotal		$5,800	$2,519,900
Reach S-3			
G-1	Louisiana Gas 16" H.P. Gas Ln	$2,500,000	$2,500,000
G-2	Koch 16" H.P. Gas Line	$2,500,000	Already Relocated in Reach S-1
Subtotal		$5,000,000	$2,500,000
Concrete Culvert None			
Reach W-1			
W-6	2 – 36" Water Lines	$147,600	$147,600
TOTAL		$5,297,500	$5,586,600

36" WATERLINE RELOCATION ESTIMATED CONSTRUCTION COST

RAISE WATERLINE

The two 36" diameter waterline crossings over the Cousins Pump Station discharge basin floodwall complex. The layout of these lines is shown on drawings M-001 and M-002. The 2 36" waterlines shall be raised from Centerline-Of-Pipe elevation 14 to elevation 16.5 to facilitate the elevation of the discharge flood walls from elevation 11 (Current Elevation) to elevation 14. When the new T-wall is built on the west side of the discharge canal it will displace the existing upper concrete pipe support. Relocating this support to the protected side of the T-wall will require the lower pipe support, support spool piece, elbow and flexible connectors to be relocated. If the new upper support is placed in the discharge channel, the pipe can free span across the T-wall and be supported by the existing buried lower pile bent. This will prevent the need for modification of any buried piping. A two and one-half foot flanged spool piece will be added to the 36" diameter vertical pipe, the 36 inch 90 degree elbow will be relocated and the pipe will be re-supported by one new reinforced concrete pile bent and three fabricated steel extension saddles on the remaining pile supports. This pipe relocation will also be performed on the second water line. Layout and details of the raised waterline alternative are shown on drawings m-003 and M-004.

CONSTRUCTION COST – ELEVATION OF TWO PIPELINES

Reinforced Concrete	6 cy @ 600.00	$3,600.00
16" Concrete Piles 4 @ 80' Long	320 LF @ 50.00	$16,000.00
Fab. Steel Support Ext.	6 EA @ 5,000.00	$30,000.00
36" Steel Pipe	10 LF @ 750.00	$7,500.00
36" Steel Flanges	4 @ 3,000.00	$12,000.00
Remove and Replace Pipe	2 @ 4,000.00	$8,000.00
Marine Crane	1 LS @ 50,000.00	$50,000.00
Bent Demolition	2 @ 1,500.00	$3,000.00
Pressure Test / Sanitizing	2 @ 2,500.00	$5,000.00
Mobilization	1 LS @ 12,500.00	$12,500.00
Total		$147,600.00

PASSING THE WATERLINES THROUGH THE FLOODWALL

The through the new T-Wall plan calls for the modifications to the two (2) 36 inch diameter waterline crossing on the Harvey Canal to incorporate the crossing at the current elevations into the proposed T-Wall construction. This estimate will be broken out into two costs, one for the Westbank work and one for the future Eastbank work.

WEST SIDE PROPOSAL

Remove existing piping approximately 4'-3" east of the centerline of proposed floodwall. Cut existing pipe and prepare for expansion coupling. Remove piping through buried 90 degree elbow on west side of floodwall. Place cofferdam and drive piling for T-Wall. Drive piles for proposed concrete pipe support on East Side of floodwall pour T-Wall and block out for piping. Pour concrete pile bent. Replace existing 36" buried elbow, vertical piping and elevation 14 above ground elbow. Install two (2) 36" expansion couplings on proposed 10 LF of replaced

piping. Regrout block out between T-Wall block out and pipe annular ring. Repeat for 2nd monolith and pipe crossing.

OPINION OF PROBABLE COST (TWO PIPELINES WEST SIDE)

36" O.D. x 3/8" Wall Pipe	20 LF @ $750.00	$15,000.00
36" Dresser Style 38 Couplings	4 EA @ $9,000.00	$36,000.00
Cutting Exist 36" Pipe	4 Cuts @ $2,000.00	$8,000.00
¾" Annular Ring	2 EA @ $1,500.00	$3,000.00
Sheeting to Excavate Two 36" Risers	2 EA @ $1,500.00	$3,000.00
Remove and Replace Piping	70 LF @ $200.00	$14,000.00
4" Gate Valve	2 EA @ $1,000.00	$2,000.00
4" Connection Piping	2 EA @ $350.00	$700.00
Miscellaneous Metals	1,350 LB @ $4.50	$6,075.00
16" SQ Concrete Piles	300 LF @ $50.00	$15,000.00
Reinforced Concrete Pile Bents	8 CY @ $500.00	$4,000.00
Pressure Testing & Chlorination	2 EA @ $1,500.00	$3,000.00
TOTAL		$109,775.00

EAST SIDE PROPOSAL

The west side work described above shall be repeated in the future for modification to the pipe and wall on the east side of the pump discharge channel. The work will be identical to the west side work except the 36" riser on each T-Wall crossing can remain in place, no pipe guard is required and the air released piping is not required. This work shall be repeated for each of the two aerial pipeline crossings. Layout and details of the through the wall alternative are shown on drawings R-005 and R-006. The through the wall option is shown in profile view on drawing C-010.

OPINION OF PROBABLE COST (TWO PIPELINES EAST SIDE (FUTURE)

36" O.D. x 3/8" Wall Pipe	20 LF @ $750.00	$15,000.00
36" Dresser Style 38 Couplings	4 EA @ $9,000.00	$36,000.00
Cutting Exist 36" Pipe	4 Cuts @ $2,000.00	$8,000.00
¾" Annular Ring	2 EA @ $1,500.00	$3,000.00
Remove and Replace Piping	20 LF @ $200.00	$4,000.00
Miscellaneous Metals	250 LB @ $4.50	$1,125.00
16" SQ Concrete Piles	300 LF @ $50.00	$15,000.00
Reinforced Concrete Pile Bents	8 CY @ $500.00	$4,000.00
Pressure Testing and Chlorination	2 EA @ $1,500.00	$3,000.00
TOTAL		$89,125.00

The total cost to Pass the 2 – 36" water lines through the T-Wall on the West Side and East side of the pump station discharge channel is $198,900.

RECOMMENDED RELOCATION PLAN FOR THE 2 – 36" WATER LINES:
Raising the 2 – 36" water lines over the El. 14 floodwalls on both the West side and East side of the pump station discharge channel is $147,600. This is a $51,300 savings over the through the floodwall alternative. Based on cost savings of almost $51,300, the over the wall relocation plan is recommended.

9. COST ENGINEERING.

Quantity calculations and preliminary cost estimates were prepared for each of the alternatives on this report. For cost estimating purposes, the north side and the south side of the project were broken into separate estimates. The north side includes Wall N-1, and two estimates were prepared for the north side. Estimate 1 is for the T-wall replacement of Wall N-1, and the total is $4,000,000. Estimate

2 is for the L-Wall replacement of Wall N-1, and the total is $3,100,000. The south side includes Walls S-1, S-3 and W-1, and the concrete culvert. Estimate 3 is for the T-wall replacement of S-1, S-3, W-1 and for the parapet walls for the culvert, and the total is $15,850,000. Estimate 4 includes the L-Wall replacement for S-1, the T-wall replacement for S-3 and W-1, and the parapet walls for the culvert. The total for Estimate 4 is $14,700,000.

The cost estimates do not include right-of-way costs. A summary of Estimates 1 through 4 follows. Quantity calculations can be found in Appendix B, Structural Calculations and Quantity Take Offs.

Preliminary construction duration was calculated using the following assumptions:

1) Because of the short time frame for construction, it is assumed that two sections of the wall will be worked on at a time. Walls S-1 and S-3 will be constructed concurrently with Walls N-1 and W-1.
2) The culvert work will be concurrent with the wall construction.
3) Relocations will be completed prior to the construction contract being awarded.

Using these assumptions, the estimated contract duration for this project is 11 months. Duration calculations can be found in Appendix B, Structural Calculations and Quantity Take Offs.

Reach N-1 T-Wall Alternative - Estimate of Probable Cost

Construct 291' of T-Wall

Description	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$550,000	$290,000
Truck Wash-Down Rack	EA	1	$75,000	$75,000
Reinforced Concrete (Base Slab)	CY	518	$425	$220,150
Reinforced Concrete (Stem)	CY	316	$600	$189,600
Stabilization Slab Concrete	CY	43	$440	$18,920
Cut Existing Sheetpile and Demolish Concrete I-Wall	LF	273	$450	$122,850
HP 14x73 Steel Piles	LF	7,983	$81	$646,623
Structural Backfill	CY	621	$63	$391,123
Riprap	Tons	650	$40	$26,000
Seeding, Fertilizing, & Mulching	Acre	0.21	$3,500	$735
Temporary Retaining Structures	LS	1	$891,000	$891,000
Dewatering	LS	1	$200,000	$200,000
Silt Fence	LF	470	$1.70	$799
Relocations	LS	1	$144,100	$144,100
Subtotal				$3,216,900
25% Contingencies				$804,225

Total				$4,021,125
Rounded TOTAL				**$4,000,000**

Reach N-1 L-Wall Alternative - Estimate of Probable Cost

Construct 286' of L-Wall & 19' of T-Wall

Description	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$550,000	$225,000
Truck Wash-Down Rack	EA	1	$75,000	$75,000
Cut Existing Sheetpile and Demolish Concrete I-Wall	LF	273	$450	$122,850
Reinforced Concrete (Base Slab)	CY	480	$425	$204,000
Reinforced Concrete (Stem)	CY	385	$600	$231,000
Stabilization Slab Concrete	CY	41	$440	$18,040
Steel Sheetpile Type PZ 27	SF	23,452	$29	$680,108
Steel Sheetpile Type PZ 22	SF	817	$27	$22,059
HP 14x73 Steel Piles	LF	3594	$81	$291,114
Structural Backfill	CY	610	$63	$38,430
Compacted Fill	CY	1,310	$28	$36,680
Reinforced 8" Scour Protection	CY	233	$572	$133,276

Seeding, Fertilizing, & Mulching	Acre	0.23	$3,500	$805
Silt Fence	LF	470	$1.70	$799
Relocations	LS	1	$419,100	$419,100
Subtotal				$2,498,261
25% Contingencies				$624,565
Total				$3,122,826
Rounded TOTAL				**$3,100,000**

Reaches S-1 & S-3 T-Wall Alternative & W-1 & Concrete Culvert Parapet Walls – Estimate of Probable Cost

Reach S-1 Construct 254.5' of T-Wall (top of slab El. +3.0)
40' of T-Wall (top of slab El. -1.0)
40' of T-Wall (top of slab El. -5.5)

Reach S-3 Construct 196' of T-Wall (top of slab El. -10.0)

Reach W-1 Construct 100' of T-Wall (top of slab El. -10.0)

Concrete Culvert Parapet Walls Construct 110.87'

Description	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$1,000,000	$1,000,000
Truck Wash-Down Rack	EA	1	$75,000	$75,000
Reinforced Concrete (Base Slab)	CY	1519	$425	$645,575
Reinforced Concrete (Stem)	CY	1197	$600	$718,200
Stabilization Slab	CY	127	$440	$55,880

Concrete				
Cut Existing Sheetpile and Demolish Existing Walls	LF	630	$450	$283,500
HP 14x73 Steel Piles	LF	26,047	$81	$2,109,807
Structural Backfill	CY	3317	$63	$208,971
Riprap	Tons	1,205	$40	$48,200
Seeding, Fertilizing, & Mulching	Acre	0.48	$3,500	$1,680
Temporary Retaining Structures	LS	1	$1,842,000	$1,842,000
Dewatering	LS	1	$400,000	$400,000
Concrete Culvert Parapet Walls	CY	41	$600	$24,600
Steel Bracing for Culvert	LB	26,370	$4.00	$105,480
Silt Fence	LF	750	$1.70	$1,275
Relocations	LS	1	$5,153,400	$5,153,400
Subtotal				$12,735,568
25% Contingencies				$3,168,392
Total				$15,841,960
Rounded TOTAL				**$15, 850,000**

Reaches S-1 & S-3 L-Wall Alternative & W-1 & Concrete - Estimate of Probable Cost

Culvert Parapet Walls

Reach S-1 Construct 294' of L-Wall (top of slab El. +3.0)

40' of T-Wall (top of slab El. -1.0)

40' of T-Wall (top of slab El. -5.5)

Reach S-3 Construct 135' of T-Wall (top of slab El. -10.0)

Reach W-1 Construct 100' of T-Wall (top of slab El. -10.0)

Concrete Culvert Parapet Walls Construct 110.87'

Description	Unit	Quantity	Unit Cost	Total Cost
Mobilization	LS	1	$1,000,000	$1,000,000
Truck Wash-Down Rack	EA	1	$75,000	$75,000
Reinforced Concrete (Base Slab)	CY	1322	$425	$561,850
Reinforced Concrete (Stem)	CY	1093	$600	$655,800
Stabilization Slab Concrete	CY	110	$440	$48,400
Cut Existing Sheetpile and Remove Existing Walls	LF	609	$450	$274,050
HP 14x73 Steel Piles	LF	18,598	$81	$1,506,438
Steel Sheetpile Type PZ27	SF	23,814	$29	$690,606
Steel Sheetpile Type PZ22	SF	3440	$27	$92,880
Structural Backfill	CY	2694	$63	$169,722
Riprap	Tons	565	$40	$22,600

Compacted Fill	CY	1,350	$28	$37,800
Reinforced 8" Scour Protection	CY	240	$572	$137,280
Seeding, Fertilizing, & Mulching	Acre	0.55	$3,500	$1,925
Temporary Retaining Structures	LS	1	$920,250	$920,250
Dewatering	LS	1	$275,000	$275,000
Concrete Culvert Parapet Walls	CY	41	$600	$24,600
Steel Bracing for Culvert	LB	26,370	$4.00	$105,480
Silt Fence	LF	750	$1.70	$1,275
Relocations	LS	1	$5,167,500	$5,167,500
Subtotal				$11,768,456
25% Contingencies				$2,942,114
Total				$14,710,570
Rounded TOTAL				**$14,700,000**

10. QUALITY IMPLEMENTATION.

The signed copy of Burk-Kleinpeter, Inc.'s Design Quality Control Plan appears in Appendix D.

11. RECOMMENDATIONS.

The project area is divided into two separate independent areas for the purposes of pursuing recommended alternatives for raising the flood protection to the 100-year project grade of El. 14, the area North of the discharge channel and the area South of the discharge channel. The L-Wall alternative has been shown to be less expensive than the pure T-Wall alternative for both North and South areas. On the North side the L-Wall plan is estimated to cost $3.1 Million. The T-Wall plan is estimated to cost $4.0 Million. On the South side of the discharge channel the L-Wall plan is estimated to cost $14.7 Million as apposed to the T-Wall plan estimated at $15.85 Million.

South of the Discharge Canal (Reach N-1):

Before going with the $900,000 savings of the L-Wall in this area one must assess the issues of taking a large corridor through the industrial yard of Petrex. The rights-of-way costs must be added to the L-Wall cost thereby diminishing the $900,000 difference in the plans. More importantly environmental issues need to be investigated. The site must be surveyed for possible contamination prior to proceeding with the L-Wall alternative. The T-Wall plan is located on properties owned by Jefferson Parish. Petrex property would not have to be purchased as perpetual flood protection easement.

North of the Discharge Canal (Reaches S-1, S-3, W-1 & the Concrete Culvert):

The L-Wall plan is estimated to cost $14.7 Million as apposed to the T-Wall plan estimate of $15.85 Million. Selection of the L-Wall plan has a potential for saving the project $1.15 Million. This is a relative small savings (7.3 %). The L-Wall as designed is dependent on the presence of an earthen berm on its protected side that has to be protected by the concrete slope pavement scour protection should the wall be overtopped by a storm surge. The T-Wall is more of a stand alone

design that will not be compromised during an overtopping scenario. If the Corps of Engineers determines that the L-Wall can afford the same degree of dependability during an overtopping scenario then the L-Wall plan should be pursued in Reach S-1 on the North side of discharge canal.

