APPENDIX D

INVESTIGATION AND ANALYSIS REPORT

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LIST OF TABLES

This report provides supplementary information to the Watershed Work Plan and Environmental Assessment (EA) for the Wakarusa Watershed. Additional information relevant to each of the sections provided in this report is available as part of the administrative record for the Project.

1.0 SEDIMENTATION

The purpose of the existing structure is to retard and then release floodwaters in a controlled manner. Site No. 24 appears to be functioning adequately as there has been no record of downstream flooding.

Site No. 24 was designed for a 100-year sediment storage life and constructed with a single stage drop inlet riser. The majority of sediment is deposited in the normal pool (the area below the principal spillway [low flow orifice] crest). The remaining sediment is deposited in the floodwater retarding pool (the area between the principal spillway crest and the auxiliary spillway crest). If sediment were to fill to the elevation of the principal spillway crest, the pool would no longer have permanent water storage. If the floodwater retarding pool loses storage due to sediment deposition, the auxiliary spillway would flow more frequently. If the auxiliary spillway flows more frequently, the amount of erosion would increase, causing an increase in operation and maintenance costs.

Historical sedimentation rate has been very low. The impoundment area is currently drained, so the existing impoundment area was surveyed using survey-grade GPS equipment. Historical sediment accumulation was determined by comparing the original design capacity table with the existing capacity table, adjusted for the estimated volume of borrow used to construct the dam.

2.0 BREACH ROUTING ANALYSIS

A breach analysis was conducted by NRCS for Site No. 24 to provide a prediction of the extent and timing of flooding from a catastrophic breach of the dam. The results from this analysis are sufficient for developing an inundation map and/or an emergency action plan. Due to limitations in modeling the flow dynamics of a severe, abrupt, and debris-laden breach wave, the modeling and results should be considered approximate. The dam breach analysis was performed using equations in NRCS Technical Release 60 (TR-60), NRCS Technical Release 66 (TR-66) criteria, and Dave Froehlich's peak flow equation (Froehlich, 1995) to develop an analytical breach hydrograph. The U.S. Army Corps of Engineer's Hydrologic Engineering Centers - River Analysis System (HEC-RAS) software model was used to route the floodwater downstream to determine peak discharges and water surface elevations through the reach below the modeled breach failure.

3.0 AGENCY COORDINATION

Appendix B contains notification letters sent to agencies and organizations.

4.0 OPINION OF PROBABLE CONSTRUCTION COSTS

Table D4-1 NO FEDERAL ACTION – HIGH HAZARD ALTERNATIVE COSTS

Item	Quantity	Units	Unit Cost $	Cost $
Earthfill	10,000	CU YD	$4	$40,000
Cable Concrete Armor w/ bedding and filter	43,000	SQ FT	$15	$645,000
Seeding - Native Grass	5	AC	$1,000.00	$5,000
Water for Compaction	500	EA	$35	$17,500
Principal Spillway Works	1	EA	$167,410	$167,400
		Subtotal		$874,900
		Construction Contingency	10.0 %	$87,500
		Opinion of Probable Cost		$962,400

Table D4-2 FEDERAL RECONSTRUCTION ALTERNATIVE COSTS

Item	Quantity	Units	Unit Cost $	Cost $
Earthfill	56,000	CU YD	$4	$224,000
Concrete for Riser	60	CU YD	$600	$36,000
Reinforcing Steel	3,500	LB	$1.50	$5,250
Trash Rack	1	EA	$3,000	$3,000
30" Dia Concrete Pipe	200	LIN FT	$250	$50,000
Seeding - Native Grass	12	AC	$1,000	$12,000
Water for Compaction	1,000	MGAL	$35	$35,000
Cable Concrete Armor w/ bedding and filter	43,000	SQ FT	$15	$645,000
Clearing and Grubbing	5	AC	$300	$1,500
12-inch Diameter Valve	1	EA	$9,000	$9,000
12-inch Diameter PVC Pipe	40	LIN FT	$50	$2,000
4-inch Diameter Drain Pipe Extension	60	LIN FT	$10	$600
PS Replacement - Excavation	9,000	CU YD	$4	$36,000
Seepage Diaphragm	160	CU YD	$35	$5,600
Diaphragm Drain Pipe	100	LIN FT	$10	$1,000
		Subtotal		$1,065,950
		Construction Contingency	10.0 %	$106,595
		Opinion of Probable Cost		$1,172,545

