

U.S. Army Corps of Engineers, Kansas City District



Final Feasibility Report

EXHIBITS

*Kansas Citys, Missouri and Kansas
Flood Risk Management Project
Final Feasibility Report*



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EXHIBIT #2: Photograph of 1951 Kansas River Flood at Kansas City

- **Kansas River flood event**
- **Kansas River Basin lakes not operational**
- **All 3 Kansas River units overtopped in Kansas City**

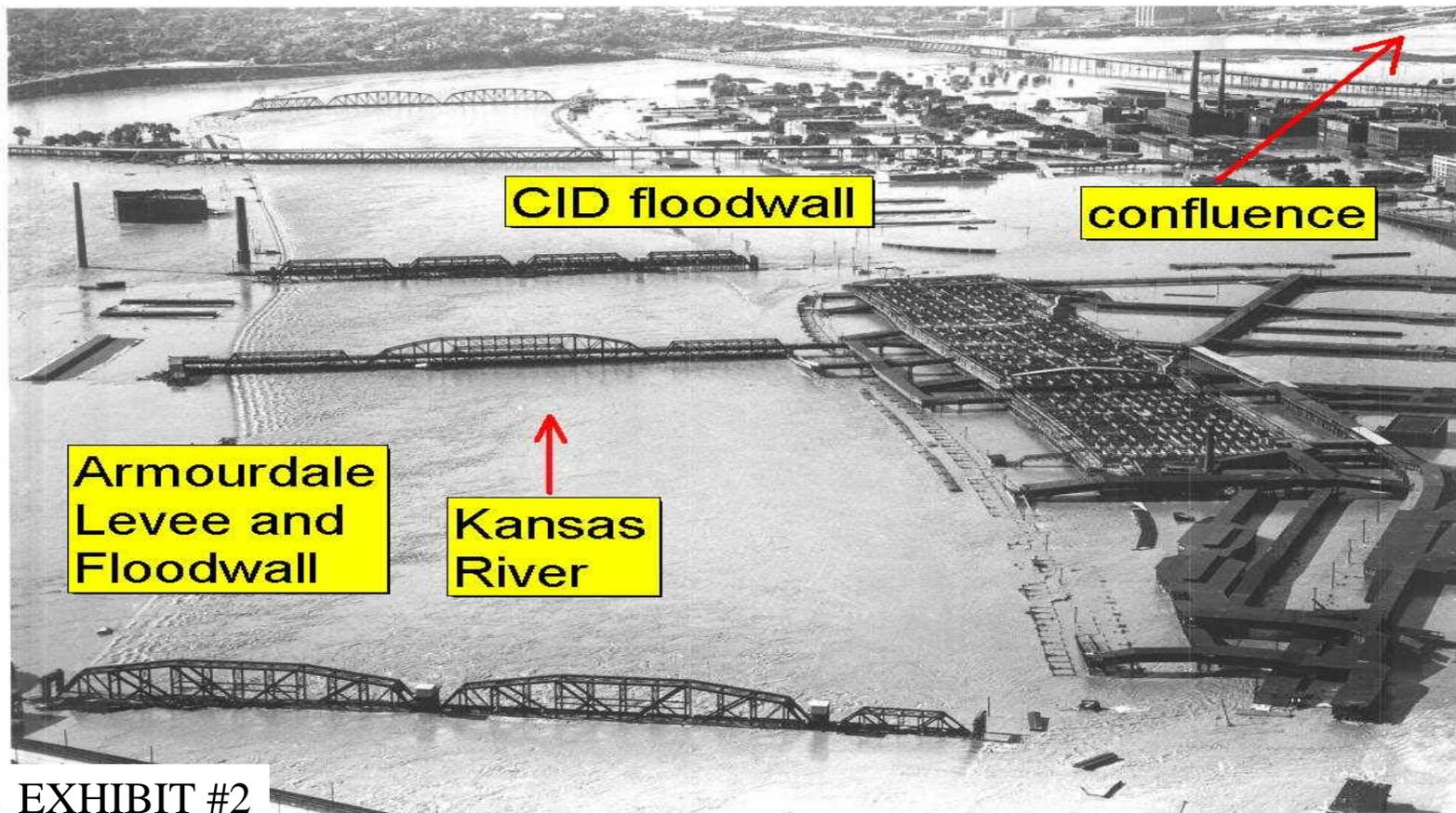
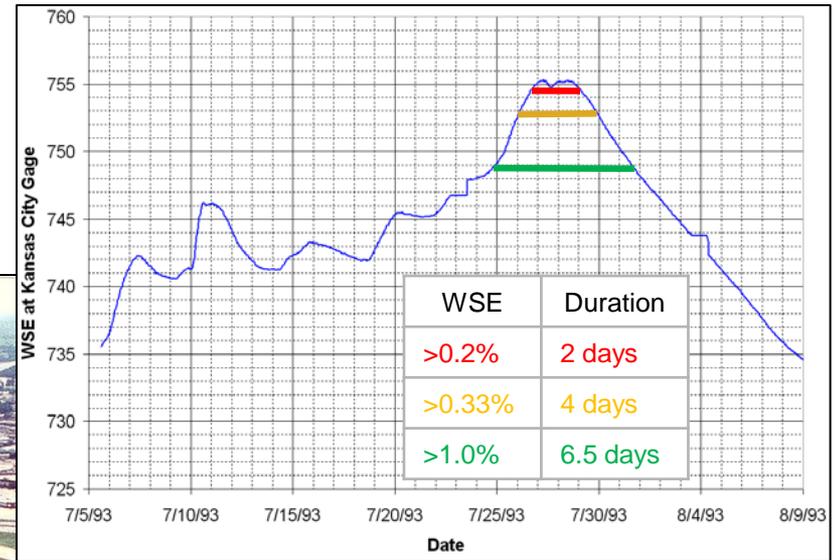