12. OPERATION AND MAINTENANCE.

The recommended alternative or plan calls for the construction of a combination of L-Walls, T-Walls and extension with cross bracing to the top of the concrete culvert. Operation and maintenance of such structures shall consist of grass cutting during the growing season to prevent small trees from developing in and around the structures that would weaken the fills around the structures and hide the structural components from visual inspection.

A yearly inspection of all of the structures shall have a check list of the minimum following components:

a) Exposure of floodwall water stops.
b) Opening-up of floodwall joints (especially at the T-Wall-Concrete Culvert joints).
c) Cracking of the reinforced concrete scour protection on the protected side berm of the L-Wall.
d) Differential settlement of wall monoliths.
e) Plate attachment to concrete cap at the Concrete Culvert channel sidewalls.

All observed deficiencies shall be repaired prior to hurricane season.

13. APPENDICES.

13. A. Soils Report.

(2 sets of Eustis's Soil Report and supplemental L-Wall analysis delivered to Chris Dunn of COE)

13. B. Sample Calculations.

(2 sets hand delivered to Chris Dunn of COE)

13 C. Survey BM Listing.

Russell attaching single page here.

13. D. Design Quality Control Plan for Burk-Kleinpeter, Inc. (signed).

14. PLATES.

C-001	LOCATION AND VICINITY MAP
C-002	GENERAL NOTES & LEGEND
C-003	SURVEY
C-004	T-WALL ALIGNMENT – SITE PLAN
C-005	L-WALL ALIGNMENT – SITE PLAN
C-006	T-WALL PLAN AND PROFILE (N-1)
C-007	L-WALL PLAN AND PROFILE (N-1)
C-008	T-WALL ALIGNEMNT PLAN AND PROFILE (S-1 & S-3)
C-009	L-WALL ALIGNMENT PLAN AND PROFILE (S-1 & S-3)
C-010	PLAN AND PROFILE (CONCRETE CULVERT & W-1)
C-011	TYPICAL SECTION

14. PLATES (Cont'd).

C-011A	TYPICAL T-WALL & L-WALL SECTIONS & L-WALL FOUNDATION PLAN
C-011B	FOUNDATION PLANS N-1, S-1, S-3 (2 LAYOUTS) & W-1
C-012	CONCRETE CULVERT SECTION
C-013	TYPICAL DEMOLITION SECTION
C-014	DEMOLITION PLAN (N-1 & S-1)
C-015	T-WALL TEMPORARY RETAINING STRUCTURE PLAN LAYOUT (N-1)
C-016	T-WALL TEMPORARY RETAINING STRUCTURE PLAN LAYOUT (S-1 & S-3)
C-017	T-WALL TEMPORARY RETAINING STRUCTURE PLAN LAYOUT (W-1)
C-018	TEMPORARY RETAINING STRUCTURE SECTION (S-3 & W-1)
C-019	HYDROGRAPH
C-020	BORING LOG
C-021	BORING LOG
R-001	T-WALL ALIGNMENT RIGHTS-OF-WAY & CONSTRUCTION EASEMENT
R-002	T-WALL ALIGNMENT RIGHTS-OF-WAY & CONSTRUCTION EASEMENT
R-003	L-WALL ALIGNMENT RIGHTS-OF-WAY & CONSTRUCTION EASEMENT
R-004	L-WALL ALIGNMENT RIGHTS-OF-WAY & CONSTRUCTION EASEMENT
M-001	36" WATER LINE EXISTING PLAN
M-002	PROFILE OF EXISTING 36" WATER LINE AERIAL CROSSINGS

14. PLATES (Cont'd).

M-003	TYPICAL RELOCATION 36" WATER LINE RAISED LINE ALTERNATIVE
M-004	RAISED LINE ALTERNATIVE PROPOSED PIPE SUPPORT DETAILS
M-005	TYPICAL RELOCATION 36" WATER LINE THROUGH WALL ALTERNATIVE
M-006	THROUGH WALL ALTERNATIVE PROPOSED PIPE SUPPORT DETAILS
V-001	PHOTOGRAPH ORIENTATION

Photos No. 1 through 35

APPENDIX A

SOILS REPORT

(2 sets of Eustis's Soil Report and supplemental L-Wall analysis were delivered to Chris Dunn of the COE)

APPENDIX B

SAMPLE CALCULATIONS

(2 sets of DEI's Sample Calculations were delivered to Chris Dunn of the COE)

APPENDIX C

SURVEY BENCH MARK LISTING

TABULATION OF BENCH MARKS		
DESIGNATION	DESCRIPTION	ELEVATION
Q-368	RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1994 (GAS) 2.4 KM (1.50 MI) NORTHERLY ALONG STATE HIGHWAY 45 (BARATARIA BOULEVARD) FROM THE JUNCTION OF STATE HIGHWAY 3134 IN MARRERO, THENCE 1.7 KM (1.05 MI) WESTERLY ALONG LAPALCO BOULEVARD, 21.1 M (69.2 FT) NORTH OF THE CENTERLINE OF THE WESTBOUND LANES OF THE BOULEVARD, 6.2 M (20.3 FT) EAST OF THE CENTER OF A ROAD LEADING TO THE MARRERO WASTE WATER TREATMENT PLANT AND WAREHOUSE AT 6250 LAPALCO BOULEVARD, 1.7 M (5.6 FT) EAST OF THE EAST POST OF A GATE, 0.5 M (1.6 FT) SOUTH OF A WITNESS POST AND THE SOUTHEAST CORNER OF A CHAIN-LINK FENCE ENCLOSING THE PLANT, AND 0.3 M (1.0 FT) BELOW THE LEVEL OF THE BOULEVARD. NOTE-ACCESS TO THE DATUM POINT IS THROUGH A 5-INCH LOGO CAP.	2.30 NAVD 88 (2004.65)

APPENDIX D

DESIGN QUALITY CONTROL PLAN

FOR

BURK-KLEINPETER, INC.
(signed)

DESIGN QUALITY CONTROL PLAN

West Bank And Vicinity, New Orleans, Louisiana, Hurricane Protection Project, Preparation of Engineering Alternative Report (EAR) for the Discharge Channel Floodwalls And Concrete Culvert at the Cousins Pumping Station Complex Burk-Kleinpeter, Inc. Task Order No. 0012, Contract No. 53-7217-03-10

1. **Product/Project Description:**

- Project Name:
  WBV-39B.2 Cousins Outfall Canal Phase II

- Project Location:
  Along the banks of the Cousins Pump Station discharge canal, immediately East of the Destrehan Avenue bridge, under the Lapalco Boulevard West bridge approach to the Harvey Canal, on the West bank of the Harvey Canal in Jefferson Parish, Louisiana.

- Project Description:
  Investigate means of modifying the existing structural elements to accommodate raising the permanent protection design grade to El. 14.0 NAVD 88 (2004.65). The features of construction requiring retrofit or replacement:
  1) Existing I-wall on the north side of the canal (recently fortified with grouted riprap on the protected side) from the Destrehan Bridge to the tie-in at the new T-type closure wall, currently under construction (Reach N-1).
  2) Existing I-walls on the south and west side of the canal from the Destrehan Bridge to the float-in concrete culvert beneath Lapalco Blvd. Bridge (Reach S-1 (recently fortified with grouted riprap on the protected side) is the straight alignment; Reach S-3 is the transitional curve to the concrete culvert).
  3) Float-in concrete culvert.
  4) Tie-back walls on west side of canal from concrete culvert to tie-in at new T-walls under construction (Reach W-1).

- Project Work:
  Engineering and design (E&D) for the preparation of an Engineering Alternative Report. This Engineering Alternative Report shall incorporate the various design data, investigations and information including the structural analysis and design on the project's components for the various alternatives investigated and quantity take-offs to prepare cost estimates of all viable solutions investigated.
  - Specific work items shall include but not be limited to the following:
    1) Prepare and submit ROW required for construction for each of the

alternatives.
2) Incorporate site surveys and mapping.
3) Incorporate all geotechnical data required for detailed design.
4) Prepare and submit the geotechnical and structural design for the alternative structures considered.

- Structure Alternatives shall include:
  1) L-walls. If no unbalanced loading exists, L-walls may be employed where I-walls are currently constructed. Wherever possible, the existing sheet piling shall be utilized either in place or removed and re-driven.
  2) T-walls. A T-wall alternative shall be presented where I-walls and/or tie-back walls currently exist. The existing sheet piling shall be utilized wherever possible.
  3) Retrofit Existing Structures. Investigate ways to retrofit the existing concrete culvert and, if feasible, the existing tie-back system.
  4) Parapet wall for the culvert.

2. Purpose and Scope of Design Quality Control Plan (DQCP):

- Purpose: This DQCP outlines the professional expertise, technical criteria, and technical review processes that will be used to produce a quality product satisfying technical, functional, legal, safety and environmental requirements.

- Scope: The scope of this quality control effort is to enhance the synergy between the Product Delivery Team (PDT) and the Independent Technical Review Team (ITR) in order for these two entities to work hand-in-hand to submit a design product that not only meets and exceeds the Scope of Work requirements, but also does so within the very restrictive schedule constraints. An ITR is essential more than ever to ensure correct design procedures are followed in the very limited time allowed to submit a final design product suitable for construction.
  - Consequences of a Failure: Failure of any one of the features of work being designed for these projects can result in inhibiting of normal pump station operations or, in the case of catastrophic failure, the uncontrolled release of hurricane storm surge on the protected area in the Harvey and Westwego sub-basins.
  - Nature of Work (routine or non-routine): The work being performed for this projects is non-routine due to the congestion of other flood protection work going on concurrently in the area.
  - Risks Inherent in the Project: Due to the industrial nature of the project area, there is substantial risk that there may be buried obstructions and or unidentified utilities that could inhibit construction.
  - Special Considerations:
    1) Pump Station operation must be maintained continually throughout the construction process.

2) Industrial operations must be maintained throughout the construction contract. The features constructed will be traversing the Petrex industrial facility.
3) Temporary hurricane protection must maintain the current level of protection throughout construction.
4) Existing buildings / foundation slabs must not be adversely impacted by the construction activities or the permanent floodwall.

- Crucial Design Features:
  1) L-Walls: Setback with berms to negate unbalanced load conditions.
  2) T-Walls
  3) All Floodwall Types: Monoliths, foundations, cutoff sheeting.
  4) Pipeline Crossing: New Pile Bents, raising existing pile bent caps.
  5) Temporary Retaining Structures
  6) Dewatering System (Contractor Designed)
  7) Concrete Mix Design (Contractor Designed)

3. Deliverables:

DQCP Plan
60% Submittal (with Right-of-Way plates)
65% Submittal Engineering Alternative Report
65% Comment Resolution (using Dr. Checks)
95% Engineering Alternative Report Submittal & ITR
95% Comment Resolution
Final Engineering Alternative Report

All deliverables shall be compiled and provided in electronic form.

4. Customer Involvement:

The Product Delivery Team (PDT) will engage and involve other appropriate USACE organizations, Federal agencies, state and local governments, Jefferson Parish, Department of Public Works, West Jefferson Levee District, local utility and infrastructure agencies, and local citizens groups and associations, to keep them informed and to solicit their feedback and assistance. This involvement includes formal meetings and presentations, formal reviews, informal meetings and discussions, teleconferences, E-mails and telephone conversations. Customer involvement at all levels is vital to instill confidence that the customers' needs are being addressed and the recovery efforts are of high quality.

The USACE New Orleans District has undertaken the important task of obtaining the input and feedback from concerned local governing authorities, residents, utility companies, and other stakeholders in the development of these vital projects. Burk-

Kleinpeter, Inc. will assist the USACE as instructed and as needed with regards to customer involvement as the New Orleans District takes the lead in integrating customer needs into the final design product.

5. Metric System:

- Reference: CECW-CE, Engineering and Construction Bulletin, No. 2004-13, Issued 30 Aug 2004. This guidance states that the metric system shall be used unless such use leads to inefficiencies or is otherwise impracticable.
- The existing hurricane protection projects were designed and constructed using the inch-pound system of measurement. It is not practicable to use metric on the continued design and construction of these projects due to inefficiencies.

6. Technical Criteria:

- Hurricane and Storm Damage Reduction System—Design Guidelines, New Orleans District, April 2007
- Hurricane protection System – Design Guidelines, New Orleans District, February 2007
- Guidelines for Technical Documentation, dated 30 March 2006
- ER 1110-2-1150, Engineering and Design for Civil Works Projects
- ER 1110-1-8159, Engineering and Design, DrChecks, 10 May 2001
- ER 1110-1-12, Quality Management, 21 July 2006.
- EM 385-1-1, Safety and Health Requirements Manual, ENG Form 5044-R (Nov. 03).
- EM 1110-2-2000, Standard Practice for Concrete for Civil Works Structures, Change 2 (Mar 01), (Feb 94).
- EM 1110-2-2007, Structural Design of Concrete Lined Flood Control Channels, (Apr 95).
- EM 1110-2-2100, Stability Analysis of Concrete Hydraulic Structures, (Dec 05).
- EM 1110-2-2102, Waterstops and Other Preformed Joint Materials for Civil Works Structures, (Sep 95).
- EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures, (Jan 92, Aug 03).
- EM 1110-2-2105, Design of Hydraulic Steel Structures Change 1 (May 94).
- EM 1110-2-2502, Retaining and Flood Walls, (Sep 89).
- EM 1110-2-2503, Design of Sheet Pile Cellular Structures Cofferdams & Retaining Structures (Sep 89).
- EM 1110-2-2504, Design of Sheet Pile Walls, (Mar 94).
- EM 1110-2-2701, Vertical Lift Gates (Nov 97).
- EM 1110-2-2705, Structural Design of Closure Structures for Local Flood Protection Projects (Mar 94).

- EM 1110-2-2902, Conduits, Culverts and Pipes, Changes 1-3, (Oct 97).
- EM 1110-2-2906, Design of Pile Foundations, (Jan 91).
- TL 1110-2- 322, Retaining and Flood Walls, (Oct 90).
- Building Code Requirements for Structural Concrete (ACI 318
- Allowable Stress Design Manual of Steel Construction
- See Scope of Work for full listing of Government furnished data.
- Guidelines for Technical Documentation, dated 30 March 2006.

7. Vertical Datums:

- The establishment and use of vertical datums in the design work will follow the guidance provided in CECW-CE, INTERIM GUIDANCE FOR A PRELIMINARY EVALUATION OF VERTICAL DATUMS ON FLOOD CONTROL, SHORE PROTECTION, HURRICANE PROTECTION, AND NAVIGATION PROJECTS, dated 31 October 2006
- The following PBMs were used for this project (Datasheets and validation found separately in Government QA/QC package):
  - **i.** Primary: Q-368
  - **ii.** Additional: T-368
  - **iii.** Additional: U-368
- Information relating to the location and determination of elevations of all vertical datums used in the project design will be provided to the Engineering Alternative Report.

8. Product Delivery Team (PDT)

The PDT is led by an experienced leader who has designed or led PDTs in the successful completion of similar work. Other PDT members have extensive professional experience in their assigned responsibilities. Should future requirements require the application of different skills or experience, appropriate personnel will be added to the PDT.

BKI	Burk-Kleinpeter, Inc. (in Joint Venture with DEI)
DEI	Design Engineering, Inc. (Structural Sub)
Eustis	Eustis Engineering Company, Inc. (Geotechnical Sub.)

