LJA ENGINEERING

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September 29, 2017

Board of Directors
Pecan Grove Municipal Utility District
c/o Allen Boone Humphries Robinson LLP
3200 Southwest Freeway, Suite 2600
Houston, Texas 77027

Re: Preliminary Hurricane Harvey Drainage Evaluation
For Pecan Grove Municipal Utility District
LJA Job No. 1747-0300 (12.3)

Dear Board of Directors:

LJA Engineering, Inc. ("LJA") was engaged by Pecan Grove Municipal Utility District ("PGMUD" or the "District") on September 14, 2017, to perform a preliminary evaluation to determine possible causes of flooding in residential areas within the District during the Hurricane Harvey rainfall event that occurred August 25 through August 30, 2017. Our evaluation is specifically limited to Pecan Grove Plantation Sections 4 and 5 and the drainage improvements that were recently completed in that particular area of the District.

Our evaluation is based on the review of the following documents and on-site topographic survey of the Pecan Grove Plantation 4 & 5 Drainage Improvements performed on September 18, 2017. The documents reviewed are as follows:

- Construction Plans for Pecan Grove Plantation 4 & 5 Drainage Improvements, dated December 11, 2014 prepared by Jones & Carter, Inc., consulting engineer for PGMUD.
- 44 CFR §65.10 – Federal regulations related to mapping of areas protected by levee systems.
- The report, Storm Drainage Analysis and Improvements for Pecan Grove Municipal Utility District in Fort Bend County, Texas, dated June 2014 and prepared by Jones & Carter, Inc. (Storm Drainage Analysis).

We reviewed two sets of construction plans: (1) an approved set dated December 11, 2014, which was provided by the Fort Bend County Engineering Department and (2) a set of plans dated September 20, 2016, that were provided by Allen Boone Humphries Robinson LLP. The following paragraph details our review of the set of plans dated December 11, 2014.

As shown on the plans, the intent of the project was to implement the solution presented in the Storm Drainage Analysis for Plantation Sections 4 & 5 by adding an off-line pond to provide additional storm water runoff storage to reduce the level of street ponding during larger rainfall events. The project consisted of adding storm water runoff storage north of Plantation Drive that would channel excess runoff to the storage facility during extreme rainfall events, allowing it to

eventually drain through the existing storm sewer system when capacity is available. Several additional drainage inlets and storm sewer improvements both within the pond and the adjacent road system were also needed for the proposed system to perform. The runoff storage pond was designed to be approximately 15 feet deep, with a general slope from east to west. The storm sewer improvements consisted of constructing 24-inch and 48-inch storm sewers to direct storm water runoff to the pond. A 60-inch storm sewer was designed to convey runoff from the pond back into the internal storm sewer system at an existing manhole. The pond was initially designed to tie back into natural ground at Bullhead Slough, and, in the original construction plans dated December 11, 2014, the 24-inch and 48-inch storm sewer each included a flap gate at the pond outfall and the 60-inch storm sewer had a proposed sluice gate. Since the proposed pond was outside the levee system, the storm sewers were constructed with openings to the outboard side of the existing District levee system. The plans for the proposed project were fully approved by all applicable governmental entities including the City of Richmond, the Fort Bend County Drainage District, and Fort Bend County.

In our opinion, the original Plantation Sections 4 & 5 Drainage Improvements provided additional rainfall runoff storage during extreme rainfall events and provided positive closure of openings of the levee in accordance with 44 CFR §65.10 regulations. Closures are defined in 44 CFR §65.10 (b)(2). The regulations state as follows: *"all openings must be provided with closure devices that are structural parts of the system during operation and design according to sound engineering practice".*

The design concept was changed in a revision dated September 20, 2016. Part of this revision removed the proposed flap gates and sluice gates that provided positive closure on the storm sewers that extend outside of the levee. A berm designed to be constructed to an approximate elevation of 82 feet mean sea level (msl) was added to the storage pond. It appears from our review of the September 20, 2016 revised plans that the proposed height of the berm was meant to provide the District with protection from the effective base flood elevation of 81 feet msl for Bullhead Slough. The revised September 20, 2016 plans that we were provided did not include any approval signatures by governmental agencies, and, upon subsequent investigation, we could not confirm that the plan revisions were approved by any governmental agencies.