5.0 ECONOMIC EVALUATION

The NRCS National Watershed Manual (NWM) was used as a reference for the economic analysis along with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G), U.S. Water Resources Council, March, 1983. P&G was developed to define a consistent set of project formulation and evaluation instructions for all federal agencies that carry out water and related land resource implementation studies. The basic objective of P&G is to determine whether or not benefits from proposed actions exceed project costs. P&G also requires that the "National Economic Development" or NED Alternative, which maximizes monetary net benefits, be selected for implementation unless there is an overriding reason for selecting another alternative based on federal, state, local, or international concerns related to the social and environmental accounts. The allowance for exceptions to the NED plan recognizes the fact that not all project considerations or benefits can be quantified and monetized when it comes to some ecological systems and social effects.

Critical to direction and focus of an environmental assessment (EA) is the project sponsor's purpose and need for requesting assistance. For this EA, the sponsors purpose and need is to maintain floodwater retarding structure #24 (Site 24) as a viable flood control dam that would continue to provide flood reduction benefits to rural areas of Douglas County. In this analysis, there were two alternative plans – No Federal Action – High Hazard plan and the Federal Reconstruction plan - that met the sponsors' purpose and need. These alternative plans, which are described in Section 4.2 of this EA, would maintain the same level of flood protection as Site 24 currently provides but would meet the criteria of the federal high hazard dam requirements.

5.1 ECONOMIC BENEFITS

Site 24 is a structure that provides significant flood protection to both rural and developing Douglas County. The benefit estimate for this EA is based on the 1966 Watershed Work Plan for the Lower Wakarusa Watershed economic analysis (including a 1973 Supplemental Work Plan and some 1977 updates). In that analysis, flood reduction benefit categories included crop and pasture, other agricultural, flood scour, and non-agricultural benefits (road and bridges). In the 1966 plan, Site 24 was originally a multipurpose structure, but in the 1973 supplemental, it was reduced to principally a floodwater retarding structure.

The original plan analysis did not identify intensive use benefits associated with flood protection. Indexing was the procedure used to update original plan benefits to 2009 dollars.

Although indexing of original values is appropriate for much of the agricultural benefits, the area both upstream and downstream of Site 24 have developed since constructed in 1974. Therefore, additional benefits are now present and discussed within. The following is a summary of the economic benefits analyzed related to Site 24 based on 100 year flood - without dam:

1. Flood Damage Reduction
    a. Agricultural benefits (index from original plan benefits)
    b. Non-Ag Recreation Loss (calculated annualized benefits)
    c. Non-Ag Roads and Bridges (calculated annualized benefits)

2. Flood Scour (index from original plan benefits)

3. Cost Avoidance
    a. Avoidance of upstream property value devaluation
    b. Avoidance of construction cost avoidance downstream

Annualized benefits are calculated using a discount rate of 4.375% over 101 years (1 year for construction and 100 years of flood protection benefits).

5.1.1 Flood Control Benefits

Indexing original work plan benefits is an abbreviated procedure for estimating benefits for Site 24. This procedure is supported by sections 1.7.2(a)(4)(ii) and 2.1.1(b)(2) of the P&G which allows for abbreviated procedures in evaluating project benefits. The decision to use this abbreviated procedure, and not undertake a timely and costly hydrologic and economic evaluation of the watershed, did not alter the evaluation of alternatives, nor the selection of the NED alternative, for the following reason:

> All reasonable alternatives examined in detail would maintain Site 24 as a floodwater retarding structure that would maintain the same level of flood protection. Therefore, any land use changes in benefit area that have occurred in the last 50 years, which would positively or negatively impact flood reduction benefits, would impact both alternatives equally.

