BUFFALO BAYOU AND TRIBUTARIES

ADDICKS AND BARKER DAMS

INTERIM RESERVOIR CONTROL ACTION PLAN

U.S. ARMY ENGINEER DISTRICT, GALVESTON

CORPS OF ENGINEERS

GALVESTON, TEXAS

JULY 16, 2010

Memorandum for Record (CESWG-EC-HB)
Subject: Addicks & Barker Dams: Interim Reservoir Control Action Plan

1.0 PURPOSE. The purpose of this Interim Reservoir Control Action Plan is to develop interim reservoir operations to reduce the risk of catastrophic failure by evacuating pools quicker and increasing embankment surveillance. The potential failures addressed include seepage and/or piping near the conduit due to high reservoir pool elevations and conduit failure due to high release rates and pressure full condition. This Reservoir Control Action Plan will lower the likelihood of these failures by incorporating specific proactive operational procedures deviating from those of the Addicks and Barker Water Control Manual and the Addicks and Barker Reservoirs Emergency Action Plan.

2.0. HISTORY. Addicks and Barker Dams were screened by national risk cadre as part of the FY 2007 Screening for Portfolio Risk Analysis (SPRA). Based on the results of this risk screening, the dams were categorized as Dam Safety Action Classification (DSAC) II (Urgent). After the National Cadre initiated a Potential Failure Mode Analysis (PFMA) in September 2009, the Senior Oversight Group reviewed the DSAC and reclassified Addicks and Barker Dams as DSAC I (Urgent and Compelling). This classification is for those dams where progression toward failure is confirmed to be taking place under normal operations and the dam is almost certain to fail under normal operations within a time frame from immediately to within a few years without intervention; or, the combination of life or economic consequences with probability of failure is extremely high.

3.0 GENERAL OBJECTIVES. The Plan increases maximum reservoir pool releases in order to limit maximum reservoir pool elevations. Maximum pool limits are set at 97.5 ft NAVD 88 for Addicks Reservoir and 93.6 ft NAVD 88 for Barker Reservoir. These limits correspond to the maximum pool levels in the reservoirs experienced to date. Appendix A lists pool elevation triggers for increased dam monitoring and pool forecasting.

The allowed combined flow limit (including local runoff) at the downstream regulating gauge [Piney Point] is raised from 2,000 cfs to 4,000 cfs. Discharges greater than 4,000 cfs require authorization by the Division Engineer. Releases greater than 2,500 cfs must be authorized by the District Engineer and the District Dam Safety Officer (DSO). When possible, District Engineer will consult with Division Engineer prior to making releases greater than 2,500 cfs. For releases greater than 2,500 cfs, visual monitoring will be conducted to assess potential flooding impacts on specified locations downstream of the Reservoirs.

Specific release rates are recommended based on hydrology and hydraulics modeling. The regulating objective is to minimize the likelihood of exceeding target maximum reservoir pool elevations and flood damages to downstream structures. Appendices B and C contain tables and graphs for forecasting Addicks or Barker Reservoir pool elevations given a rainfall event in Addicks or Barker watershed. Appendix D relates the intensity and duration of a rainfall event in Buffalo Bayou watershed to resulting runoff flow at stream gages along Buffalo Bayou.

4.0 ASSESSMENT OF POTENTIAL FLOOD DAMAGE. Determinations of potential flood damages were assessed using USACE surveys of 1st floor structure elevations. Using USACE

surveys of 1st floor elevation data, it was determined that the lower level of homes in the vicinity of the West Beltway Bridge (approximately 6.5 miles downstream of the reservoirs) experience flooding at discharges in Buffalo Bayou of 4,100 cfs. This data is consistent with complaints of property inundation typically received by the District at discharges of 2,500 cfs and above. At flows greater than 4,100 cfs, a large percentage of the structures incurring flood damage are located between the bridges over Buffalo Bayou at North Wilcrest Drive (approximately 5 miles downstream of the reservoirs, measured along the streambed) and Chimney Rock Road (approximately 16 miles downstream of the reservoirs).