Name	Discipline	Professional Registration	Role/Responsibility	Years of Experience in Field
Michael Chopin BKI	Civil Engineer	P.E. #26797, Civil Engineering	Project Manager/Team Lead	16
Russell J. Young BKI	Civil Engineer	E.I. #14157, Civil Engr.	Project Engineer/Civil Design	38.5

Tony Moschella BKI	Mechanical Engineer	P.E. # 27965, Mechanical Engineering	Project Engineer/Mechanical Design	11
April Hurry DEI	Structural Engineer	P.E. # 26384, Civil Engineering	Project Engineer/Structural Design	17
Tom Stremlau Eustis	Geotechnical Engineer	P.E. #, 16248 Civil Engineering	Project Manager/Project Engineer/Geotechnical Design	37
Danny Caluda BKI	Mechanical Engineer	-	Mechanical Design	20
Eric Dallimore BKI	Civil Engineer	E.I. # 27922, Civil Engineering	Civil Design	2
Jody Coyne BKI	CADD/Tech.	-	Senior CADD Tech.	36
Michael Pilkerton BKI	CADD/Tech.	-	Civil/Structural CADD	10
Tommy Litchliter BKI	CADD/Tech	-	Mechanical/Electrical CADD	24

Russell Young of BKI will be in responsible charge of the daily civil design and CADD supervision activities. April Hurry of DEI will be in responsible charge of the daily structural design activities. Tony Moschella and Danny Caluda of BKI will be in responsible charge of the daily mechanical and CADD supervision activities. Michael Chopin of BKI will be the professional in responsible charge of the design work. He will be the official point of contact for communication between the USACE and the BKI. Russell Young will serve as Mr. Chopin's alternate point of contact.

9. Independent Technical Review (ITR)

- Independent Technical Review will be performed on all products, following the guidance provided in ER 1110-1-12, Engineering and Design, QUALITY MANAGEMENT, dated 30 September 2005.
- This Independent Technical Review Team will be consistent throughout the design process. The ITR team will be available for guidance and advice on an as-needed basis throughout the development of the EAR. The ITR Team will perform a formal review of the EAR prior to review by the Government. The team will consist of the following members:

Name	Discipline	Professional Registration	Role/Responsibility	Years of Experience in Field
Michael Jackson BKI	Civil Engineer	P.E. #15148, Civil Engineering	ITR Team Lead & Mechanical Design ITR	36
Rene Chopin BKI	Civil Engineer	E.I. #25174, Civil Engineering	Civil Design ITR	19
Mark Roberts BKI	Civil Engineer	P.E. #28568, Civil Engineering	Civil Design ITR	13
John Holtgreve DEI	Structural Engineer	P.E. #, 16383, Civil Engineering	Civil Design ITR	35
Gwen Sanders Eustis	Geotechnical Engineer	P.E. #27104, Civil Engineering	Geotechnical Design ITR	15
Max Shukla DEI	Structural Engineer	P.E. # 17008, Civil Engineering	Structural Design ITR	40
Ricardo Contreras DEI	Structural Engineer	P.E. # 28533, Civil Engineering	Structural Design ITR	12

Mr. Jackson will provide the official ITR team comments to Mr. Michael Chopin, PDT Leader, who will in turn be in charge of resolving the comments and providing official responses for the file.

10. Biddability, Constructability, Operability, and Environmental (BCOE) Review:

Not applicable to Engineering Alternative Reports.

11. Schedule/Checklist

Work Items	Completion Date
Pre-work Conference	9 Nov. 07
Submit DQCP Plan	13 Nov. 07
60% Submittal (with Right-of-Way plates)	15 Dec. 07
65% Submittal Engineering Alternative Report	26 Dec. 07
65% Review	2 Jan. 08

65% Comment Resolution	31 Jan. 08
95% Engineering Alternative Report Submittal & ITR	7 Feb 08
95% Review	21 Feb. 08
95% Comment Resolution	25 Feb. 08
Furnish Final Engineering Alternative Report	3 Mar. 08

12. Record Maintenance

The following QC documentation will be provided, in both hard copy and electronic format, to the PRO:

- The initial Design Quality Control Plan (within 14 days of commencing design) and any changes during the design process.
- ITR statement of technical review and certification (with 95% submittal of design product).
- Resolution of review comments using DrChecks.
- The Engineering Alternative Report, which includes the technical documentation of the design (e.g. calculations, load cases, etc. as required) plus the items above.

13. Signatures

We hereby certify that the guidelines and procedures outlined in this Design Quality Control Plan will be followed during the entire duration of this task order.

Michael Chopin, P.E.
Vice-President
Burk-Kleinpeter, Inc.
PDT Leader

Michael Jackson, P.E.
Executive Vice-President
Burk-Kleinpeter, Inc.
ITR Leader

APPENDIX C

SURVEY BENCH MARK LISTING

TABULATION OF BENCH MARKS		
DESIGNATION	DESCRIPTION	ELEVATION
Q-368	RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1994 (GAS) 2.4 KM (1.50 MI) NORTHERLY ALONG STATE HIGHWAY 45 (BARATARIA BOULEVARD) FROM THE JUNCTION OF STATE HIGHWAY 3134 IN MARRERO, THENCE 1.7 KM (1.05 MI) WESTERLY ALONG LAPALCO BOULEVARD, 21.1 M (69.2 FT) NORTH OF THE CENTERLINE OF THE WESTBOUND LANES OF THE BOULEVARD, 6.2 M (20.3 FT) EAST OF THE CENTER OF A ROAD LEADING TO THE MARRERO WASTE WATER TREATMENT PLANT AND WAREHOUSE AT 6250 LAPALCO BOULEVARD, 1.7 M (5.6 FT) EAST OF THE EAST POST OF A GATE, 0.5 M (1.6 FT) SOUTH OF A WITNESS POST AND THE SOUTHEAST CORNER OF A CHAIN-LINK FENCE ENCLOSING THE PLANT, AND 0.3 M (1.0 FT) BELOW THE LEVEL OF THE BOULEVARD. NOTE-ACCESS TO THE DATUM POINT IS THROUGH A 5-INCH LOGO CAP.	2.30 NAVD 88 (2004.65)

Photo No. 1
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

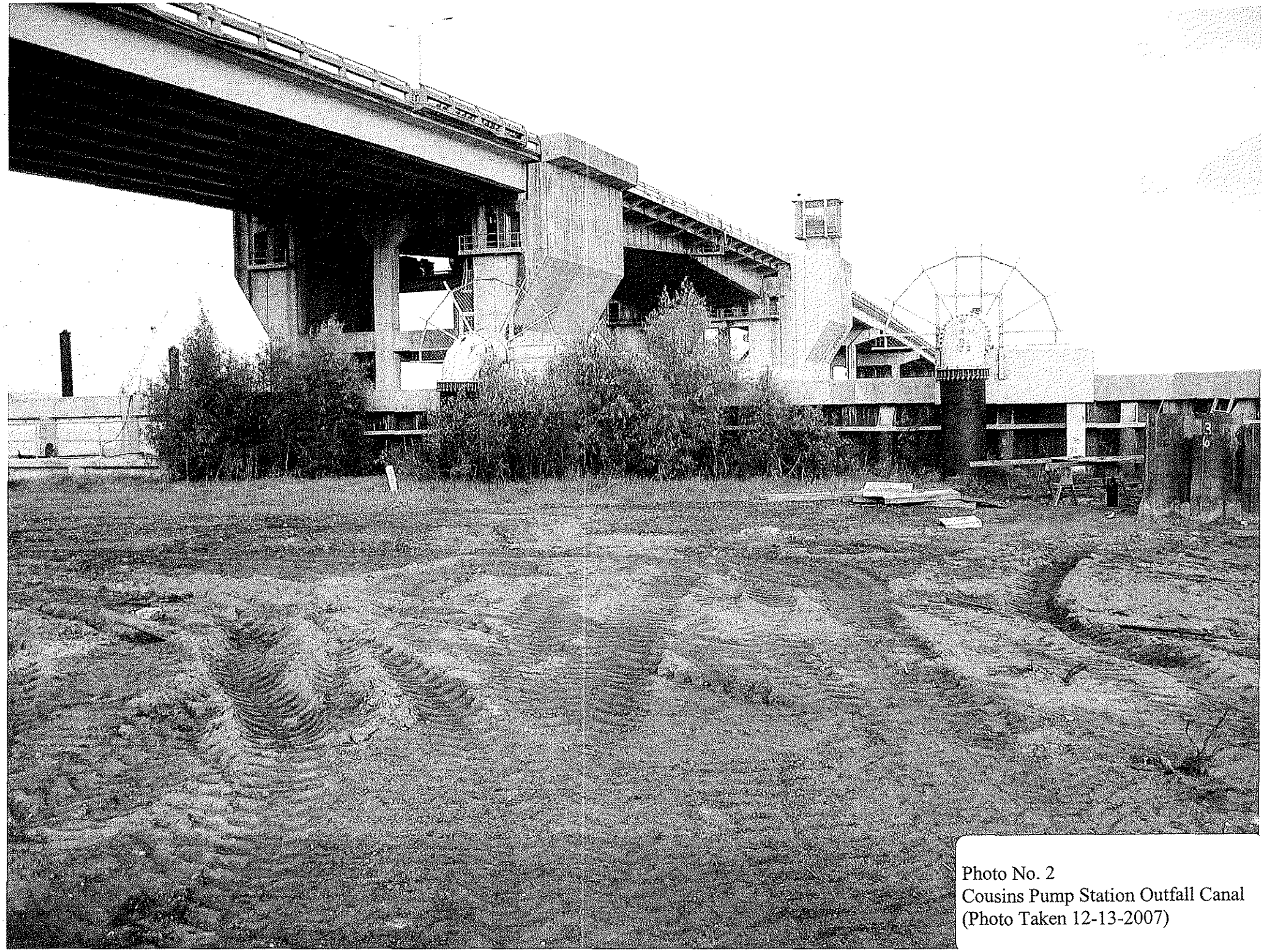

Photo No. 2
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

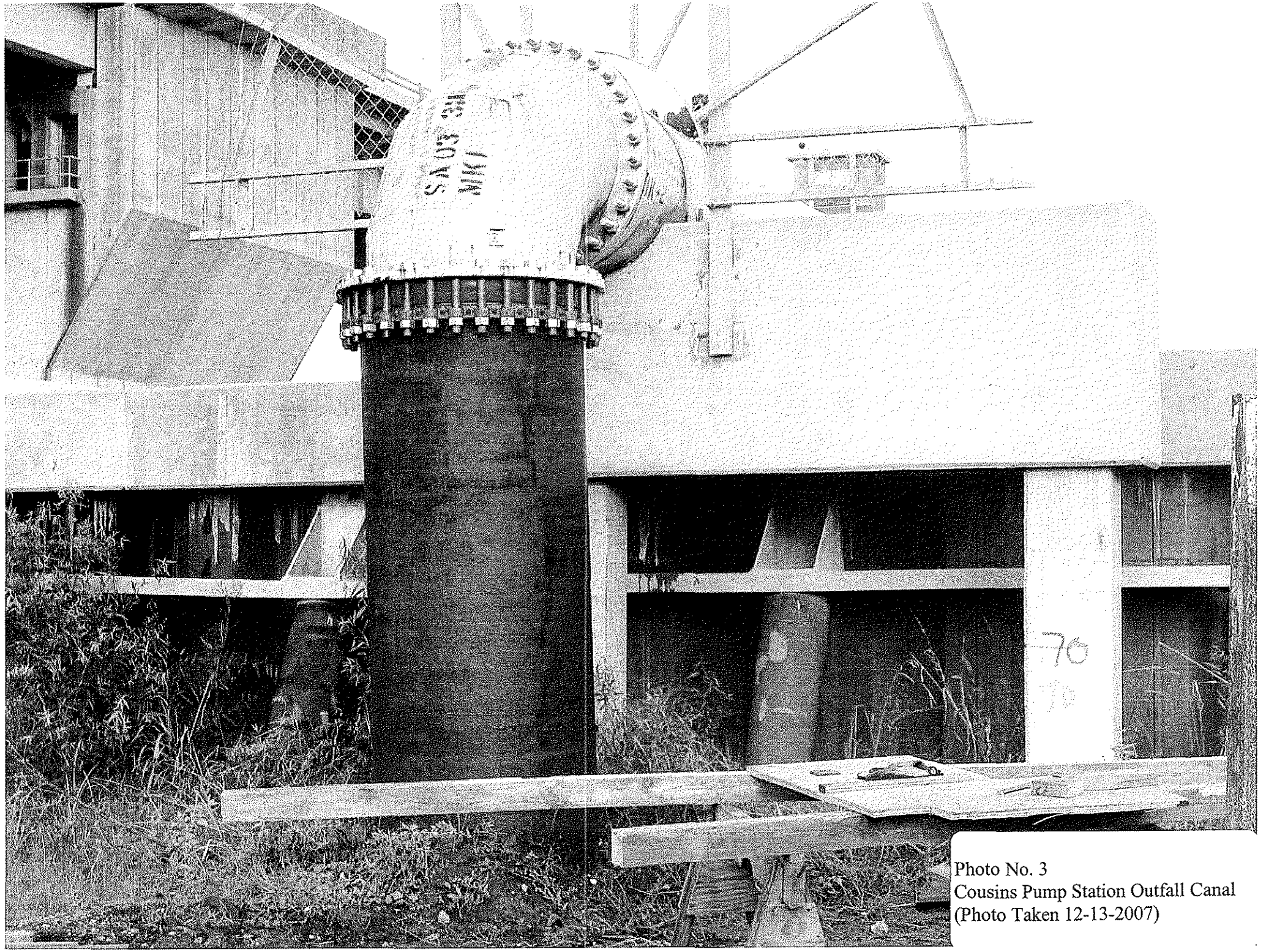

Photo No. 3
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

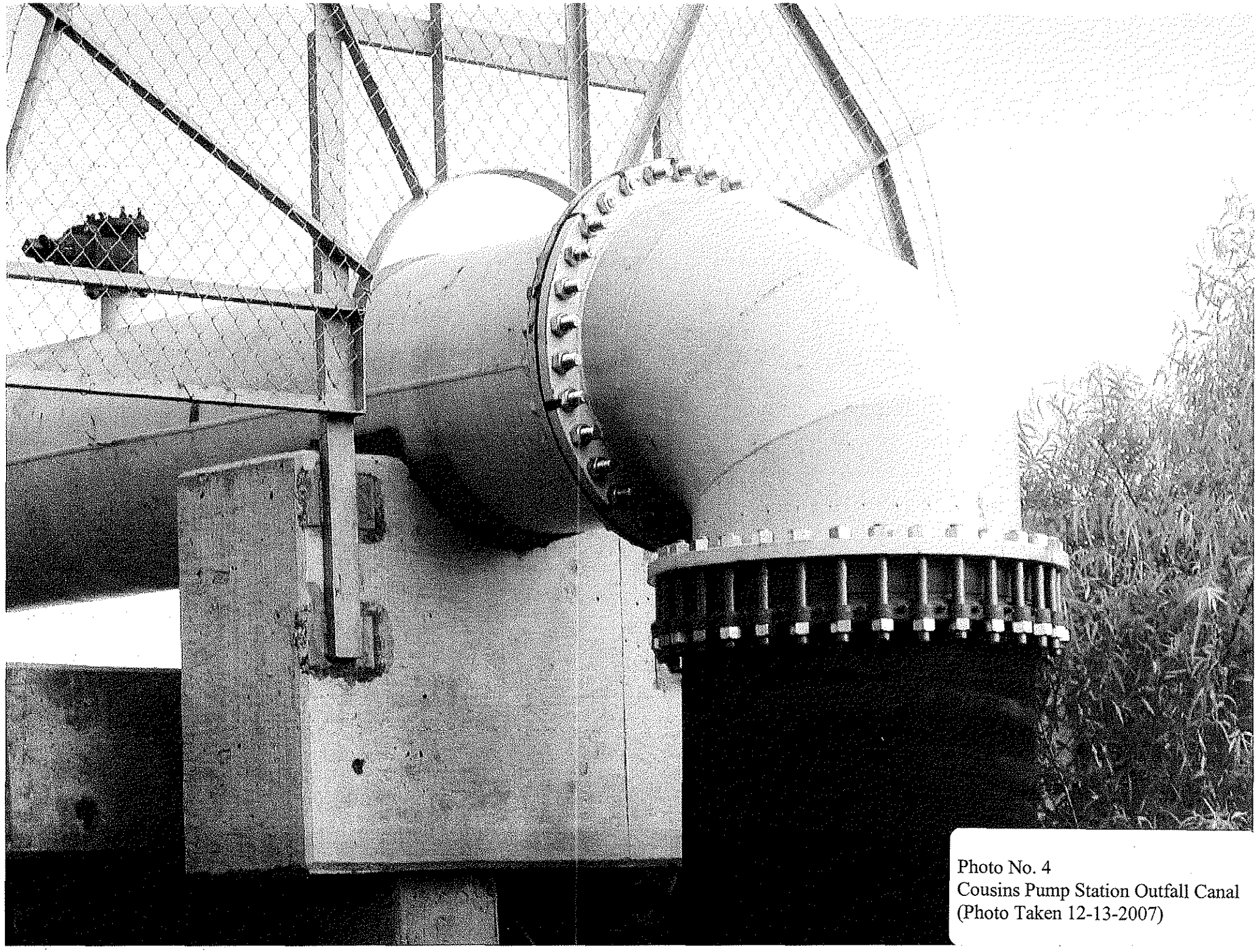

Photo No. 4
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 5
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