5.1.1.1 Agricultural

The agricultural and floodplain scour damage reduction benefits were based on the acres for the entire Lower Wakarusa Watershed. Site 24 represented 7.5% of the total watershed benefit area (411 acres of 5,461 total watershed acres). Therefore, the total 1966 crop and pasture, other agricultural, and floodplain scour benefits are multiplied by 7.5% and indexed up to 2009 dollars in Table D5-1.

Table D5-1 1966 Work Plan Annual Benefits Indexed to 2009 Dollars

	1966 Value	1966 Value Indexed to 2009 Dollars
Without Dam		
Flood Damage Reduction:		
Crop and Pasture [1]	$5,200	$35,900
Other Agricultural [1]	$900	$6,300
Flood Plain Scour [1]	$200	$1,700
Total Flood Damage	$6,300	$43,800
With Dam		
Crop and Pasture [1]	$1,900	$13,000
Other Agricultural [1]	$500	$3,200
Flood Plain Scour [1]	$200	$1,200
Total Flood Damage	$2,500	$17,400
Average Annual Damage Reduction Benefit		
Flood Damage Reduction:		
Crop and Pasture [1]	$3,300	$22,900
Other Agricultural [1]	$500	$3,100
Flood Plain Scour [1]	$100	$500
Total Net Flood Benefits	$3,800	$26,500

Notes:
[1] Source: KASS, USDA based on average value for Kansas of $229 per acre in 1966 and $1,590 in 2009.

The above benefits were indexed to 2009 dollars using a land value index. Land values would more likely reflect the wide range of changes in the value of flood damage prevented by Site 24. The value of land should accurately reflect changes in the land's use for various crops, changes in price, and the dramatic improvements in productivity. According to the Douglas County extension Officer, Mr. Bill Wood, the mix of agricultural uses over the past 20 to 30 years has changed in the project area. Presently uses are rotated between corn and soybeans replacing a mix of wheat, (est. 33%) and sorghum (33%) and corn (33%) in the floodplain area in the past. Kansas Agricultural Statistical Service (KASS), *Land Value,* is the source of the land value index. KASS does not have 2010 values as of the date of this report.

5.1.1.2 Non-Agricultural – Roads and Bridges

Roads and bridges were not considered beneficiaries of Site 24 in the original work plan as the current roads and bridges were not present in 1974, the year the dam was constructed. Therefore annualized non-agricultural damage reduction benefits are calculated based on specified design storms. The benefits were based on land improvement values and did not include benefits based on contents or depth of water at individual storm events.

As the alternatives evaluated provide similar benefits (as discussed in Section 5.11), the decision to use this abbreviated procedure, and not undertake a timely and costly hydrologic and economic evaluation of the watershed, did not alter the evaluation of alternatives, nor the selection of the NED alternative.

The design storms used in calculating the damage reduction benefits are the 1%, 2%, 10%, and 50% chance storms (100-year, 50-year, 10-year, and 2-year storms, respectively).

Expected annual flood damages are the sum of the damages from the range of evaluated floods (50%, 10%, 2%, and 1% annual probability storm or also referred to as the 2- 10-, 50- and 100-year storm), weighted by the probability of each. For instance, the 100-year flood event has an associated water elevation and unique damage estimate based upon the stage damage relationships of the structures and contents. This damage estimate is multiplied by a factor of 0.01. The 50-year event has an associated water elevation and damage estimate, with a probability of 0.02, and so on.

The linear feet of roads impacted by flood events were calculated by overlaying the calculated floodplain over an aerial base map. The 2-year flood event does top Clinton Parkway without the dam. Flood maps are included in Appendix C.

Table D5-2 provides the non-agricultural road and bridge flood benefits with and without the dam using the design storm series and then annualized.