EXHIBIT #3: 1993 Flood at Kansas City

Kansas and Missouri River Confluence



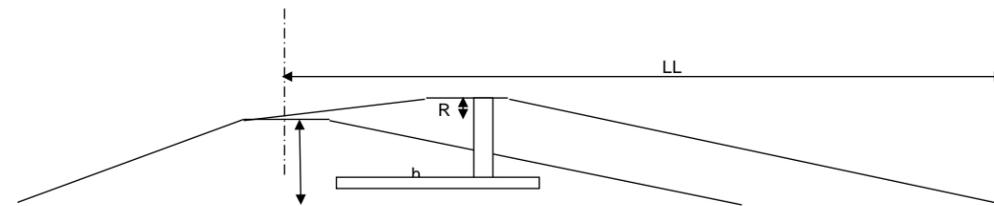
Event Hydrograph
Kansas City Gage – Missouri River
WSE = Water Surface Elevation

Map Sheet #	Unit Descriptions			Existing			Proposed				HTRW	Real Est. (RE)		Notes
	Station Beginning	Station Ending	Length of Unit FT	Description	Relief Well Systems, Pump Plants, and Stability Features	Primary Levee Height (h) FT	Description	Stability Control Needed	Under-seepage Control	Proposed Primary Levee Raise R=N500+3 FT		HTRW	Real Estate Notes	
A1	00+05UE	3+25UE	320	Stop log Gap		13	New SLG			3.8		RR lost time issues if traffic stopped	Busy RR crossing will make replacement a challenge. Existing SLG is integral with forcemain valve.	
	3+25UE	10+00UE	675	Levee		9	Riverside Levee Raise	L Berm		3.8		No RE Issues at this time	H&H input needed for this riverside Levee Raise.	
	10+00UE	16+48UE	648	Levee	13+50 to 14+50: Riverside Slope Stability Berm	9.5	Modify F-AC					No RE Issues at this time. Coordination for removal of abandon RR tract required.	RR tracks are landside. Two out fall structures (Mattoon Creek is one) are riverside. Floodwall will reduce RR and outfall issues.	
	16+48UE	20+08.89UE	360.89	Levee		9.5	Levee Raise			3.9		No RE Issues at this time	High Ground landside above top of existing levee.	
	Station Equation: 20+08.89UE BK = 9+71.16AH.													
	9+71.16	15+00	528.84	Levee		9.5	Levee Raise			3.9		No RE Issues at this time	High Ground landside above top of existing levee.	
	15+00	35+00	2000	Levee		4 to 6	Levee Raise	Flattened Slope		4.1		May go beyond current right-of-way when the estimated 15 feet of permanent and 15 feet of temporary right-of-way is added. May get into abandoned rails. Looking at UP ownership.		
35+00	42+50	750	Levee		13.5	Levee Raise	Flattened Slope w/ Berm		4.1		Will go beyond current right-of-way. Estimate up to 15 feet of permanent and 15 feet of temporary right-of-way will be needed. Will get into abandoned rails. Looking at UP ownership.	Need to confirm we can take abandoned RR - 1 set exists		
A2	42+50	58+00	1550	Levee		11.5 to 13.5	T-wall on exist Levee	Flattened Slope w/ Berm		4.3	HTRW A	Potential P&G interference. RR @ toe of levee. Not in use. Need to identify the track owner. Loss of operation area and fence replacement. Fencing will have to be replaced.	1 set Rails visible but unused	
	58+00	60+40	240	Levee		11.5 to 13.5	Modify F-AC				HTRW A	Area for temporary right-of-way will be limited	Floodwall to avoid Procter & Gamble	
	60+40	77+80	1740	Floodwall	Osage PP Sta 76+83	11 to 15	Replace F w/ F-AC		COW starts at 62+00	4.3	HTRW A	No RE Issues at this time	Positive cut off wall to bedrock with be used for underseepage 62+00 to 82+00. Riverside earthen levee raise was considered but deemed too costly compared to floodwall. Environmental impacts are minimized with floodwall.	
	77+80	81+00	320	Levee	Osage PP Sta 76+83	13	Replace L with F-AC		COW	4.6	HTRW A	Determine compensability of KAW Valley Power utilities.	Positive cut off wall to bedrock with be used for underseepage 62+00 to 82+00. KAW PP utilities will be cut off due to slurry wall. This includes all intake lines, discharge lines and associated utilities. Intake access bridge will be removed. Intake bridge is owned by KAW PP. Osage Pump Plant and Piping to remain. KAW PP Sealing weir drainage structures' and pipes exist and must be cut for installation of cutoff wall. With T-wall or levee at 77+78 would possibly interfere with operational RR tracks.	