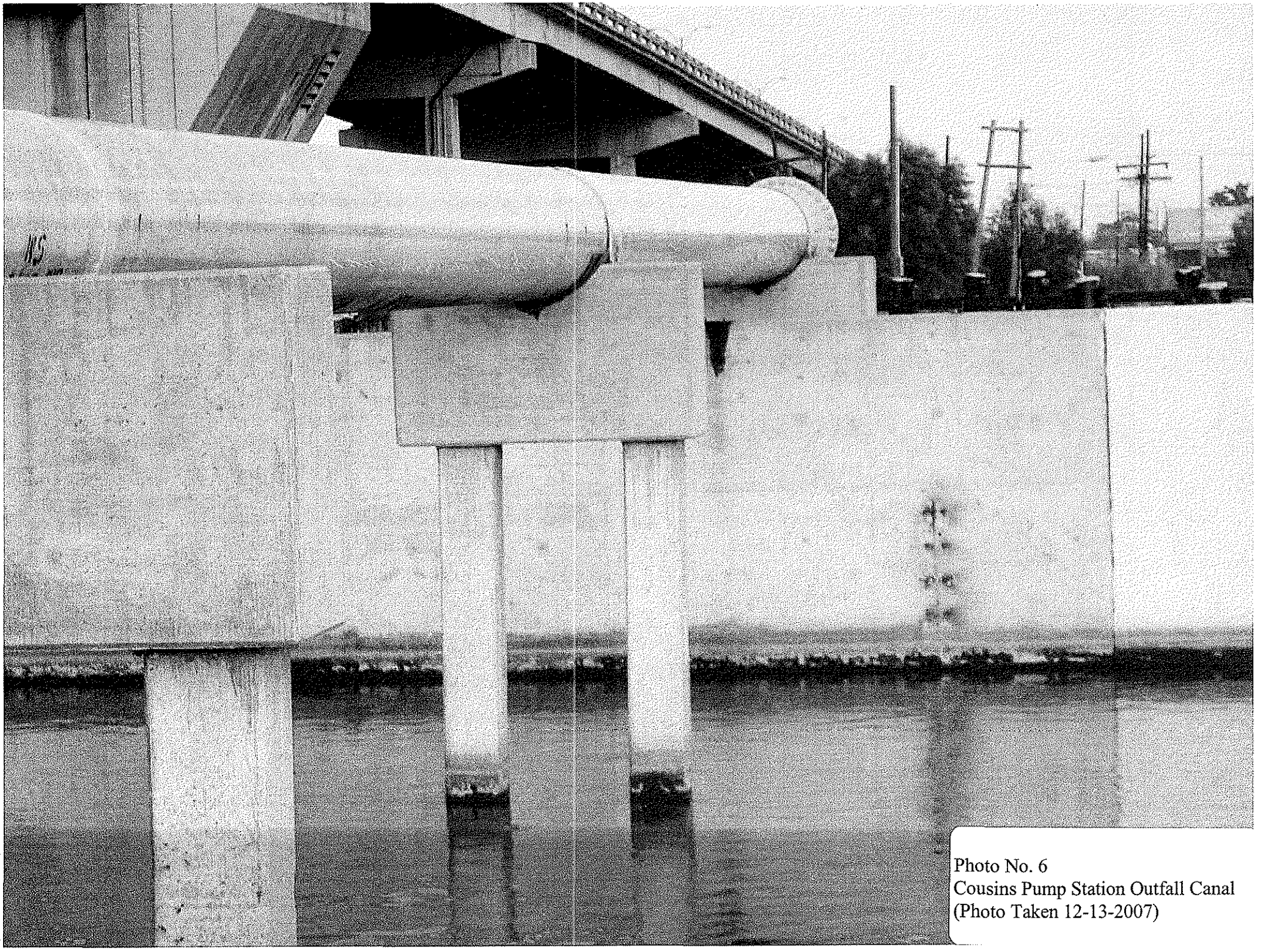

Photo No. 6
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 7
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 8
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 9
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