Table D5-2 Non-Agricultural Road and Bridge Benefits

Road and Bridges
With Dam

	Linear Feet Impacted by Flood Event			
Road	**100 year**	**50 year**	**10 year**	**2 year**
E 1048 Rd (Speicher Rd)	0	0	0	0
Clinton Parkway	0	0	0	0
K-10	0	0	0	0
N 1350 RD	0	0	0	0
E1200 Rd	1300	1300	0	0
Total	**1300**	**1300**	**0**	**0**
Cost to Repair (a)	$338,000	$338,000	$0	$0
	1%	2%	10%	50%
Flood Damage	$3,400	$6,800	$0	$0
Average Annual Damage Benefit	$100	$300	$0	$0
			TOTAL	$400

Without Dam

	Linear Feet Impacted by Flood Event			
Road	**100 year**	**50 year**	**10 year**	**2 year**
E 1048 Rd (Speicher Rd)	1340	1325	590	0
Clinton Parkway	1340	1335	1265	890
K-10	290	240	95	0
N 1350 RD	2430	2425	1360	0
E1200 Rd	1300	1300	0	0
Total	**6700**	**6625**	**3310**	**890**
Cost to Repair (a)	$1,742,000	$1,722,500	$860,600	$231,400
	1%	2%	10%	50%
Flood Damage	$17,400	$34,500	$86,100	$115,700
Average Annual Damage Benefit	$800	$1,500	$3,800	$5,100
			TOTAL	$11,300

(a) There are two KDOT construction projects on US 59 south of the watershed underway in Franklin County. The two current construction costs per linear foot are $563 and $611. It is not unreasonable to conclude that repair/replacement costs would be approximately one-half of the cost of new construction. Using this approach, and averaging these two costs, one gets $294 per linear foot for repair. An estimate based on 2009 City of Manhattan, Kansas total cost per linear feet for flood damage repair included ($204 per linear foot repair cost plus $21 per linear foot engineering cost). Average the figures and reach a cost of $260 per l.f. (average of $294 and $225).

5.1.1.3 Non-Agricultural Construction Avoidance Cost Benefit

Clinton Parkway and K-10 were constructed after Site 24 was constructed and the culvert system installed under Clinton Parkway and K-10 was designed with Site 24 in place with smaller peaks from storm events. Therefore, the cost of providing larger culvert structures designed for larger peaks without the dam that is adequate for present day standards is a savings of installing Site 24.

It was determined that if the dam were not in place, the county would have built a larger box culvert system instead of current small box culvert at a cost difference of approximately six million dollars. Mr. Matt Bond, engineer currently with the City of Lawrence but formerly with KDOT, concurs with this order of magnitude cost and indicated that a bridge structure could cost as much as 12 million dollars if a bridge were constructed instead of box culverts. In other words, had there been no federal action to build the dam, the county would have spent more to build an expensive large peak system. This is considered an 'Avoided Cost benefit" (i.e. because the dam is in place, they avoided the cost of having to build an more expensive system). Note the current box culvert would be overtopped by a 2-yr storm if the dam were not in place.

Table D5-2A Non-Agricultural Construction Avoidance Benefits

	With Dam	Without Dam
Avoidance Benefits		
Increased Construction Cost for larger box structures (1)	$0	$6,000,000
Average Annual Savings over 101 years (2)	$0	$266,200

(1) Based on A/E calculations for construction of large storm water culvert system instead of the current small box culverts
(2) Annualized benefits based on 101 years at 4.375%.

5.1.1.4 Non-Agricultural Recreation Benefit

Commercial/recreational facilities were not considered beneficiaries of Site 24 in the original work plan as the current commercial properties were not present in 1974, the year the dam was constructed.

Four commercial parcels are present within the 100 year floodplain (without dam) and were constructed after the dam was installed in 1974.

The commercial properties consisted of the following parcels:

Parcel 3258 - Softball and Youth Sports complex
Parcel 5572 - Pat Dawson Billing Native Area *
Parcel 6266 - Kanza Southwind Native Preserve *
Parcel 2744 - Sport 2 Sport One LLC, just down stream of dam with buildings (not being acquired and buildings out of 100 year flood plain)

* - no user data available

The 50 and 100 year storms both impact the four referenced commercial properties. The 10 year storm impacted a portion of the athletic complex and both native/nature areas. The 100 year damage with the Dam is to both native/nature areas.

The project's recreation loss benefits have been determined. The major public recreation use in the watershed is a municipally owned and operated sports complex with multiple field for baseball, softball and soccer use. It is one of the most intensely used outdoor recreation complexes in Douglas County operating near capacity with a reported 389,120 total users days in 2007.