A3	81+00	96+00	1500	Levee		11 to 12	Levee Raise	Flattened Slope	COW End Sta. 82+00	4.8		No RE Issues at this time	Trash may have been dumped near area proposed for levee expansion.	
	96+00	105+00	900	Levee		11	T-Wall on Levee	Flattened Slope w/ Berm		5.2		Storage Silo, Maint Bldg and Access Road possibly affected. Relocation needs to be determined. The need for estimated permanent and temporary easement will affect building, access road, and maneuver area. Land survey required to verify current easement line.	Twall to avoid KC Hardwood property. 58' to building but access to bldg is needed between levee and bldg. T-wall on bridge will jog around bridge piers. Need to route levee road to the land side to avoid 18th St. Bridge pier.	
	105+00	129+00	2400	Levee		8.5 to 14	Levee Raise	Flattened Slope (w/ Berm 115 to 129)		5	HTRW B	Land survey essential to determine correct right-of-way. Both salvage yards and KC Railway will be affected by perm easement. Work area easement on KC Railyard also of concern.		
A4	12th Street Bridge Crossing						New SBG							
	129+00	157+00	2800	Levee	12th Street PP Sta 129+00; Mill St PP Sta 156+75	5.5	T-Wall on Levee	Flattened Slope		4.8	HTRW C	May go beyond current right-of-way. Estimate that will need 30 additional feet. Ditch at Station 155+00, between Trimodal and adjacent landowner to east, will need to be maintained with fill for integrity of project (this will require a permanent easement). Land survey required to verify existing easement line, encroachments and determine additional ROW required	T-wall extended upstream to reduce impacts that a levee raise would have on the 12th Street Pump Station. T-wall extended downstream to reduce impacts that a levee raise or T-wall would have on the Mill Street Pump Station. Access onto Trimodal Container Recycling has been discussed with Corps attorney and preliminary review indicates we will be able to allow contractor to drive on top of the area. This is pending a review by a Real Estate Attorney who would look into the Construction Easement issues.	
A5	157+00	172+50	1550	Levee		4.5	Levee Raise	Flattened Slope	Fill ditch behind Mill St. PP	4.6	HTRW C	No RE issues at this time		
	172+50	185+00	1250	Levee		4.3	T-Wall on Levee	Flattened Slope		4.5		Appears to be within existing right-of-way except for approximately 30 feet of permanent and temporary easement requirements. Additional 30 feet will interfere with access roads, loading dock, parking, storage areas, power lines and fire hydrant.		
	185+00	197+00	1200	Levee	5th St PP Sta 185+70, W-I; Midwest Cold PP Sta 194+60	14 to 15.5	Modify F-AC		RW	4.3		No RE Issues at this time but limited RE available for work area.	Floodwall extended upstream to reduce impacts on 5th Street P.S. with a levee raise or T-wall and berm. Midwest Cold Storage building may need to be evaluated due to its old age and closeness to the levee	
	197+00	206+12	912.43	Levee	W-I	10.5 to 13	Levee Raise	Flattened Slope	RW	4.3		Acq of approximately 20 ft of parking areas, storage area, and note diesel tanks at station 204+05 (this may require relocation). Land survey required to verify existing easement line, have attorney review the survey to determine any adverse possession rights entitled to landowner.	Raise Well Manholes w/ Levee Raise. Relief well collection system W-I is deep. Addition to or replacement of will be difficult.	
Station Equation 206+12.43 BK = 212+00 AH														
	212+00	227+85	1585	Levee	W-I	15	Modify F-AC		RW	4		No RE Issues at this time	Floodwall reduces impacts on adjoining businesses.	