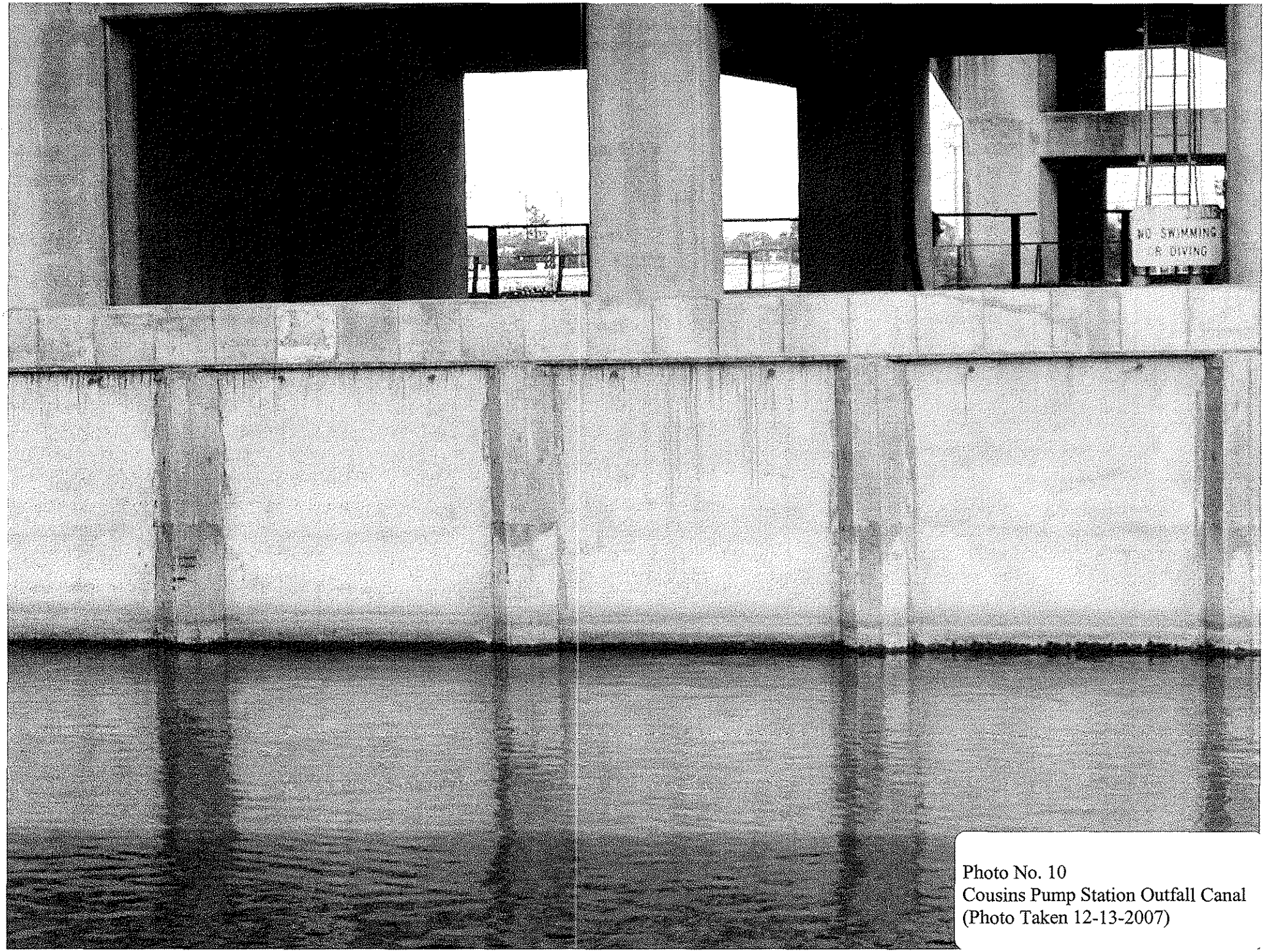

Photo No. 10
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

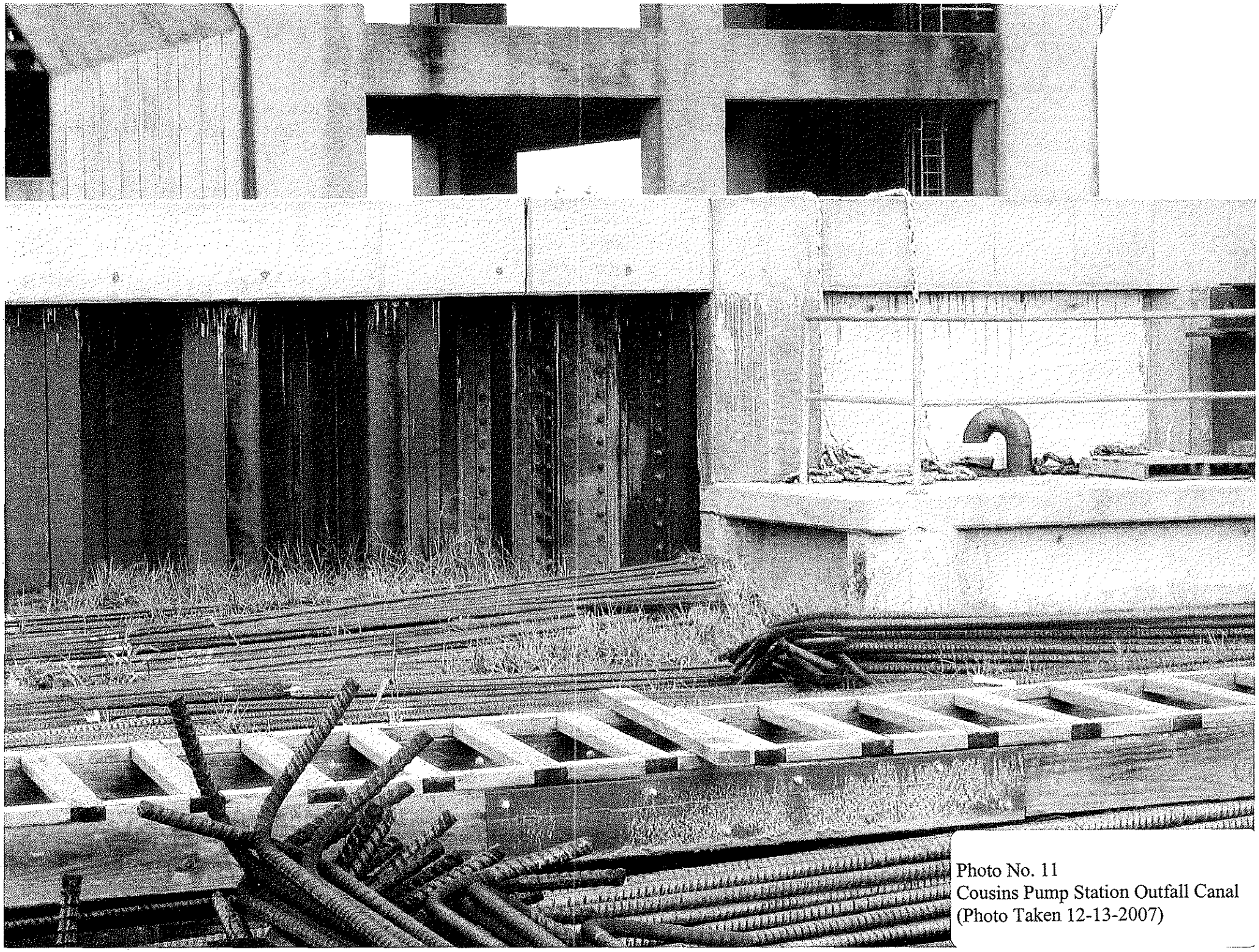

Photo No. 11
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

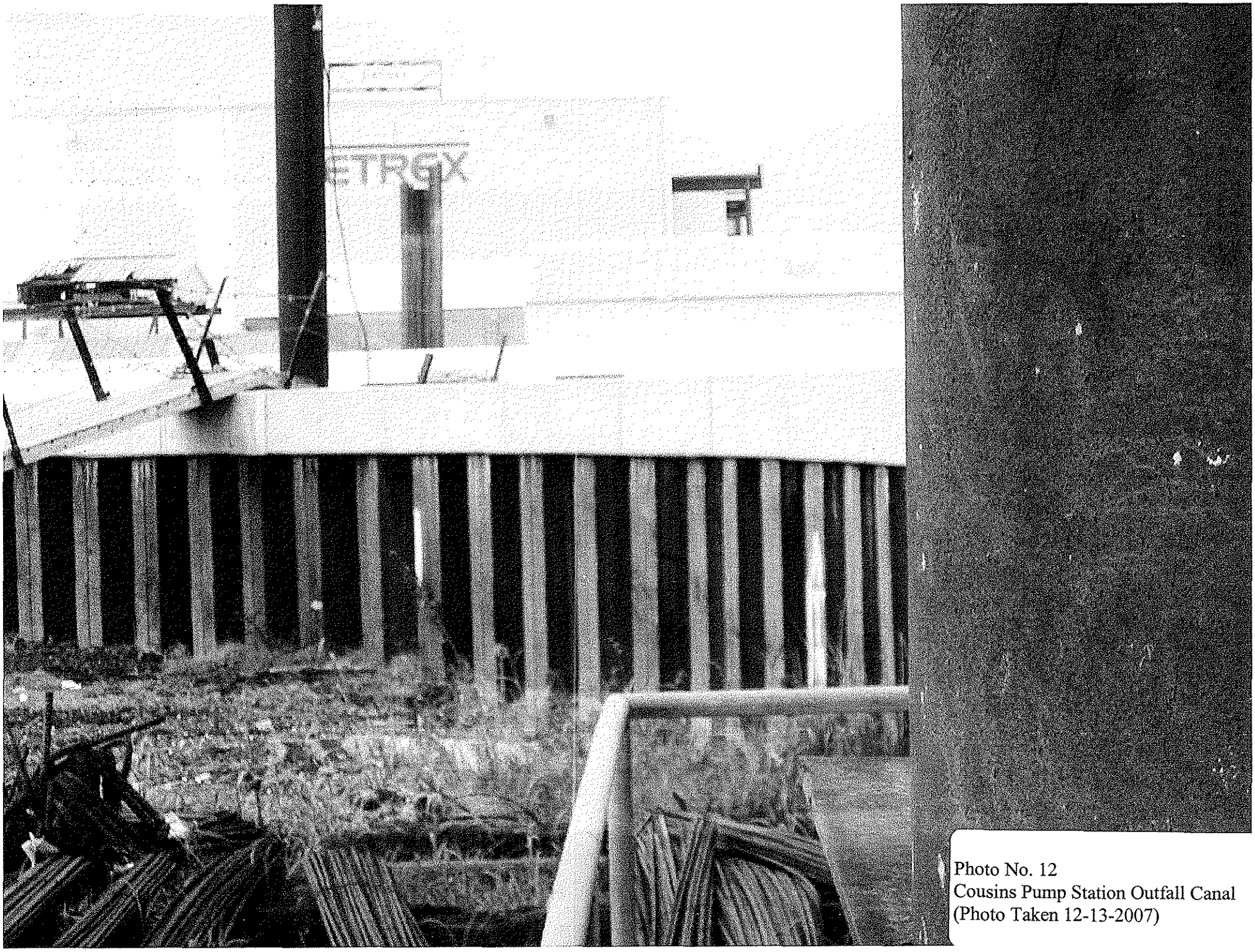

Photo No. 12
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

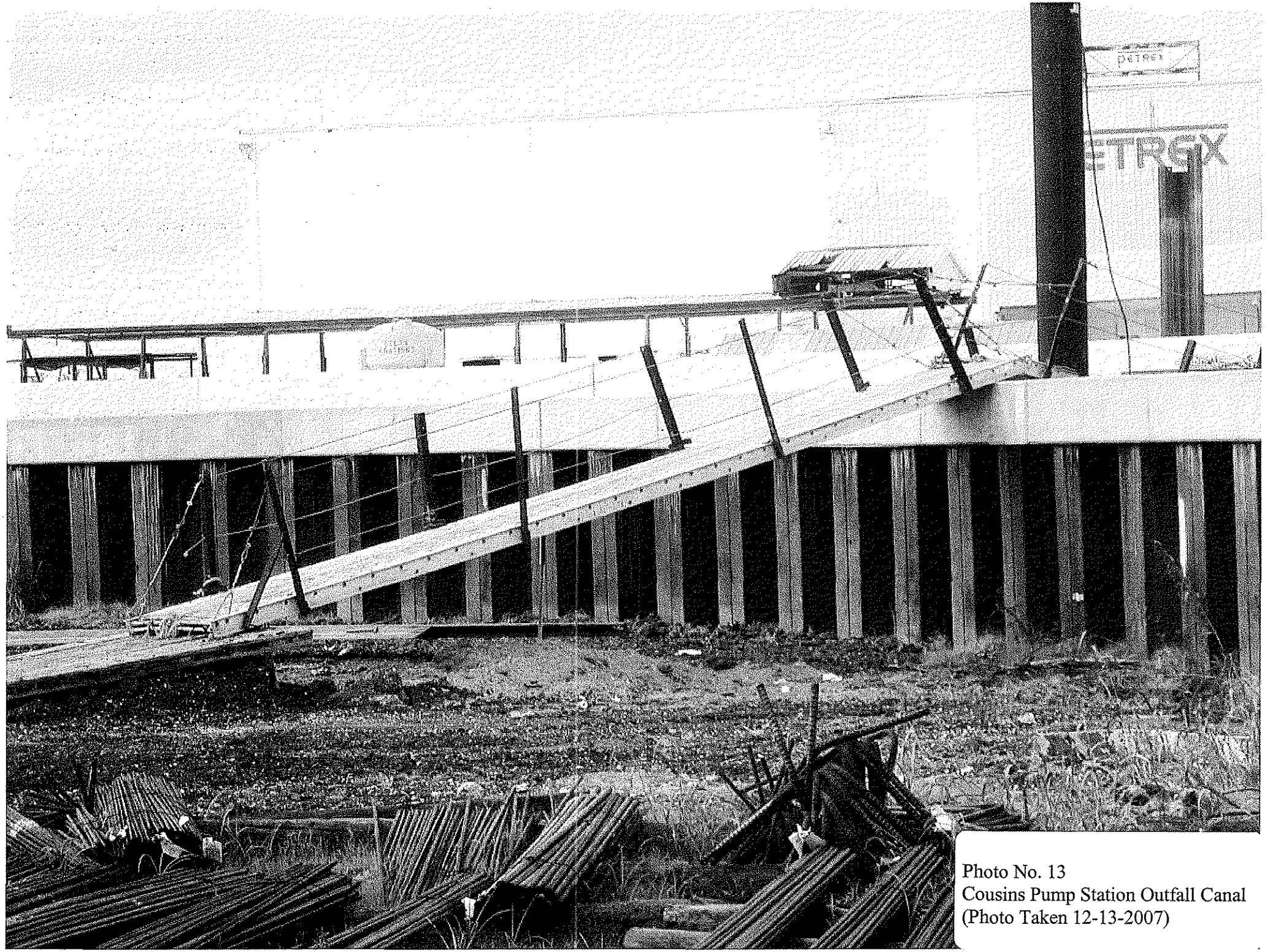

Photo No. 13
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

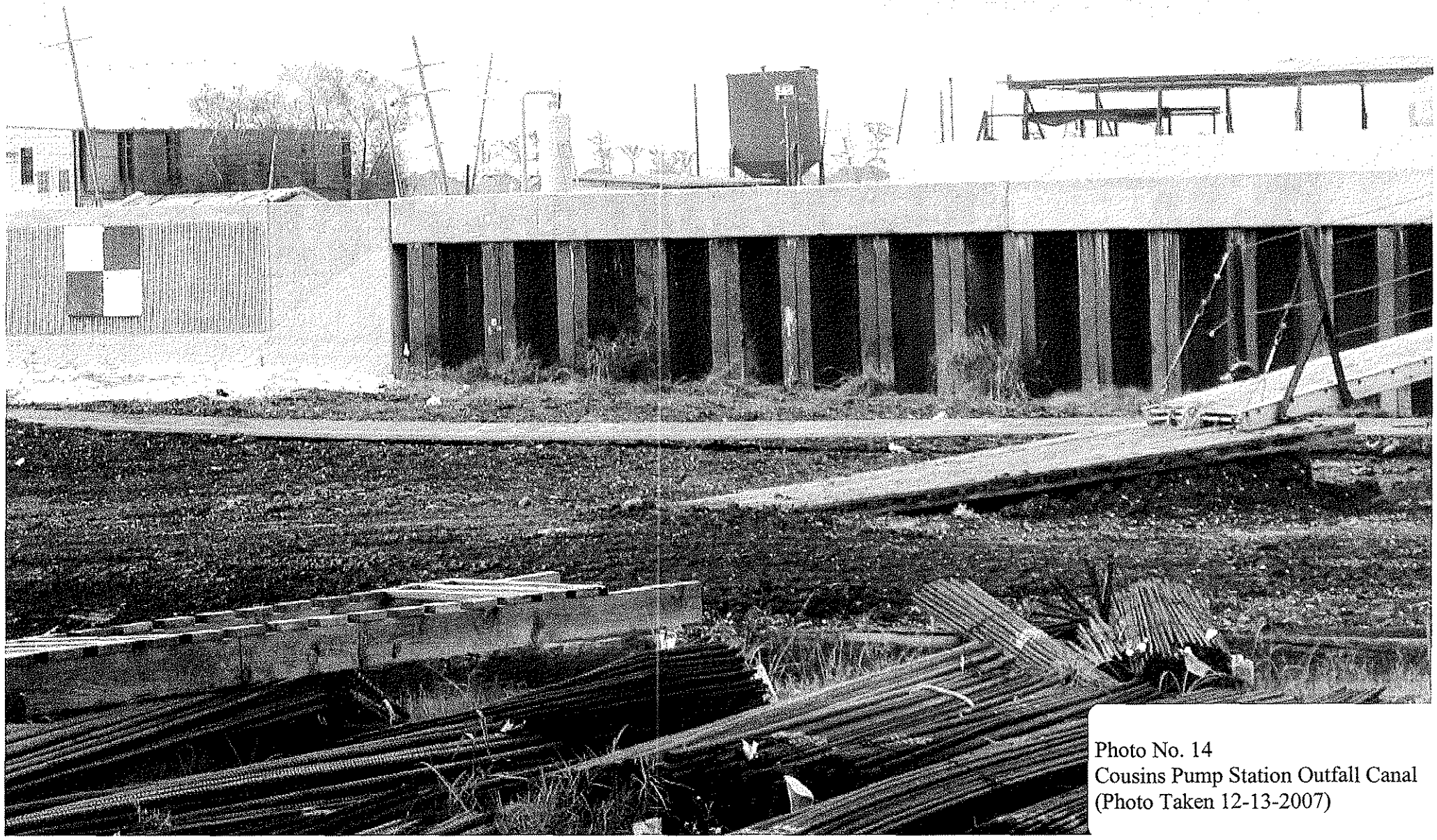

Photo No. 14
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

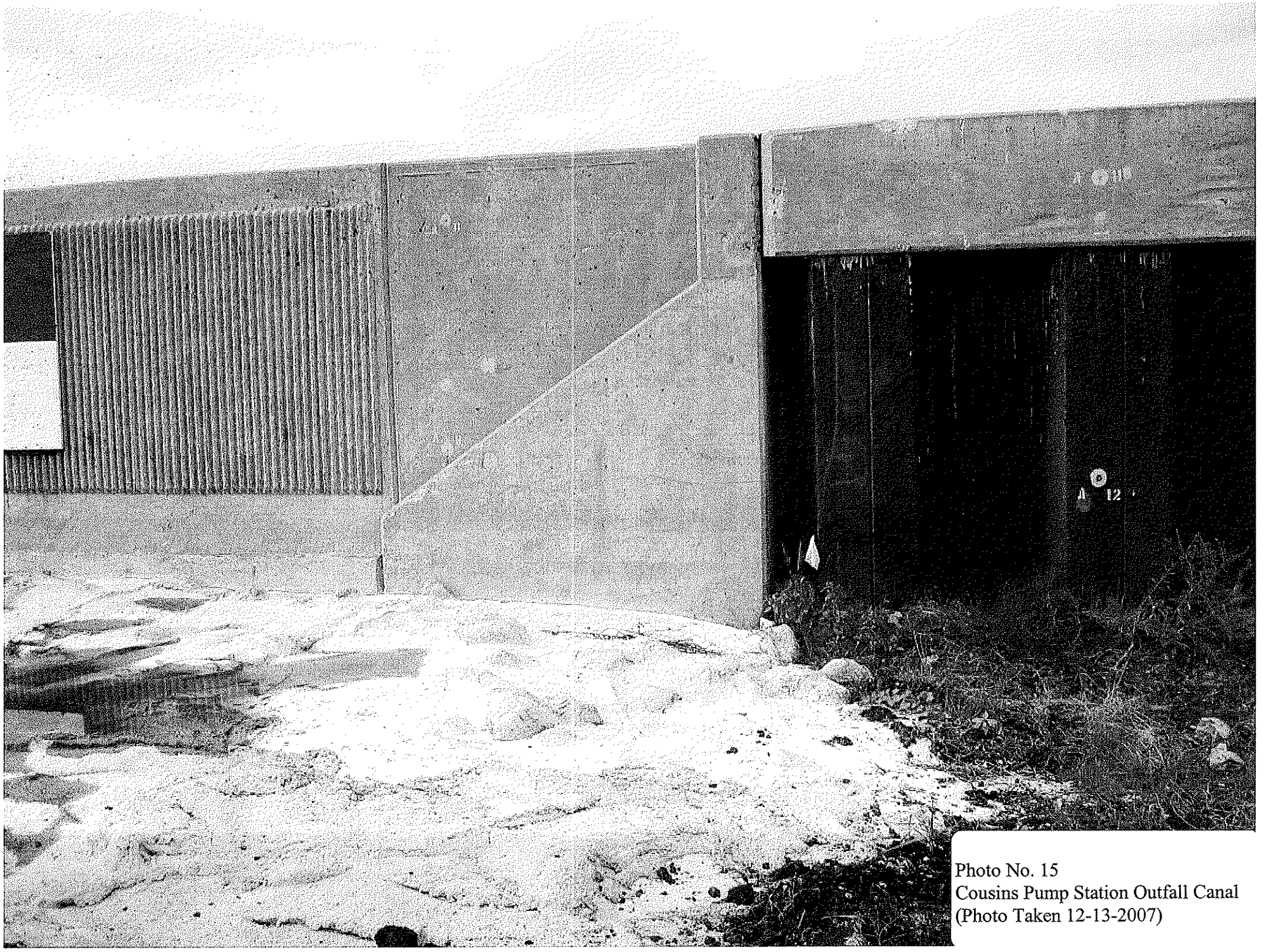

Photo No. 15
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

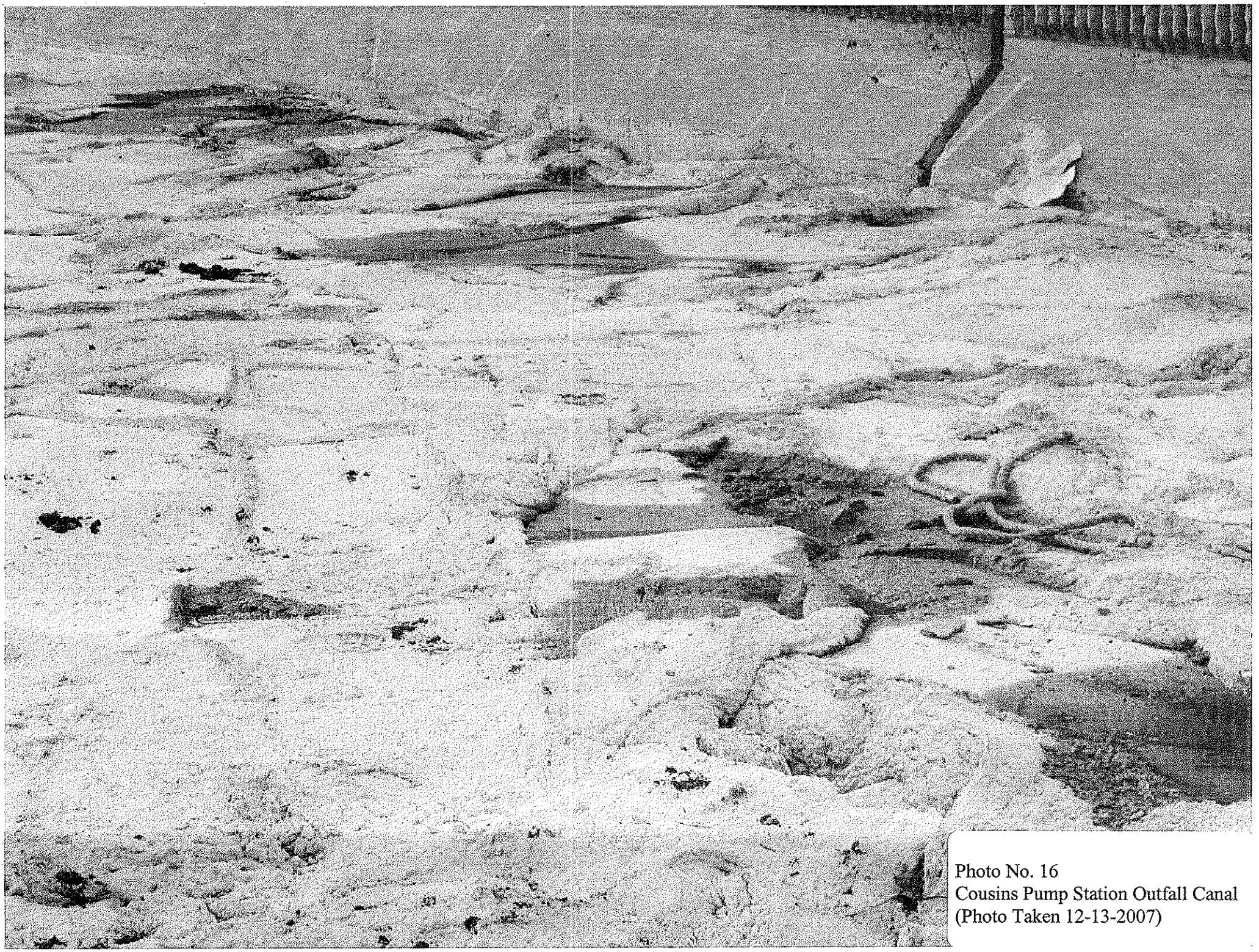

Photo No. 16
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 17
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 18
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 19
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