The recreational benefit (without the dam) is calculated using the P&G NED recreation unit day value method. The City of Lawrence recreation complex is a specialized recreation facility. Out of a total of 100 maximum points, the five criteria were judged to range from 40 percent of the maximum point value (12 of 30 points) for the recreation experience to over 70% of the maximum point value (10 of 14 points) for the carrying capacity as the community's most widely used outdoor recreation facility. The criteria and their relative weights and basis for these values are presented in the following table.

Recreation Complex Benefit Evaluation
(Unit Value Day Method)

Criteria	Maximum Point Value	Point Value Assigned	Basis for Point Value
Recreation Experience	30	12	The recreation complex contains multiple fields for three sports (baseball, softball, soccer) and is designed to serve adults and young persons. The complex is the most widely used recreation facility in the community.
Availability of Opportunity	18	9	The facilities are owned and managed by the City of Lawrence and user fees are kept to a minimum and routinely subsidized by the city government; The facilities cannot be fully duplicated elsewhere in the community. Loss of the facilities would cause a hardship on the community's recreational activities and programs.
Carrying capacity	14	10	The recreation facility is the most intensely used outdoor recreation complex in Lawrence and Douglas County. It is estimated that almost 400,000 user days occurred in 2007.
Accessibility	18	9	In addition to good vehicle access, an off-road pedestrian and bike trail provides direct access to the complex.
Environmental Quality	20	12	The site is surrounded by publicly owned open space in a non-urbanized area of the community. No private uses or development infringe on the site.
Total	**100**	**52**	

a. based on Table VIII-3-2 Guidelines for Assigning Points for General Recreation, per the NED Recreational procedures using the unit day value method

Annual Use Benefit – Softball and Youth Sports Complex
(Unit Value Day Method)

	With Dam	Without Dam
Recreation Benefits		
Average Annual Use (1)	389,120 users	0
User Days per Day (2)	1441 user days	0
Average Daily Value of Use (3)	$8.02 per user	0
Total Annual Use Value	$3,120,700	0
User Days per Day Value	$11,557	0

(1) Source: City of Lawrence Parks & Recreation Department annual use of baseball and soccer fields at complex located within the Wakarusa Watershed. Note: No visitation data is available for the nature center within the watershed.
(2) The complex is primarily used from March through November; therefore user days were calculated by dividing 389,120 by 270 days (9 months). Additionally, it is most likely that flood events would occur during these 9 user months focusing more specifically during peak use seasons. Therefore, 1,441 user days would be lost due to a flood event.
(3) Unit day value (UDV) in 2009 dollars (maximum usage no change from 2007 to 2009) estimated to be 50 points at $8.02 per user (adjusted to reflect changes in the Consumer Price Index after July 1, 1982) for general recreation value

per Principles and Guidelines for Water Resource Projects, Table VIII 3-2 Guidelines for Assigning Points for General Recreation.

Even though this sports complex would not be present without the dam, a design storm series was used to assess the non-agricultural recreational loss benefit. The design storms used in calculating the damage reduction benefits (recreational benefit) are the 1%, 2%, 10%, and 50% chance storms (100-year, 50-year, 10-year, and 2-year storms, respectively).

Expected annual flood losses are the sum of the losses from the range of evaluated floods (50%, 10%, 2%, and 1% annual probability storm or also referred to as the 2- 10-, 50- and 100-year storm), weighted by the probability of each. For instance, the 100-year flood event has an associated water elevation and unique loss estimate based upon the stage damage relationships of the structures and contents. This damage estimate is multiplied by a factor of 0.01. The 50-year event has an associated water elevation and loss estimate, with a probability of 0.02, and so on.