Map Sheet #	Unit Descriptions			Existing			Proposed				HTRW	Real Est. (RE)		Notes
	Station Beginning	Station Ending	Length of Unit FT	Description	Relief Well Systems, Pump Plants, and Stability Features	Primary Levee Height (h) FT	Description	Stability Control Needed	Under-seepage Control	Proposed Primary Levee Raise R=N500+3 FT		Real Estate Notes		
A6	226+75			SLG			New SLG : KCT Bridge						RR lost time issues if traffic stopped	
	227+85	24000	1215	Levee	Shawnee Ave Sta 230+78; W-I	15 to 17	T-Wall on Levee	Flattened Slope w/ Berm	RW	4			Abandon RR visible. Building concerns at Sambol, SELCO and Pensky. Significant loss of parking and maneuver areas.	
	240+00	257+66.26	1766.26	Floodwall/Levee	W-I	13 to 16.5	Modify F-AC		RW	3.8			RR lost time issues if traffic stopped	CRI&P stop log gap at 249+54 has been filled in with concrete. Floodwall extended to reduce impacts on adjoining businesses having parking area and substantial loading docks. Reach includes approx. 367 lf of existing floodwall.
A7	Station Equation 257+66.26 BK = 257+64.97 AH													
	257+64.97	261+50	385.03	Floodwall	W-II	13	Modify F - New Row of Piles		Fill Slot ARW	3.5			Possible temporary lost parking due to work area easement	
	261+50	274+36	1286	Floodwall	W-II		Modify F - No New Piles		Fill Slot ARW	3.5			Possible temporary lost parking due to work area easement	
	274+36	277+21	285	SBG x 2	W-II		SLG x 2		Fill Slot ARW	3.5	HTRW D		RR lost time issues if traffic stopped	UP and MO Pac RR Bridge Closure Structure. Major coordination with RR will be needed during detailed design.
	277+21	283+50	629	Floodwall	W-II		Modify F - No New Piles		Fill Slot ARW	3				
A8	Central Avenue Bridge Crossing													
	295+50	302+58	708	Floodwall	W-III; National Beef PP Sta 295+52; Central Ave PP Sta. 299+20	17.5 to low ground	Modify F - New Row of Piles		RW	1.8			Need to ID RR ownership and verify activity. Ponding area will require a flowage easement. Two pump stations will be removed and not replaced.	A levee requires removal of pump station and well system W-III. Levee requires replacement and realignment of Cent. Ave. Off ramp. Central Ave. off ramp is in poor condition. Removal of pump stations will create a ponding area near the APAC property.
	302+58	315+00	1242	Levee		12 to 17.5	Levee Raise	Flattened Slope	RW	1.3			Temp work area may be within UP ROW	
A9	315+00	322+85.41	785.41	Levee		4 to 9	Levee Raise	Flattened Slope		1.2			Temp work area may be within UP ROW	
	Station Equation 322+85.41 BK = 39+71.83 L.E. AH													
	39+71.83LE	42+50LE	278.17	Levee		4 to 9	L	Flattened Slope		1.2			Temp work area may be within UP ROW	
	42+50LE						New SBG						RR lost time issues if traffic stopped	Since end of unit is currently high ground, the raise will end near 42+50 with a sandbag closure across the railroad.
	42+50LE	61+00LE	1850	Levee			No Raise						End authorized levee unit ~2000 feet sooner with closure structure	