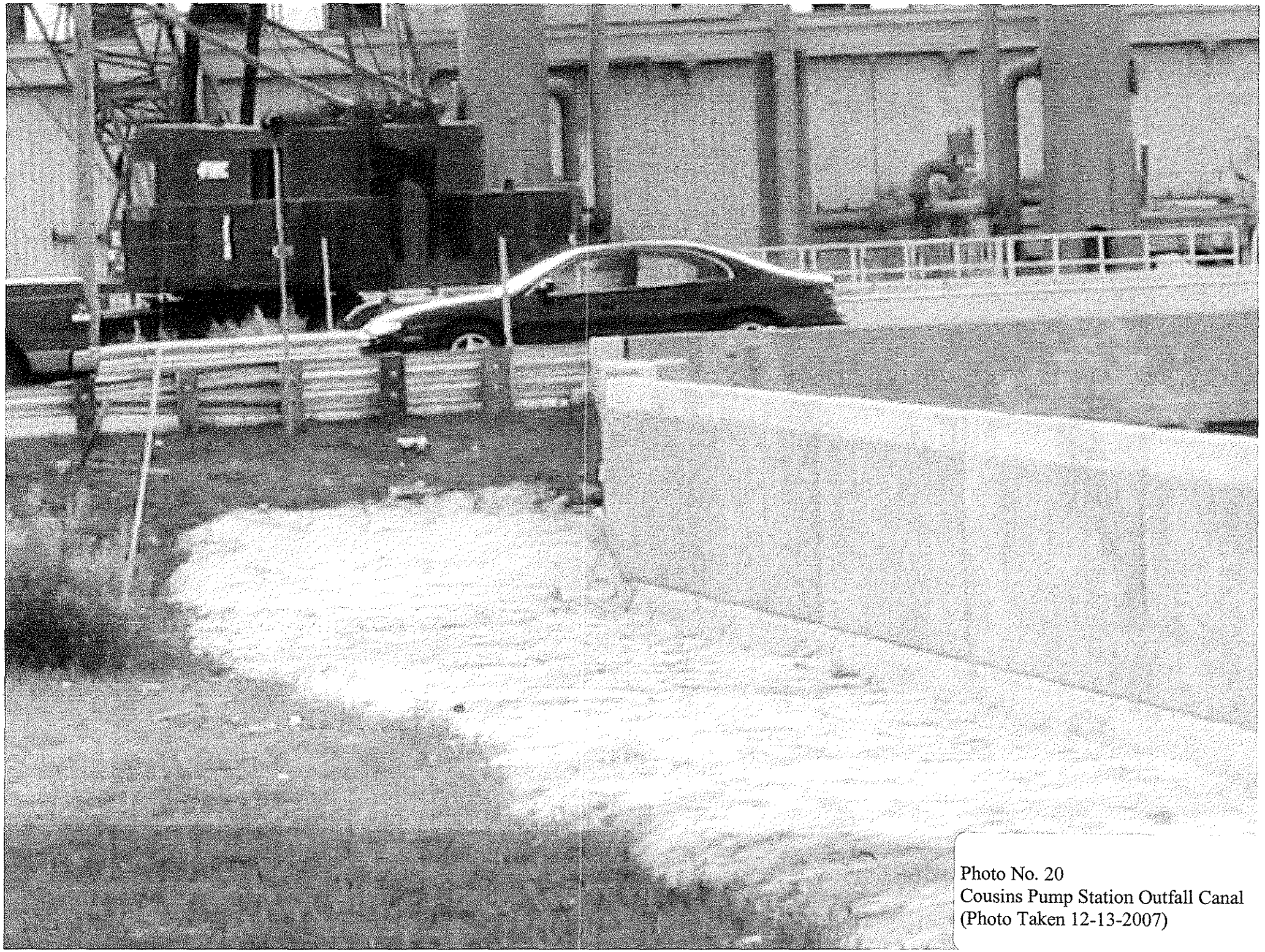

Photo No. 20
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

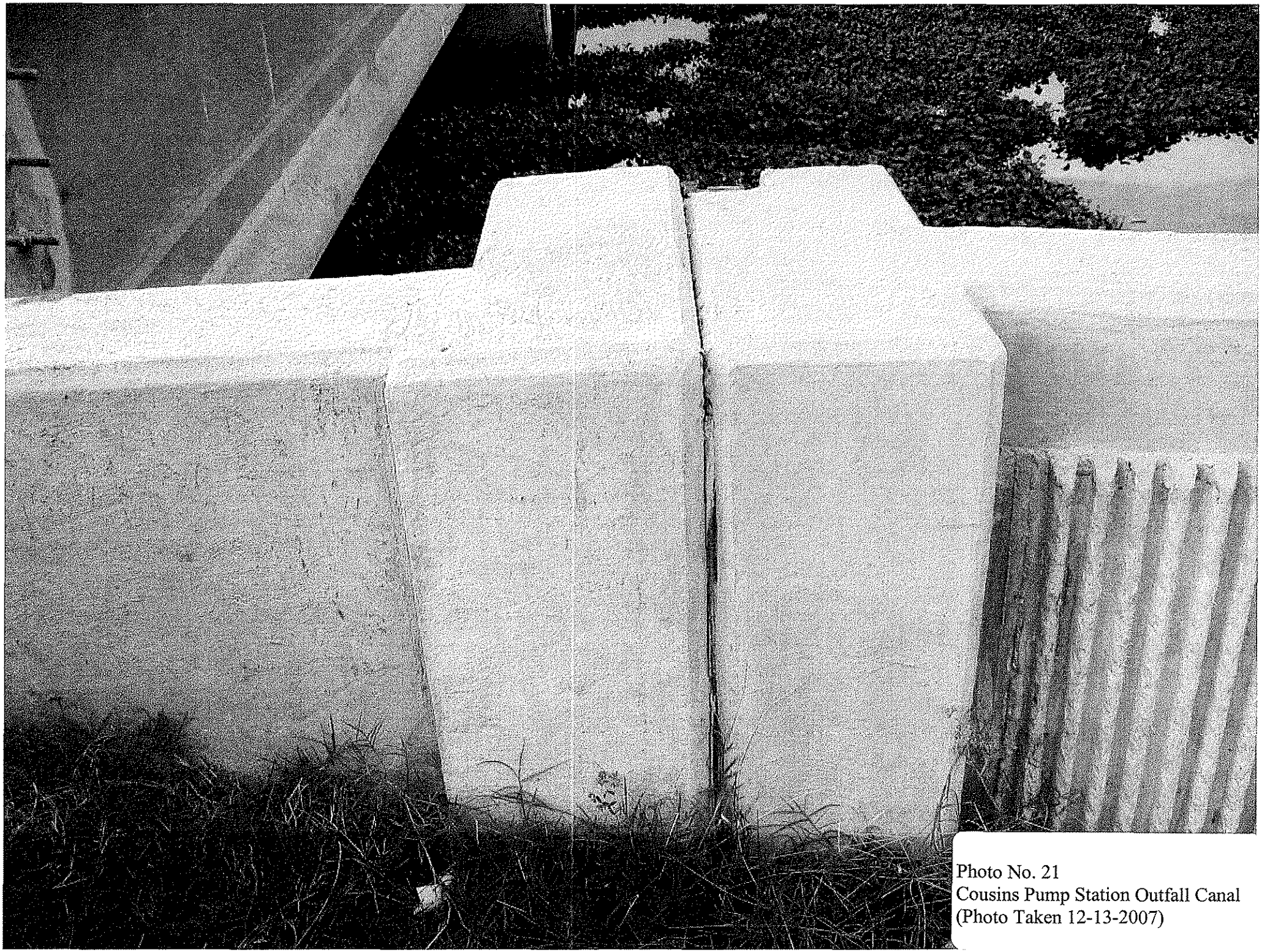

Photo No. 21
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 22
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 23
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