Table D5-2B Non-Agricultural Recreation Loss Benefits

Softball and Youth Sports Complex
Without Dam

Flood Event	Lost Days (a)	User Days/Day	Lost User Days/Storm	Probability	Lost User Days	Lost User Day Value ($8.02/day)
2 Year	2	1,400	2,900	50%	1,441	$11,600
10 Year	2	1,400	2,900	10%	288	$2,300
50 Year	5	1,400	7,200	2%	144	$1,200
100 Year	5	1,400	7,200	1%	72	$600
				Total		$15,600

With DamFlood Event	Lost Days (a)	User Days/Day	Lost User Days/Storm	Probability	Lost User Days	Lost User Day Value ($8.02/day)
2 Year	0	1,400	0	50%	0	$0
10 Year	0	1,400	0	10%	0	$0
50 Year	0	1,400	0	2%	0	$0
100 Year	0	1,400	0	1%	0	$0
				Total		$0

(a) Lost days are estimated based on the days the park may be down due to flood and related cleanup

5.1.1.4 Property Value Benefits of Lakefront Property

Property value benefits are available if the pool created by the original structure is maintained. Homeowners enjoy living near lakes and ponds because of the aesthetic value. Lakes are visually pleasing and attract wildlife and birds enjoyed by nearby residents. Due to the desirability to live near lakes and ponds, property values for adjacent parcels are greater than those not adjacent to lakes and ponds.

For this analysis the one-time property values gains from maintaining the pools are reflected in the appraised values of the residential lots. There are 11 residential parcels fronting on Lake Alvamar including five with existing single family estates. The existing homes range in appraised value from $725,000 to $1,350,000. Seven vacant lots around the lake remain for sale. The residential lots are

appraised in 2009 by the Douglas County, Kansas Appraiser at an average appraised value of $194,240.

According to the founder and owner of the largest residential real estate company in Lawrence (John McGrew of McGrew Real Estate) and the company's leading high end residential real estate agent, the homes and vacant lots on Lake Alvamar are a unique amenity value within the community and are considered the premier location for single family housing in the City of Lawrence. Homes and home sites with frontage on Lake Alvamar demand a premium of at least 20% and as much as 30% more than estate homes on either of the city's private golf courses or other non-lakefront homes and lots immediately across the street on Lake Alvamar Drive. Therefore, based on the opinions of these realtors most familiar with development trends and values, an average of 25% increase in property value has been applied to the existing homes and vacant residential lots around Lake Alvamar.

Table D5-3 shows the appraised value for each of the lots, the combined average for lakefront and non-lakefront lots and the annualized lakefront property value benefit.

Table D5-3 Lakefront Property Value Benefits

Street Number	Street Name	2009 Appraised Building Value	2009 Appraised Lot Value	Total Property Value	% Change w/out 24	Reduction of Value w/out 24 (building and lot)	Total Property Value w/out 24
1712	Lake Alvamar Dr.	$902,820	$234,960	$1,137,780	25.0%	$284,445	$853,335
1714	Lake Alvamar Dr.	$0	$203,380	$203,380	25.0%	$50,845	$152,535
1716	Lake Alvamar Dr.	$0	$210,110	$210,110	25.0%	$52,528	$157,583
1718	Lake Alvamar Dr.	$1,119,590	$230,410	$1,350,000	25.0%	$337,500	$1,012,500
1720	Lake Alvamar Dr.	$750,310	$148,310	$898,620	25.0%	$224,655	$673,965
1722	Lake Alvamar Dr.	$0	$191,970	$191,970	25.0%	$47,993	$143,978
1724	Lake Alvamar Dr.	$0	$178,990	$178,990	25.0%	$44,748	$134,243
1726	Lake Alvamar Dr.	$0	$161,120	$161,120	25.0%	$40,280	$120,840
1728	Lake Alvamar Dr.	$0	$219,870	$219,870	25.0%	$54,968	$164,903
1730	Lake Alvamar Dr.	$511,400	$213,600	$725,000	25.0%	$181,250	$543,750
1732	Lake Alvamar Dr.	$843,170	$213,600	$1,056,770	25.0%	$264,193	$792,578
		$4,127,290	$2,206,320	$6,333,610		$1,583,403	$4,750,208

Discount Rate	4.375%	Current Value of Upstream Properties, with Site 24	$6,333,600
		Average Annual Value of Upstream Properties with Site 24	$280,800
Years	101		
		Current Value of Upstream Properties, with Site 24	$6,333,600
		Estimated Value of Upstream Properties without Site 24	$4,750,200
		Difference	$1,583,400
		Net Benefits - Average Annual Value of Difference	**$70,200**
		Average Annual Value of Upstream Properties w/o Site 24	$210,600

Source: Douglas County, Kansas Appraiser's Office (2009 price basis).