Legend and Notes

**	Dimension is for entire levee footprint including stability controls on landside and riverside of levee
***	Dimension from centerline of existing levee to proposed toe includes any stability berms recommended.
L	Levee
COW	Cut off Wall for underseepage
F-AC	Floodwall with auger cast piles
ROW	Right of Way
SLG	Stop Log Gap (not all are shown)
SBG	Sand Bag Gap (not all are shown)
RW	Relief Well
W-I	Relief Well System I (Station 190+75 to 246+35) - Pumped by Shawnee Ave Pump Plant
W-II	Relief Well System II (Station 268+11 or 268+59 to 282+29) - Pumped by KCS Railroad Pump Plant
W-III	Relief Well System III (Station 296+23 to 302+40) - Pumped by Central Ave. Pump Plant
Osage	Osage Pump Station Area
RW	Relief Well
ARW	Abandon Relief Well
R	Height of Levee Raise
h	Existing Levee Height
LL	Landside Levee Width (measured from centerline of existing levee or floodwall)
HTRW A	Station 45+00 to 75+00 - Proctor and Gamble has evidence of VOCs in GW 11 & 12. Relief wells in this area may impact the contamination in the groundwater. Sta 45 to 60 - Proctor & Gamble: HTRW testing is recommended if plans call for the disturbance of soil in the fire training area.
HTRW B	Sta. 110 to 130: HTRW Testing recommended during design if plans require disturbing soil within the auto salvage yards.
HTRW C	Sta. 135 to 157: Superfund landfill and cover system adjacent to the property line. Excavation or relief wells in this area will impact the Superfund site which is not desired. Coordination with EPA is recommended for any work on site.
HTRW D	Sta. 277 to 295 - PBI Gordon: Pesticides have been found in this area. Additional investigation of the soil and groundwater is recommended prior to expansion of existing ROW limits or any relief well system.



h	existing levee height (ft)
R	proposed levee raise (ft)
LL	proposed dimension from centerline of existing levee to proposed toe (including any stability berms)