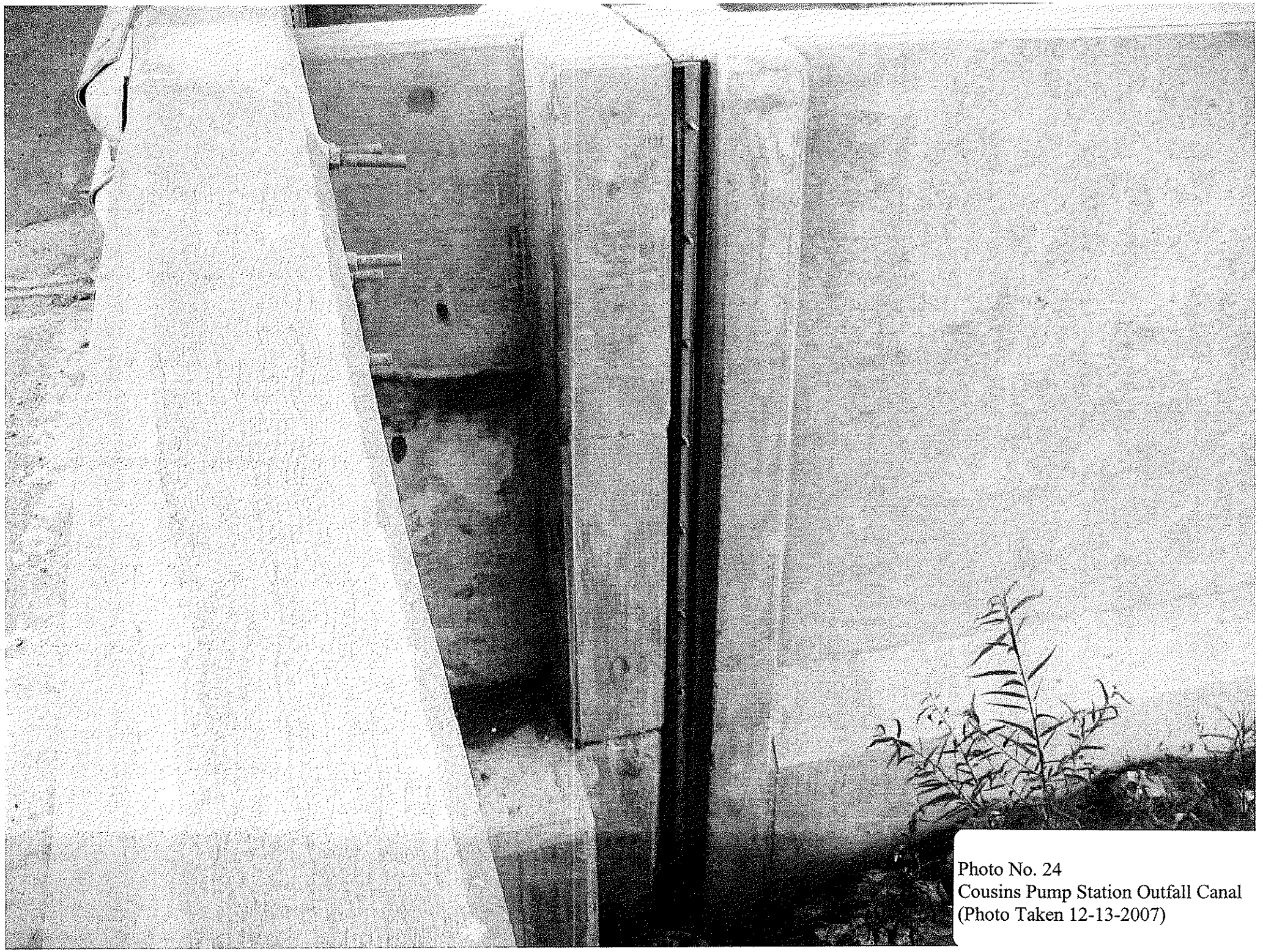

Photo No. 24
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

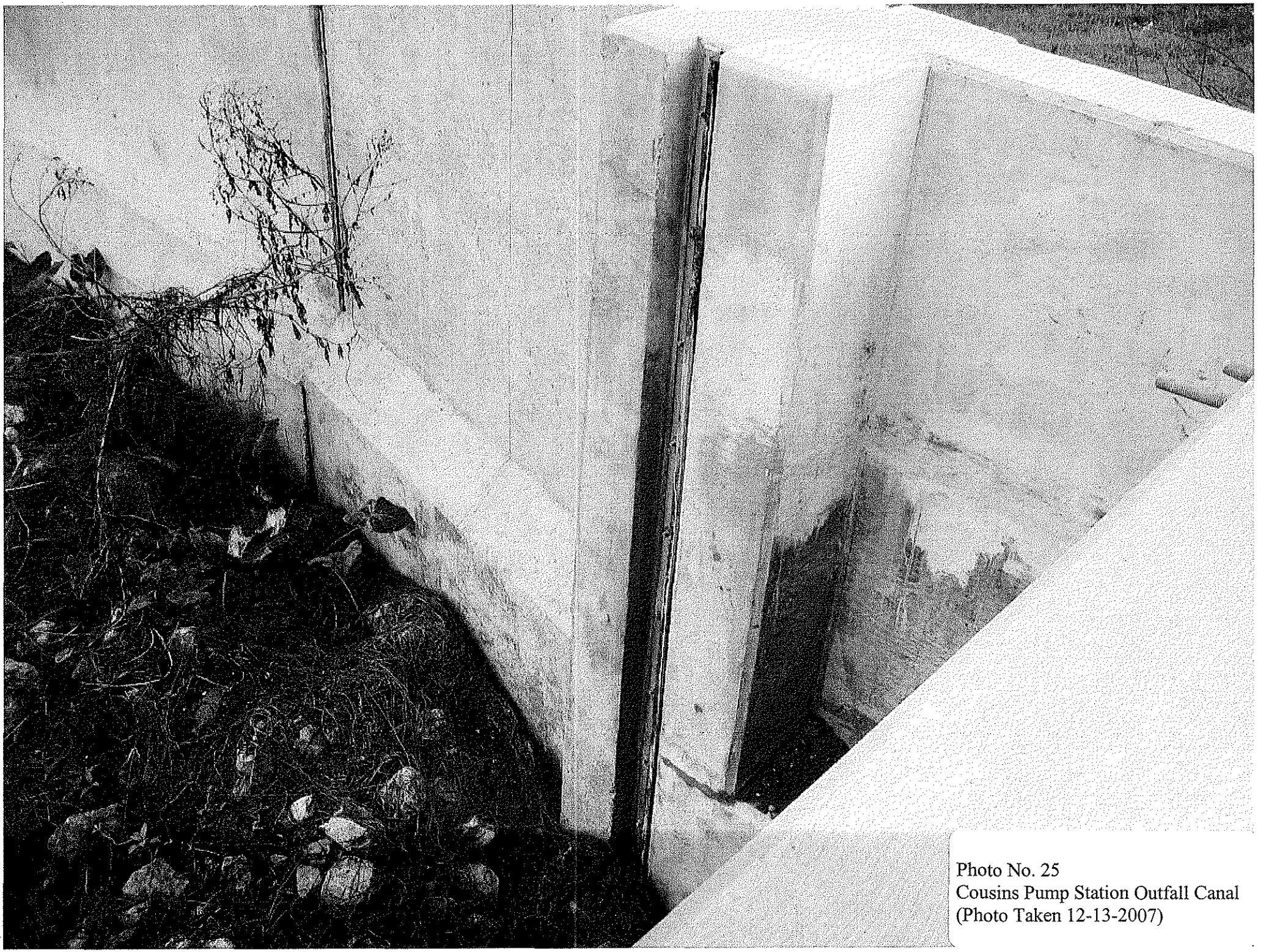

Photo No. 25
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

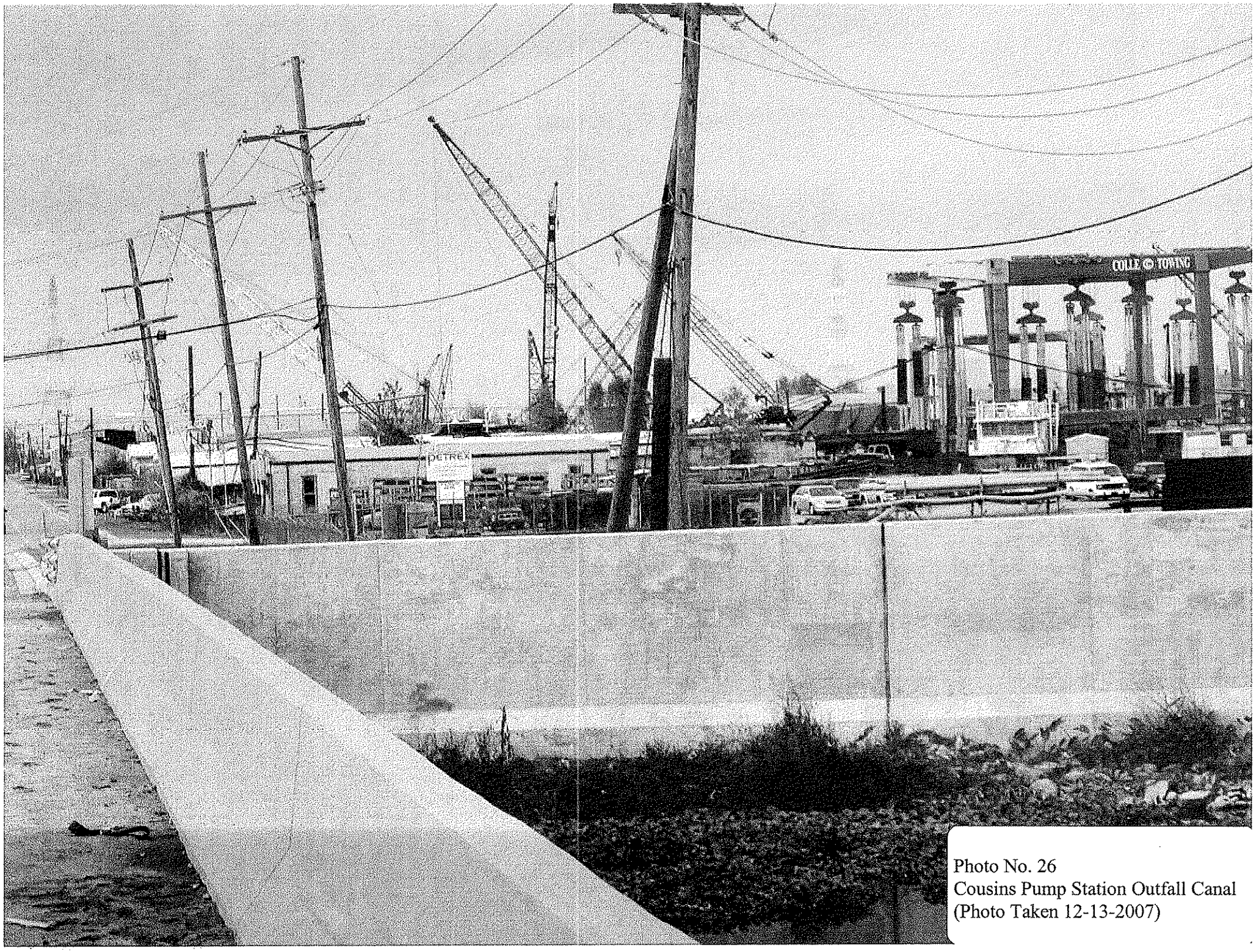

Photo No. 26
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 27
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