(a) Lots not adjacent to lakefront immediately north of the lakefront lots.

(b) Annualized benefits based on 101 years at 4.375%.

Summary

As per NWM and P&G guidance, the benefits and costs of these alternative plans were compared. As expected, and as indicated by Table A-5 and Table D5-4, there is no net difference in flood reduction benefits when comparing one plan to the other. Therefore, the NED alternative plan for this EA is the plan that costs the least to implement. Table D5-4 provides the annual economic benefits for the No Federal Action – High Hazard and the Federal Reconstruction Alternatives along with the damages without the dam.

Table D5-4 Estimated Average Annual Economic Benefits

		Average Annual Damages 3/			
Agricultural Vs. Non-Agricultural		**Without Dam**	**No Federal Action High Hazard**	**Federal Reconstruction**	**Net Annual Economic Benefit**
	Damage Reduction				
Ag	Crop and Pasture	$35,900	$13,000	$13,000	$0
Ag	Other Agricultural	$6,300	$3,100	$3,100	$0
Non-Ag	Roads and Bridges	$11,300	$400	$400	$0
Non-Ag	Nonagricultural - Commercial	$15,600	$0	$0	$0
Subtotal		**$69,000**	**$16,600**	**$16,600**	$0
Ag	**Erosion** Floodplain Scour	$1,700	$500	$500	$0
Non-Ag	**Property Value Benefits** Lakefront Property	$0	$70,200	$70,200	$0
Non-Ag	**Construction Avoidance Cost** – Larger Stormwater Culvert System	$266,200	$0	$0	$0
Total		**$336,900**	**$87,300**	**$87,300**	$0

Notes:

1/ Price Base: 2009 - Original plan damages were indexed to 2009 dollars.
2/ Net Annual Economic Benefit compares the difference in benefits provided for this site between the No Federal Action – High Hazard and the Federal Reconstruction Alternative.
3/ See Tables D5-1, D5-2, D5-2A, D5-2B, and D5-3 for calculation of annualized benefits.

5.2 PROJECT COSTS

The No Federal Action – High Hazard Alternative includes the rehabilitation of the structure to minimum State of Kansas criteria for a High Hazard structure. This alternative includes armortizing the auxiliary spillway and raising the top of dam elevation. An opinion of approximate construction cost for these repairs is $962,400.

The Federal Reconstruction Alternative includes rehabilitation of the structure to NRCS High Hazard Class criteria. This alternative includes raising the dam approximately 6 feet in elevation,

raising the auxiliary spillway, and replacing the principal spillway. This alternative has an opinion of approximate construction cost of $1,172,545 and a design life of 100 years.

Based on the Fiscal Year 2010 federal discount rate of 4.375 percent over the life of each project, the annual total costs for No Federal Action – High Hazard Alternative is $67,500. The annual total costs for the Federal Reconstruction Alternative is $96,200 over 101 years.

Table D5-5 Estimated Average Annual NED Costs

Evaluation Unit	Project Outlays		Total
	Amortization of Installation Cost	Operation and Maintenance[3]	
No Federal Action – High Hazard: [1]	$61,900	$5,600	$67,500
Federal Reconstruction [2]	$88,200	$8,000	$96,200

Notes:
[1] Amortized cost over 101 years at 4.375%
[2] Amortized cost of Table A-2 over 101 years at 4.375%
[3] Annual Operation and Maintenance costs estimated at 0.4% of installation cost

Table D5-6 Estimated Average Annual Flood Damage Reduction Benefits

	Average Annual Damages (without Dam)		Average Annual Damages (with Dam)		Net Damage Reduction Benefit	
	No Federal Action – High Hazard	Federal Reconstruction	No Federal Action – High Hazard	Federal Reconstruction	No Federal Action – High Hazard	Federal Reconstruction
Floodwater Average Annual Benefit	**$69,000**		**$16,600**		**$52,400**	

Note: From Table D5-4

5.2.1 BENEFIT-COST RATIO OF ALTERNATIVES

The No Federal Action – High Hazard Alternative provides a benefit-cost ratio of 3.7 resulting from average annual benefits of $249,600 and 101-year annualized cost of $67,500. The Federal Reconstruction Alternative (Option 1) provides a benefit-cost ratio of 2.6 resulting from average annual benefits of $249,600 and annualized cost of $96,200. Table D5-7 shows the calculation of these benefit-cost ratios.