We offer the following limited opinions based on our review of the available information:

- The consulting engineer for the District made material changes to the December 11, 2014 plans that were approved in February 2015 and may not have obtained updated agency approvals for the changes to the plans dated September 20, 2016.

- The revisions to the plans removed the closure devices from the openings in the levee. Since the berm was proposed at elevation 82 feet msl, PGMUD was now susceptible to external storm water intrusion at approximately four (4) feet lower than the existing levee height of +/- 86 feet msl.

- The failure to provide closure devices on the openings in the levee appeared to directly contribute to internal flooding within the District.

- Based on on-the-ground surveys, the actual height of the berm on the east side of the rainfall storage pond varied in height from 81.1 feet msl to 82.0 feet msl which did not

provide one foot of freeboard over the calculated base flood elevation of Bullhead Slough of 81 feet msl. A high water mark of 82.02 feet msl on the northeast corner of the berm at Bullhead Slough was noted during our on-site topographic condition survey which would allow for overtopping of the berm and backflow of external storm water runoff into the internal Pecan Grove system.

- As a licensed engineer, we would not have recommended award of the construction contract for the Plantation 4 & 5 Drainage Improvements without the inclusion of proper closure devices on the three openings in the levee, as this would violate the 44 CFR §65.10 regulations.

- Based on the preceding statements, in our opinion the design of the Plantation Sections 4 & 5 Drainage Improvements were not performed in accordance with the standard of professional practice ordinarily exercised by the applicable profession at the time and within the locality where the services were performed.

As a temporary measure to provide non-structural closure of the drainage facilities, temporary plugs should be in the District's operator's possession for the 24-inch, 48-inch, and 60-inch storm sewers. These plugs should be installed and inflated when water surface elevations in Bullhead Slough reach pre-determined elevations. These procedures and closure levels would be discussed with the District prior to implementation.

As a permanent solution, the District has a minimum of two options to bring the levee system back into compliance with 44 CFR §65.10 regulations:

- Install flap gates on the 24-inch and 48-inch outfalls and also install sluice gates on each of the 24-inch, 48-inch and 60-inch storm sewers to provide proper closure.

- Construct a permanent levee on the north and east banks of the existing detention pond to properly close the levee system.

LJA's recommendation would be to proceed with the construction of the permanent levee along the north and east banks of the existing detention pond to provide permanent closure of the levee system. We include with this evaluation, cost estimates of the above recommended options for the District's information.

Finally, once the permanent levee is completed, the District should submit documentation to Fort Bend County and the Federal Emergency Management Agency (FEMA) to show the flood protection system for PGMUD is in compliance with 44 CFR §65.10 regulations.

This is a preliminary report based on currently available information. We reserve the right to modify, amend, or revise the report as additional information becomes available to us.

If you have any questions, please contact us.

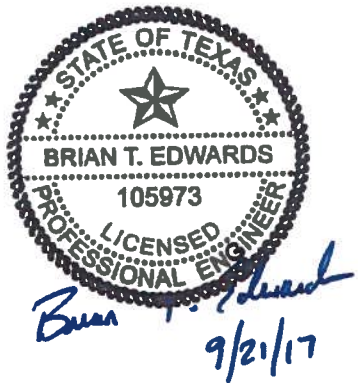
Sincerely,

Jason M. Kelly, PE
Vice President

Carolyn S. Gilligan, PE
CSG Water Resources Engineering, PLLC
Firm # 14001

CSG/JMK/rca

Attachments



NORTH BASIN LEVEE IMPROVEMENTS
TO SERVE THE PECAN GROVE MUD
OPTION 1 - CONSTRUCTION OF LEVEE

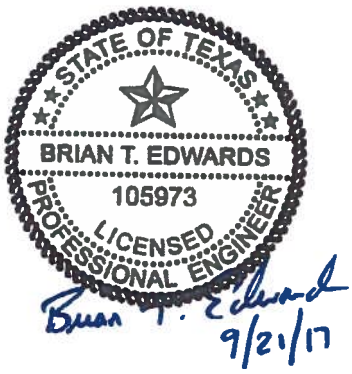
PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST