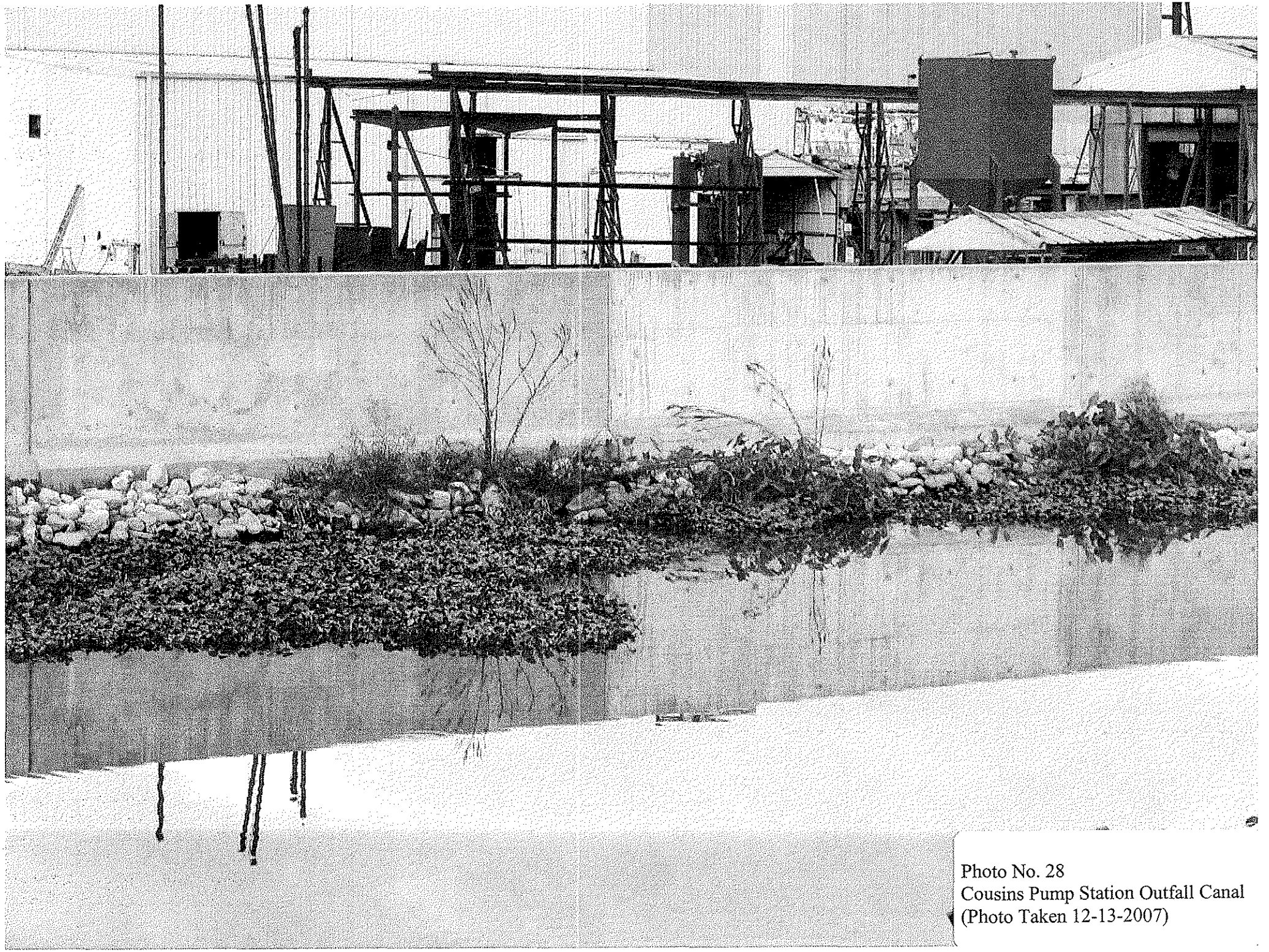

Photo No. 28
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

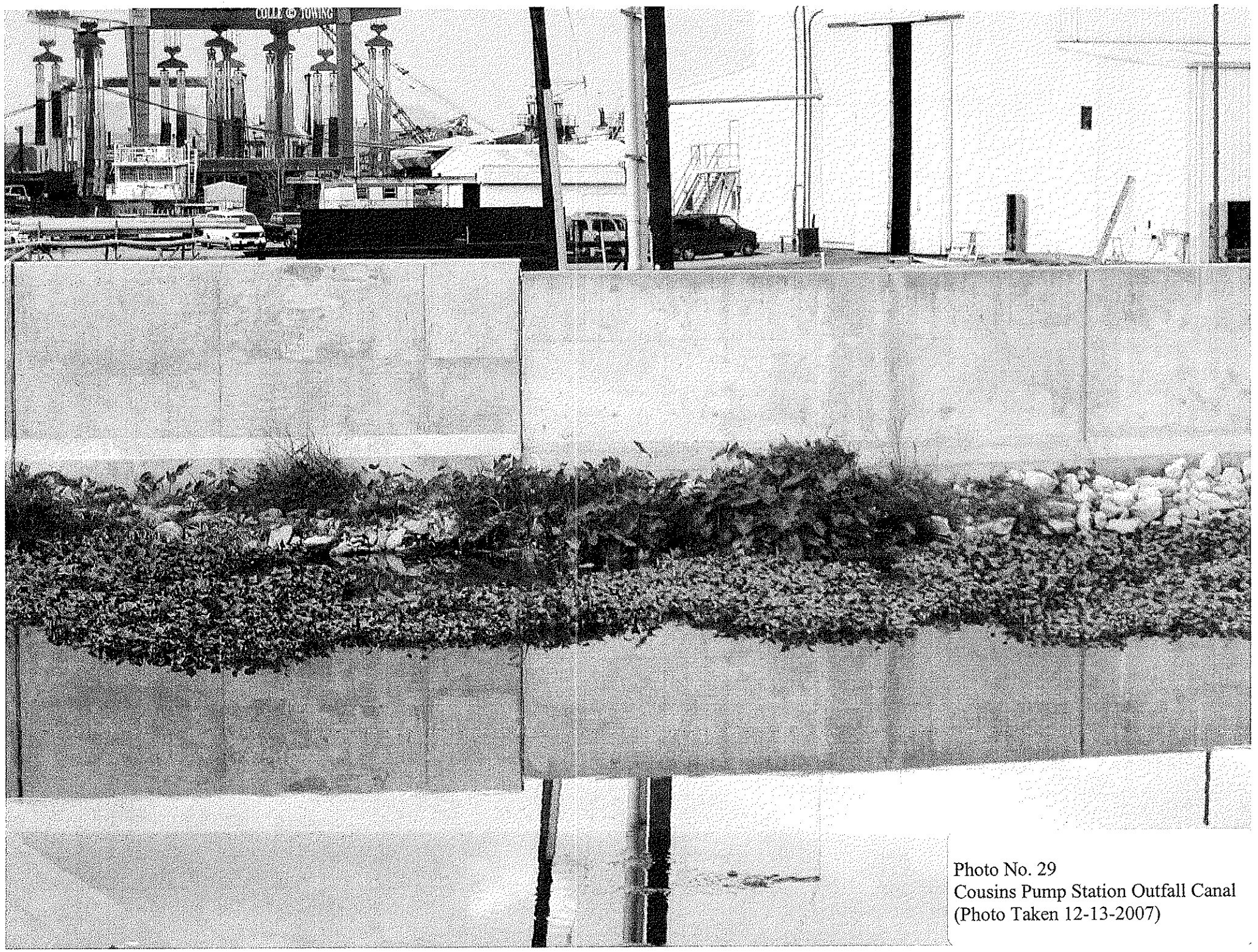

Photo No. 29
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

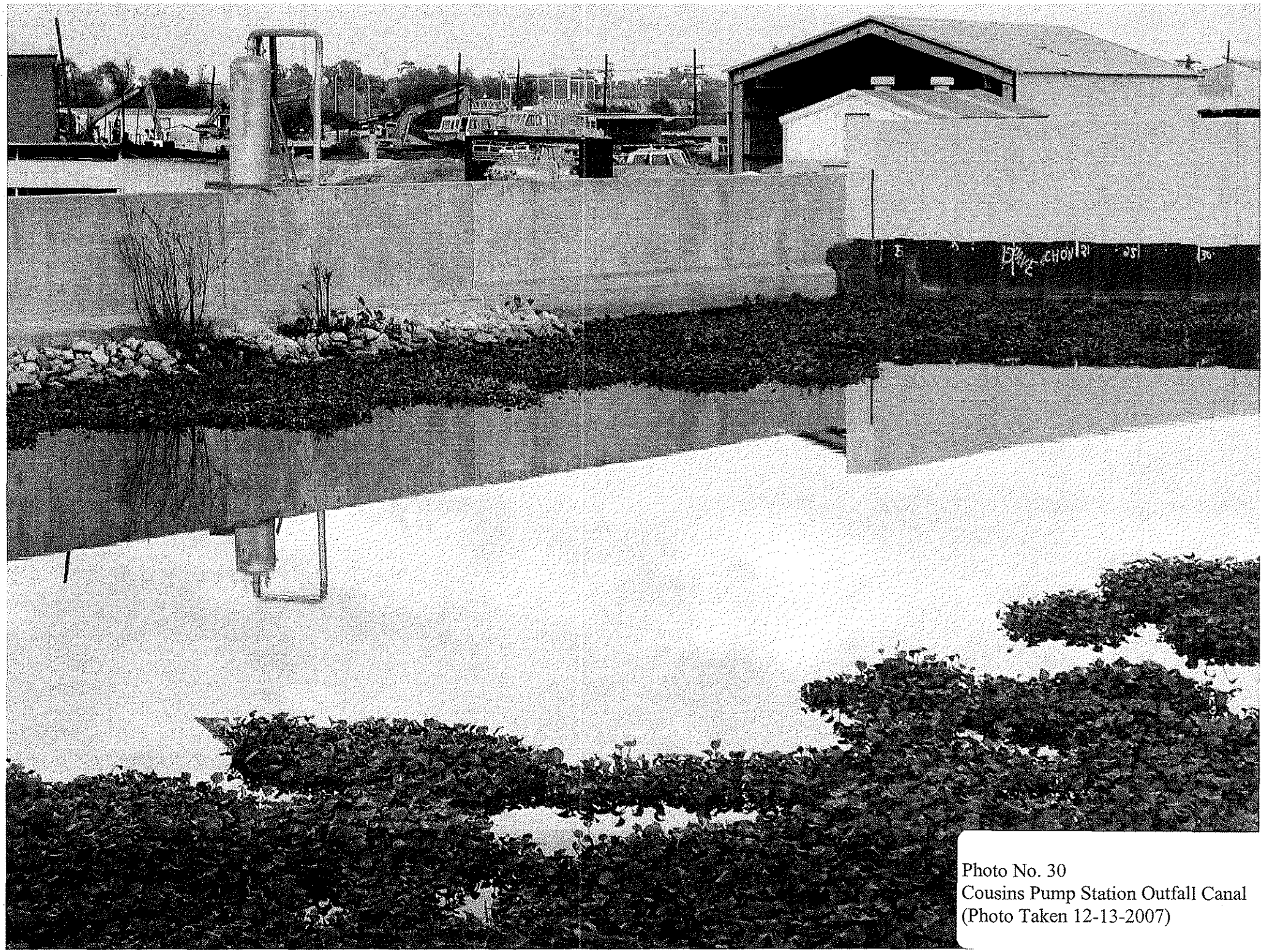

Photo No. 30
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

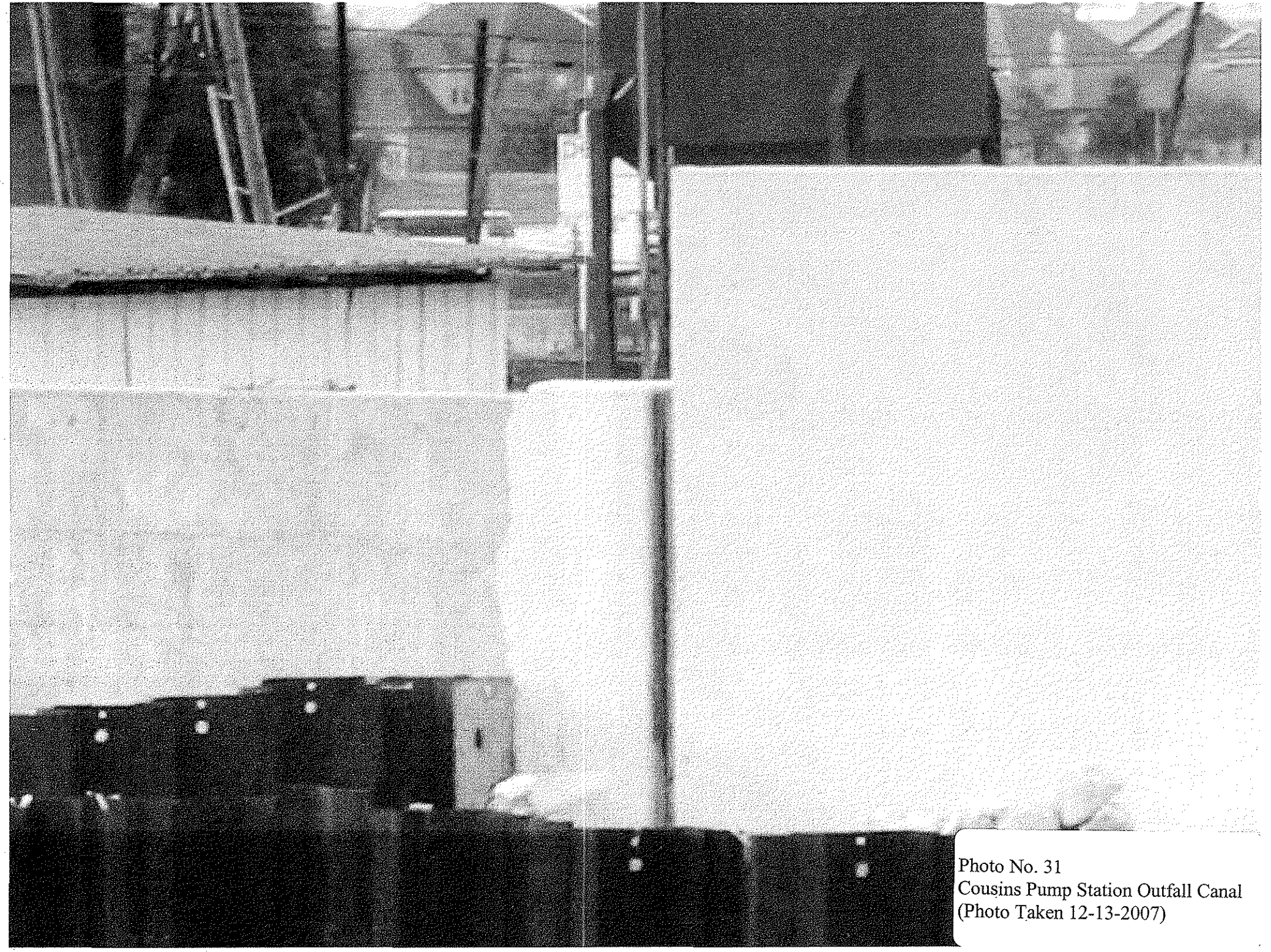

Photo No. 31
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

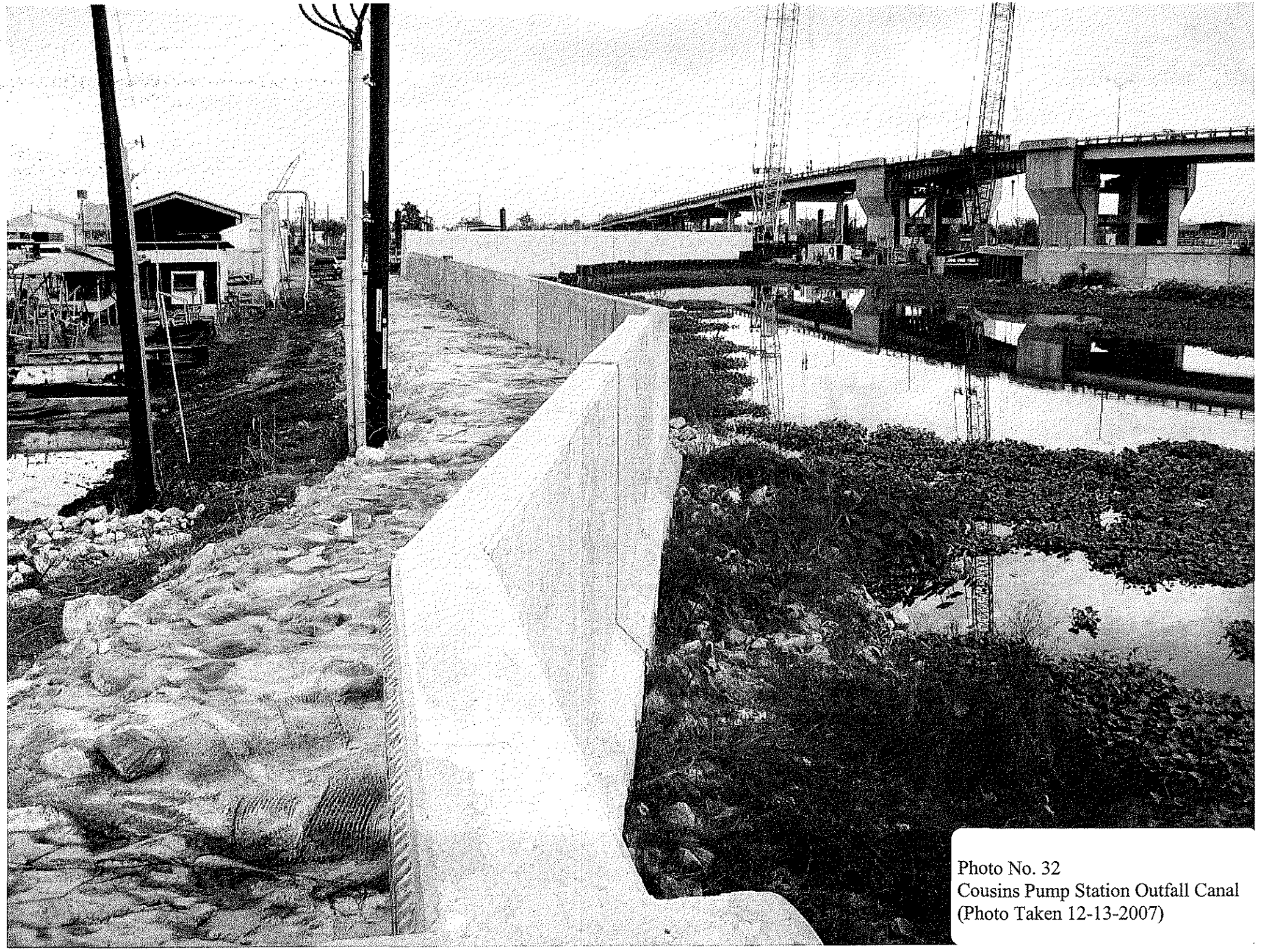

Photo No. 32
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

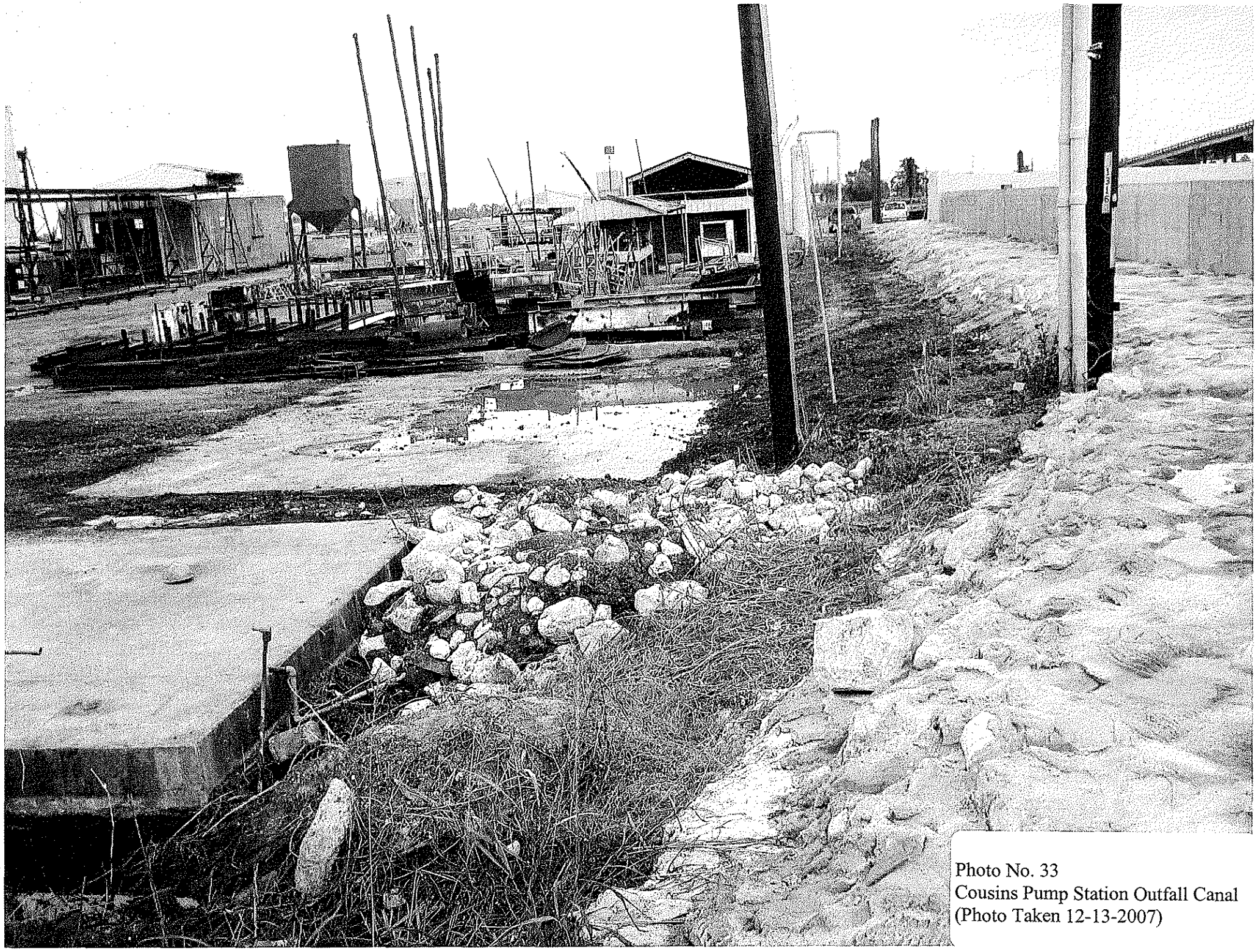

Photo No. 33
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

Photo No. 34
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)

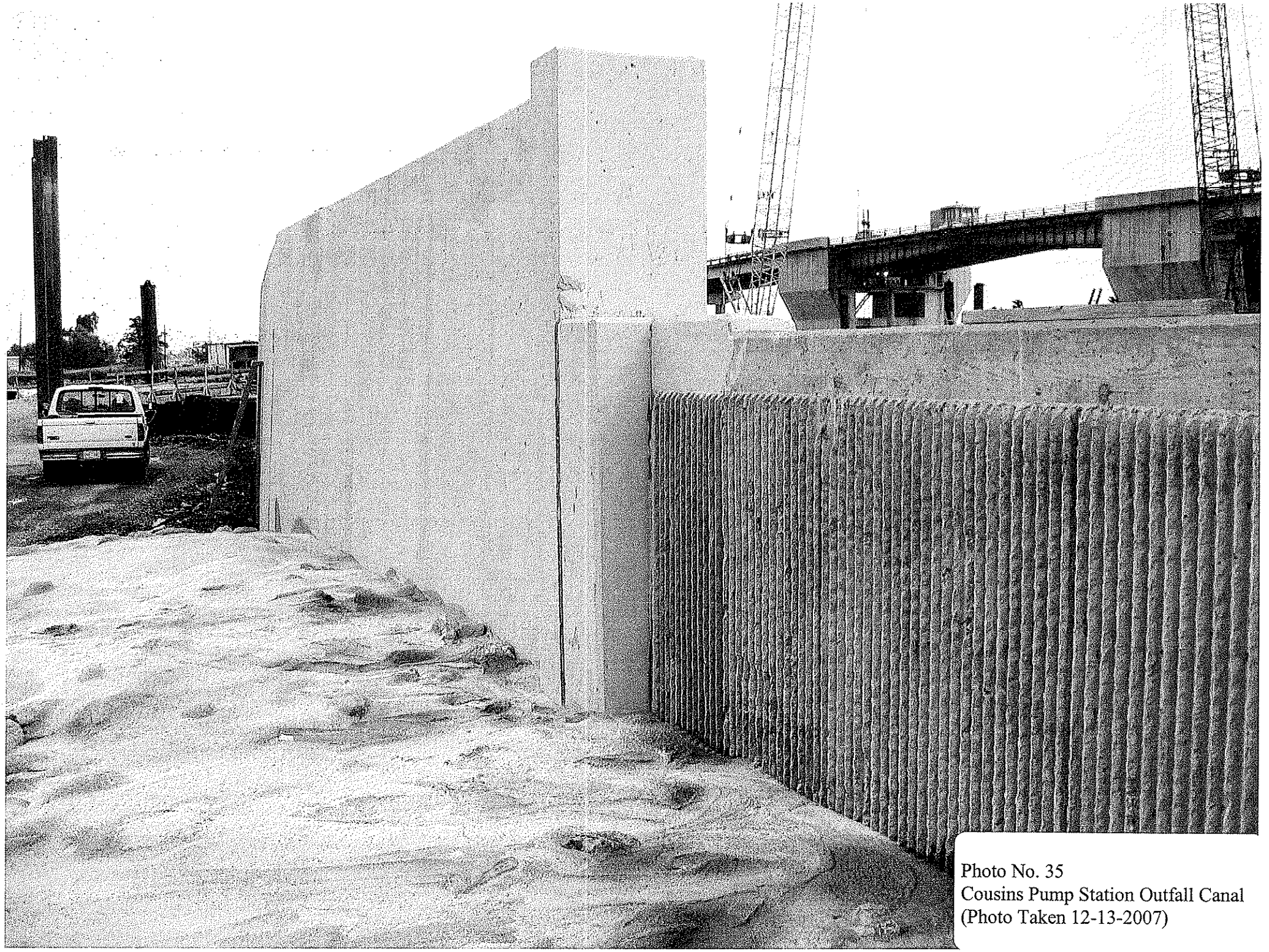

Photo No. 35
Cousins Pump Station Outfall Canal
(Photo Taken 12-13-2007)