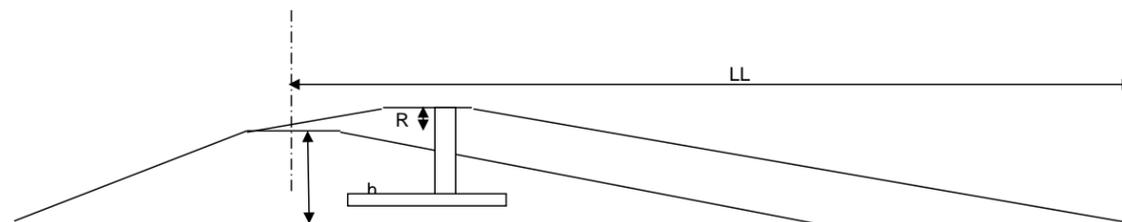
Map Sheet #	Unit Descriptions			Description	Existing		Description	Proposed				HTRW	Real Est. (RE)	Notes
	Station Beginning	Station Ending	Length of Unit FT		Relief Well Systems, Pump Plants, and Stability Features	Primary Levee Height (h) FT		Stability Control Needed	Under-seepage Control	Existing Centerline to Proposed Toe Dimension (LL), FT ***	Proposed Primary Levee Raise R=N500+3 FT		Real Estate Notes	
A1	83+01.29	85+00	198.71	Levee	Ohio Ave Pump Plant Sta 83+52	7.90	No Raise	na		NA	0.00		See Note A - Sheet M2	
	85+00	89+37.34	437.34	Levee		7.90	No Raise	na		NA	0.00		See Note A - Sheet M2	
	Station Equation STA 89+37.34 BK = STA 0+00 AH													
	0+00	5+00	500	Levee		0.00	No Raise	na		NA	0.00		See Note A - Sheet M2	
	5+00	10+00	500	Levee		0.00	No Raise	na		NA	0.00		See Note A - Sheet M2	
	10+00	15+00	500	Levee		0.00	No Raise	na		NA	0.00		See Note A - Sheet M2	
	15+00	18+15	315	Levee		0.00	No Raise	na		NA	0.00		See Note A - Sheet M2	
	18+15	19+73	158		Railroad Bridge								See Note A - Sheet M2	
	19+73	20+00	27	Levee		3.90	Levee Raise	na		25	0.20		See Note B - Sheet M2	Start of levee raise at station 19+73
	20+00	25+00	500	Levee		3.90	Levee Raise	na		25	0.70		See Note B - Sheet M2	
	25+00	25+90	90	Levee		3.90	Levee Raise	na		25	0.80		See Note B - Sheet M2	
	25+90	26+72.66	82.66		James Street Bridge Crossing					3.25	1		See Note A - Sheet M2	
	26+72.66	30+00	327.34	Floodwall	Cut off Wall at Sta 26+72.66	11.5	Modify Floodwall			3.25	1.1		See Note C - Sheet M2	
	30+00	32+50	250	Floodwall		11.5	Modify Floodwall			3.25	1.2		See Note C - Sheet M2	
32+50	38+00	550	Floodwall	Mistletoe Pump Plant Sta 37+07	11.5	Modify Floodwall		Area Fill	3.25	1.3		See Note D - Sheet M2	Area Fill from Sta 32+50 to Sta 38+00, to a minimum elevation of 748, with storm drain modification.	
38+00	40+31.25	231.25	Floodwall		11.5	Modify Floodwall			3.25	1.4		See Note C - Sheet M2		
40+31.25	40+61.66	30.41	Levee		10.10	Levee Raise	na		50	0.40		See Note E - Sheet M2		
Station Equation STA 40+61.66 BK = STA 40+91.60 AH														
A2	40+91.60	45+00	408.40	Levee		10.10	Levee Raise	na		50	0.40	Advantage Metals Recycling - HTRW Concern Sta 40+31.25 to Sta 51+00	See Note E - Sheet M2	The landside slope will be steepened to avoid HTRW area.
	45+00	50+00	500	Levee		10.10	Levee Raise	na		50	0.90		See Note E - Sheet M2	
	50+00	55+00	500	Levee		10.10	Levee Raise	na		60	1.30		See Note E - Sheet M2	
	55+00	57+07	207	Levee		10.10	Levee Raise	na		60	1.50		See Note E - Sheet M2	
	57+07	57+49	42		Central Avenue Double Deck Bridge									
	57+49	60+00	251	Levee	Well Numbers 1, 2, 3, and 4 (All Plugged), KCK Flood Station #16 sta 58+35, Stock Yards #3 Pump Plant 74+21	12.10	Levee Raise	na		70	1.80	Concrete Rubble Mixed with Municipal Solid Waste	See Note G - Sheet M2	
	60+00	63+00	300	Levee		12.10	Levee Raise	na		70	2.10		See Note G - Sheet M2	
	63+00	65+00	200	Levee		11.10	Levee Raise	na		70	2.30		See Note H - Sheet M2	Area Fill from Sta 63+00 to Sta 74+75, to a minimum elevation of 751 at levee toe. Approx slope of fill from levee to ground is 1%
	65+00	70+00	500	Levee		11.20	Levee Raise	na	Area Fill	70	2.70		See Note H - Sheet M2	