LJA Proj No. 1747-0300
Prepared By: BTE
Date: 9/21/17

ITEM	DESCRIPTION	QUANTY	UNIT	UNIT COST	TOTAL COST
BASE BID ITEMS					
1	EXCAVATION OF BORROW MATERIAL FROM HARVEST GREEN PROPERTY ADJACENT TO NORTH BASIN LEVEE, INCLUDES HAUL TO NORTH BASIN LEVEE CONSTRUCTION AREA, STRIPPING AND STOCKPILING OF STRIPPINGS, COMPLETE IN PLACE	16,200	CY	$ 2.50	$ 40,500.00
2	CONSTRUCTION OF PROPOSED LEVEE FOR NORTH BASIN, INCLUDES COMPACTION, FINAL GRADING, STRIPPING, STOCKPILE OF STRIPPINGS, DE-MUCKING EXISTING DITCHES IN LEVEE FILL AREAS AND RE-APPLYING STRIPPINGS, COMPLETE IN PLACE	16,200	CY	$ 3.50	$ 56,700.00
3	CONNECT NORTH BASIN LEVEE TO EXISTING PECAN GROVE LEVEE, INCLUDES KEY-IN, COMPLETE IN PLACE	2	EA	$ 50,000.00	$ 100,000.00
4	REMOVE AND DISPOSE OF BACKSLOPE SWALE INTERCEPTOR STRUCTURE, INCLUDES REMOVAL OF 24" CMP, REINFORCED CONCRETE, AND CEMENT STABILIZED SAND, COMPLETE IN PLACE	3	EA	$ 3,000.00	$ 9,000.00
5	DRAINAGE SWALE, V-BOTTOM, 3:1 SIDE SLOPES, COMPLETE IN PLACE	1,620	LF	$ 3.00	$ 4,860.00
6	CELLULAR CONCRETE MATTRESS SLOPE PROTECTION FOR DRAINAGE SWALE OUTFALL INTO BULLHEAD SLOUGH, INCLUDES BACKFILL, GEOTEXTILE FABRIC, TOPSOIL, SEED AND FERTILIZER, COMPLETE IN PLACE	150	SY	$ 80.00	$ 12,000.00
7	HYDROMULCH SEEDING AND FINE GRADING OF LEVEE IMPROVEMENTS AND SWALES, COMPLETE IN PLACE	5.4	AC	$ 2,000.00	$ 10,800.00
				SUBTOTAL BASE BID ITEMS	***$ 233,860.00***
SWPPP ITEMS					
1	STORM WATER POLLUTION PREVENTION PLAN COMPLIANCE AND INSPECTIONS, COMPLETE IN PLACE	1	LS	$ 1,500.00	$ 1,500.00
2	INSTALLATION, MAINTENANCE AND REMOVAL OF STABILIZED CONSTRUCTION EXIT, COMPLETE IN PLACE	1	EA	$ 2,500.00	$ 2,500.00
3	INSTALLATION, MAINTENANCE AND REMOVAL OF REINFORCED FILTER FABRIC FENCING, COMPLETE IN PLACE	2,500	LF	$ 1.50	$ 3,750.00
				SUBTOTAL SWPPP ITEMS	***$ 7,750.00***
MISCELLANEOUS ITEMS					
1	PURCHASE OF ADDITIONAL LAND FOR NORTH BASIN	1	AC	$ 40,000.00	$ 40,000.00
				SUBTOTAL MISC. ITEMS	***$ 40,000.00***
				SUBTOTAL	$ 281,610.00
				20% CONTINGENCY	$ 56,322.00
				TOTAL	**$ 338,000.00**

* Since the Engineer has no control over the cost of labor, materials, or equipment, or over the contractor(s) methods of determining prices, or over competitive bidding or market conditions, his opinions of probable Project Cost or Construction Cost provided for herein are to be made on the basis of his experience and qualifications and represents his best judgment as a design professional familiar with the construction industry, but Engineer cannot and does not guarantee that proposals, bids or the Construction Cost will not vary from the opinions of probably cost prepared by him