5.0. INTERIM PERIOD. Adjustments to the operation of Addicks and Barker Reservoirs and procedures outlined in this Interim Reservoir Control Action Plan will be in effect until the dams can be operated safely under normal flood risk management regulation as outlined in the Addicks and Barker Water Control Manual.

6.0 INTERIM ADJUSTMENTS TO THE FLOOD RISK MANAGEMENT REGULATIONS. The Interim Reservoir Control Action Plan will also direct operating the reservoirs to maximize their available storage capacity. However, flows at the downstream regulating gauge, Piney Point, can be raised to 4,000 cfs to limit maximum reservoir pool elevations. Forecasting models will be used to calculate optimum pool release rates. With consideration of these additional constraints, the current flood risk management operations will stay basically the same except for a few interim adjustments.

6.1 Interim Adjustment to Equal Available Storage Requirement. In order to maintain equal available storage in both reservoirs (in inches of runoff from the respective drainage areas above the dam), releases, based on available downstream channel capacity, are required to be made at rates necessary to maintain a difference in reservoir storages of no more than 20 percent. If there is a justifiable need to remove water faster from either reservoir, the 20 percent differential in storage between the reservoirs can be waived during the interim period after all impacts have been identified and determined to be negligible for each situation.

6.2 Interim Adjustment to Reservoir Regulation for Special Events. Since 1989, SWD has provided a standing approval to store water in both reservoirs up to 78.9 feet NAVD 1988 in Addicks and 79.7 feet NAVD 1988 in Barker for special events with an annual notification in lieu of a specific deviation request. For Addicks Reservoir, this elevation corresponds to 0.25% of government-owned land storage capacity and a water surface 11.4 feet above the invert of the box culverts (8'X6'each). For Barker Reservoir, this elevation corresponds to 0.71% of government-owned land storage capacity with a water surface 9.5 feet above the invert of the box culverts (9'X7'each).

During the interim period, this request to hold water for special events without SWD approval for the above mentioned elevations is rescinded. All operations not covered by the approved reservoir regulations will be coordinated with SWD. When the dams are removed from the extremely high risk category and determined to be safe for the resumption of normal operations, the special event dispensation will be discussed with SWD for inclusion into the Water Control Manual.

6.3 Interim Adjustment to the Coordination of Deviations. Deviations to the approved Water Control Plan regarding reservoir regulation will also be coordinated with the Galveston

District Dam Safety personnel. This coordination will include emergency, unplanned and planned deviations.

6.4 Interim Adjustment Phase 1 of the Addicks and Barker Reservoirs Emergency Operation Plan. Phase 1 elevations will be lowered to the maximum pool of record elevation for each reservoir. Since Addicks and Barker Dams have never experienced pools above these levels, Dam Safety personnel have indicated the dams need to get additional attention as water levels go above their perspective record pools.

6.5 Interim Adjustment Increased Dam Monitoring. As part of the interim operations plan, tables B1 and B2 highlighting pool elevation triggers for increased dam monitoring will be included. Because of the episodic frequency of high pools in the reservoir, these trigger elevations may be coincident to those published in the existing Emergency Action Plan. Tables B1 and B2 shows trigger elevations with response actions to be taken on Addicks & Barker Dams.