	70+00	74+35.94	435.94	Levee		11.50	Levee Raise	na		70	2.80		See Note H - Sheet M2	
74+35.94	75+25	89.06	Floodwall	Well Number 5 (Plugged)	12.8	Modify Floodwall			8	2.8		See Note I - Sheet M2		
A3	75+25	75+76	51		Missouri Pacific Railroad Bridge	12.8				8	2.9		See Note I - Sheet M2	
					Well Number 6 (Plugged)									
				Sandbag Gap	Union Pacific Railroad Bridge								See Note I - Sheet M2	
	75+76	77+27.75	151.75	Floodwall		12.8	Replace FW w/ New FW			30	3		See Note C - Sheet M2	
	77+27.75	80+00	272.25	Levee	Well Numbers 7 thru 17 (Number 7 is plugged), Gateway Pump Plant 80+90, South Stockyards 84+90, 88+19, and 94+32, Stockyards #1 98+05	13.50	Levee Raise	Replace landward retaining wall with berms	Area Fill	120	3.30		See Note H - Sheet M2	Area Fill from Sta 77+27 to Sta 94+50, to a minimum elevation of 749, with Gateway 2000 Inlet Modification. Approx slope of Area fill from levee to ground is 1%
	80+00	85+00	500	Levee		13.50	Levee Raise		Area Fill	120	3.60	See Note H - Sheet M2		
	85+00	90+00	500	Levee		13.80	Levee Raise		Area Fill	120	3.70	See Note H - Sheet M2		
90+00	95+00	500	Levee	14.50		Levee Raise	Area Fill		120	3.40	See Note H - Sheet M2			
95+00	100+00	500	Levee	14.10		Levee Raise				120	3.20	See Note H - Sheet M2		
100+00	102+73.39	273.39	Levee		4.55	Levee Raise			120	2.90		See Note H - Sheet M2		
A4	102+73.38	106+00	326.62	Floodwall	Abandoned CRI&P RR Bridge Sta 104+51.5	13.3	New Floodwall at RR Bridge			11.75	2.8		See Note C - Sheet M2	The Abandoned CRIP RR Bridge had a SLG that was filled in. Replace gap with new raised floodwall.
	106+00	110+00	400	Floodwall	Kemper Arena Pump Plant 106+49	13.3			Wells	11.75	2.9		See Note J - Sheet M2	27 new relief wells, surface discharging at total of 18 cfs.
	110+00	115+00	500	Floodwall		13.4	Modify Floodwall		Wells	11.75	3		See Note J - Sheet M2	
	115+00	116+70	170	Floodwall		13.5	Modify Floodwall		Wells	11.75	3.1		See Note J - Sheet M2	
	116+70	120+00	330	Floodwall		13.6	Modify Floodwall			11.75	3.2		See Note C - Sheet M2	
	120+00	125+00	500	Floodwall		13.6	Modify Floodwall			11.75	3.3		See Note C - Sheet M2	
	125+00	130+00	500	Floodwall		13.6	Modify Floodwall			11.75	3.6		See Note C - Sheet M2	
A5	132+20			SLG	KC Terminal Double Deck Hydraulic RR Bridge		Replace SLG						See Note K - Sheet M2	
	130+00	137+50	750	Floodwall		13.6	Modify Floodwall		Wells	11.75	3.8		See Note J - Sheet M2	Construct approximately 600 feet of new concrete floodwall tieback from existing wall at Station 137+50 southeasterly to the existing bluff. Install 30 new relief wells surface discharging a total of 45 cfs. Install two new stop log gaps at railroad crossings.
	137+50	BLUFF	600	Floodwall		13.7	New Floodwall		Wells	11.75			See Note G - Sheet M2	
	137+50	145+00	750	Floodwall		13.9	No Raise	na		NA	0.00			
	145+00	150+00	500	Floodwall		13.9	No Raise	na		NA	0.00			
	150+00	155+00	500	Floodwall		14.1	No Raise	na		NA	0.00			
	155+00	160+00	500	Floodwall		14.2	No Raise	na		NA	0.00			
	160+00	165+00	500	Floodwall		14.4	No Raise	na		NA	0.00			
	165+00	166+25	125	Floodwall		14.5	No Raise	na		NA	0.00			
166+25	168+16	191	Stop log Gap	Railroad Corridor					NA	0.00				
168+16	168+36	20	Levee		8.80	No Raise	na		NA	0.00				