NORTH BASIN LEVEE IMPROVEMENTS
TO SERVE THE PECAN GROVE MUD
OPTION 2 - INSTALLATION OF GATES



PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST

LJA Proj No. 1747-0300
Prepared By: BTE
Date: 9/21/17

ITEM	DESCRIPTION	QUANTY	UNIT	UNIT COST	TOTAL COST
BASE BID ITEMS					
1	INSTALLATION OF REINFORCED CONCRETE JUNCTION BOX WITH CAST IRON GRATE TOP AND 60" SLUICE GATE WITH FLUSH BOTTOM MOUNT, INCLUDES REMOVAL OF EXISTING 60" HDPE PIPE AND CONNECTION OF 60" HDPE PIPE TO JUNCTION BOX, COMPLETE IN PLACE	1	EA	$ 75,000.00	$ 75,000.00
2	INSTALLATION OF REINFORCED CONCRETE JUNCTION BOX WITH CAST IRON GRATE TOP AND 48" SLUICE GATE WITH FLUSH BOTTOM MOUNT, INCLUDES REMOVAL OF EXISTING 48" HDPE PIPE AND CONNECTION OF 48" HDPE PIPE TO JUNCTION BOX, COMPLETE IN PLACE	1	EA	$ 75,000.00	$ 75,000.00
3	INSTALLATION OF REINFORCED CONCRETE JUNCTION BOX WITH CAST IRON GRATE TOP AND 24" SLUICE GATE WITH FLUSH BOTTOM MOUNT, INCLUDES REMOVAL OF EXISTING 24" HDPE PIPE AND CONNECTION OF 24" HDPE PIPE TO JUNCTION BOX, COMPLETE IN PLACE	1	EA	$ 75,000.00	$ 75,000.00
4	REMOVAL OF EXISTING CONCRETE SLOPE PAVING AND 48" HDPE PIPE AS NECESSARY TO CONSTRUCT STANDARD TXDOT CONCRETE WINGWALL AND INSTALL 48" WATERMAN F-10 DRAINAGE FLAP GATE, COMPLETE IN PLACE	1	EA	$ 28,000.00	$ 28,000.00
5	REMOVAL OF EXISTING CONCRETE SLOPE PAVING AND 24" HDPE PIPE AS NECESSARY TO CONSTRUCT STANDARD TXDOT CONCRETE WINGWALL AND INSTALL 24" WATERMAN F-10 DRAINAGE FLAP GATE, COMPLETE IN PLACE	1	EA	$ 15,000.00	$ 15,000.00
6	HYDROMULCH SEEDING AND FINE GRADING OF DISTURBED AREAS, COMPLETE IN PLACE	0.5	AC	$ 1,500.00	$ 750.00
				SUBTOTAL BASE BID ITEMS	***$ 268,750.00***
SWPPP ITEMS					
1	STORM WATER POLLUTION PREVENTION PLAN COMPLIANCE AND INSPECTIONS, COMPLETE IN PLACE	1	LS	$ 1,500.00	$ 1,500.00
2	INSTALLATION, MAINTENANCE AND REMOVAL OF STABILIZED CONSTRUCTION EXIT, COMPLETE IN PLACE	1	EA	$ 1,750.00	$ 1,750.00
				SUBTOTAL SWPPP ITEMS	***$ 3,250.00***
				SUBTOTAL	$ 272,000.00
				20% CONTINGENCY	$ 54,400.00
				TOTAL	**$ 326,400.00**

* Since the Engineer has no control over the cost of labor, materials, or equipment, or over the contractor(s) methods of determining prices, or over competitive bidding or market conditions, his opinions of probable Project Cost or Construction Cost provided for herein are to be made on the basis of his experience and qualifications and represents his best judgment as a design professional familiar with the construction industry, but Engineer cannot and does not guarantee that proposals, bids or the Construction Cost will not vary from the opinions of probably cost prepared by him.