Appendix A

Table A1. Addicks Reservoir: Reference Pool Elevations

Pool Elev 1988 NAVD	Pool Elevation Triggers	Name/ Condition	% Gov	% Total	Action/ Response
67.5	Conduit Invert		0	0	None
75.5	2' above top conduits		<1	<1	**Begin Forecast Modeling**
87.0	None	Extended Watch	6	4	Monitor Situation
92.9	2 – year		24	15	Monitor Situation
95.7	5 – year		39	25	Monitor Situation
96.5	10 – year		45	28	Monitor Situation
97.46	Record Observed Pool ~25 – year	Interim Phase 1	51	33	Target Maximum Reservoir Pool Elevation
100.3	100 – year		74	47	
103.0	Gov't - owned Land		100	64	
108.0	NG End of Dam		100	100	

Table A2. Barker Reservoir: Reference Pool Elevations

Pool Elev 1988 NAVD	Pool Elevation Triggers	Name/ Condition	% Gov	% Total	Action/ Response
70.2	Conduit Invert		0	0	None
79.2	2' above top conduits		<1	<1	**Begin Forecast Modeling**
85.0	None	Extended Watch	7	3	Monitor Situation
88.9	2 – year		25	10	Monitor Situation
91.7	5 – year		55	22	Monitor Situation
92.7	10 – year		68	27	Monitor Situation
93.6	Record Pool ~25 – year	Interim Phase 1	80	32	Target Maximum Reservoir Pool Elevation
95.0	100 – year		100	40	
95.0	Gov't - owned Land		100	40	
104.0	NG End of Dam		100	100	

Appendix B

Table B1. Single Event Rainfall to Achieve Reservoir Capacities

ADDICKS RESERVOIR				
	DRAINAGE AREA 136 SQ. MI.		1" RUNOFF = 7253 ACRE-FT	
Elevation* (feet)	Flood Frequency (years)	Surface Area (acres)	Capacity (acre-feet)	RAINFALL - No losses
108.00	Max. Pool	16432	200840	29.0
107.50	SPF	15402	178556	25.8
103.00	250	12460	116263	16.8
100.30	100	11150	91454	13.2
98.40	50	9874	74591	10.8
97.46	Mar. 9, '92	8846	57956	8.4
97.50	25	8386	57283	8.3
87.00		1602	5707	0.8
67.50		0	0	

BARKER RESERVOIR				
	DRAINAGE AREA 130 SQ. MI.		1" RUNOFF = 6933 ACRE-FT	
Elevation* (feet)	Flood Frequency (years)	Surface Area (acres)	Capacity (acre-feet)	RAINFALL - No losses
104.00	Max. Pool	16740	209000	30.1
99.00	SPF	13889	123653	17.8
95.00	100	12293	89498	12.9
95.00	70	12060	83410	12.0
93.90	50	11706	75087	10.8
93.60	Mar. 7, '92	11338	66910	9.7
93.40	25	11043	59189	8.5
85.00		2280	6005	0.9
70.20		0	0	

Appendix C

Forecasting Charts

The following charts were developed as an interim measure to aid in forecasting reservoir pool elevations based on average rainfall over the entire reservoir watershed, reservoir releases, and initial reservoir pool elevation and inflow. CWMS computer models were manually utilized using several controlled gate outflow release rates ranging from fully closed to fully open gate conditions. This allows the experienced Reservoir Control Officer to use engineering judgment to interpolate within and between the different curves to fit specific on-site conditions. An initial inflow into the reservoir of 1000 cfs is assumed in all these charts. Additional charts will be added using different initial inflow conditions. It should be noted that when water begins to go around the dam (Pool elevation: 104 ft Barker, 108 ft Addicks), these charts will return higher pool elevations. Those elevations should not be considered valid.

Additionally Appendix D shows corresponding runoff flows at the Dairy Ashford gage, West Belt gage, and Piney Point gage for similar rainfalls over the downstream Buffalo Bayou watershed to Shephard Drive. These forecasted runoff flows at the respective gages do not include reservoir release outflows.

Appendix D

Downstream Rainfall-Runoff Forecasting

The graph below shows forecasted rainfall-runoff amounts for the Dairy Ashford gage, West Belt gage, and Piney Point gage for various rainfall-duration amounts over all runoff contributing areas downstream from the reservoirs. These runoff amounts are separate from any possible reservoir outflow releases.