LEGEND AND NOTES

Abbreviation	Description
**	Dimension is for entire levee footprint including stability controls on landside and riverside of levee
***	Dimension from centerline of existing levee to proposed toe includes any stability berms recommended.
L	Levee
FW	Floodwall
NR-FW	New Raised Floodwall
COW	Cut off Wall for underseepage
F-AC	Floodwall with auger cast piles
RAP	Railroad or Roadway above Protection
ROW	Right of Way
SLG	Stop Log Gap (not all are shown)
SBG	Sand Bag Gap (not all are shown)
RW	Relief Well
W-I	Relief Well System I (Station 190+75 to 246+35) - Pumped by Shawnee Ave Pump Plant
W-II	Relief Well System II (Station 268+11 or 268+59 to 282+29) - Pumped by KCS Railroad Pump Plant
W-III	Relief Well System III (Station 296+23 to 302+40) - Pumped by Central Ave. Pump Plant
Osage	Osage Pump Station Area
RW	Relief Well
ARW	Abandon Relief Well
R	Height of Levee Raise
h	Existing Levee Height
LL	Landside Levee Width (measured from centerline of existing levee or floodwall)
HTRW	

Station Equations
Station Equation STA 89+37.34 BK = STA 0+00 AH
Station Equation 40+61.66 BK = 40+91.60 AH

Real Estate Notes	
A	No Real Estate Concerns at this time
B	Some additional permanent ROW and 15' of temporary ROW will be required.
C	Some temporary ROW may be needed.
D	Some temporary ROW may be needed. Will need temporary construction ROW for the area fill.
E	Will need 15' additional permanent ROW and 15' temporary ROW.
F	Need to determine how much additional permanent and temporary ROW will be required.
G	Will need additional permanent ROW and 15' temporary ROW.
H	Will need additional permanent ROW and 15' temporary ROW. Will need temporary construction ROW for the area fill.
I	Need to determine if additional permanent ROW is needed and how much temporary ROW will be required.
J	Some temporary ROW may be needed. Need to determine if additional permanent ROW will be needed for the relief wells.
K	Need to determine if additional permanent ROW is required and how much temporary ROW is required.



h existing levee height (ft)
R proposed levee raise (ft)
LL proposed dimension from centerline of existing levee to proposed toe (including any stability berms)