The recommended plan (Federal Reconstruction) has the same average annual flood damage reduction benefits as the Future Without project (No Federal Action) with a net $0.0 annual benefit between them. The recommended plan has a cost avoidance of the annual construction cost of the non-federal (FWOP) avoided by proceeding with the recommended plan (Federal Action) of $67,500. The benefit to cost ratio of the recommended plan is then 0.7 relative to unity/scale of 1.0.

Net Benefit Effects

Economic benefits and impacts associated with the rehabilitation of the Lower Wakarusa floodwater retarding structure were calculated based on the flood control benefits the structure was intended to provide. Table D5-4 compares each alternative relative to the potential benefits derived or reduced for each.

Table D5-7 Comparison of NED Benefits and Costs

Evaluation Unit	Annual Flood Damage Reduction Benefits[1]		Non-Ag Property Value Benefits[2]	Non-Ag Construction Cost Avoidance[3]	Total Annual Benefits[4]	Average Annual Costs[5]	Benefit-Cost Ratio
	Ag	Non-Ag					
No Federal Action – High Hazard	$27,200	$26,400	$70,200	$266,200	$249,600	$67,500	3.7
Federal Reconstruction	$27,200	$26,400	$70,200	$266,200	$249,600	$96,200	2.6

Notes:
[1] From Table D5-1 and D5-2. (without Dam minus with Dam)
[2] From Table D5-3.
[3] From Table D5-2A.
[4] From Table D5-4, (without Dam minus with Dam)
[5] From Table D5-5.

Period of Analysis

The period of analysis for the No Federal Action – High Hazard Alternative and the Federal Reconstruction Alternative includes a 100-year design life plus one year for construction.

Project Life

The project life for the No Federal Action – High Hazard Alternative and the Federal Reconstruction Alternative is 100 years based on a 100-year design life.

6.0 ENVIRONMENTAL EVALUATION

The environmental evaluation (EE) is an NRCS planning process as described in the NRCS National Planning Procedures Handbook. The EE identifies and analyzes the economic, environmental, and social concerns. This planning process is then documented/summarized on the KS-CPA-52 Environmental Evaluation for Conservation Planning form. This EE planning process started with the identification of problems and opportunities and continues through the application and evaluation of the project.

Additional resources discussed within Section 504.37 of the National Watershed Manual are incorporated into the Scope of the EA.

The NRCS completed the wetland determination and report (dated September 29, 2009) by reviewing associated aerial photographs, completing a site visit, advancing several on-site test pits, and compiling wetland determination data forms, for the Midwest Region.

The riparian areas (a riparian zone or riparian area is the interface between land and a stream) were assessed through by reviewing associated aerial photographs, review of the September 29, 2009 Wetland Determination Report, and visiting the site.

6.1 KS-CPA-52

The KS-CPA-52 has been developed according to guidance found in the NRCS National Environmental Compliance Handbook and policy from the General Manual. Section J. Special Environmental Concerns of the form addresses the primary laws, executive orders, and policy that are of planning concern. For each of these concerns there is an Evaluation Procedure Guide Sheet that has been developed to assist the planner in determining the status of their project in relation to that particular concern.

For planning purposes of this Supplemental Watershed Plan and EA, the KS-CPA-52 has been utilized for scoping and documentation of concerns and then has been updated as the planning process has proceeded. The results of the EE (scoping and documented KS -CPA-52) are used in Chapter 3 of the Supplemental Watershed Plan and EA Table 3-1, which identifies the primary resource concerns. When a resource concern was found to be not relevant and sufficient rationale is provided, then the concern was eliminated from further consideration. Each of the resource concerns that are noted in Table 3-1 as “Yes” in the “Relevant to the Proposed Action” column was then carried forward to Chapter 4, Alternatives and Table 4-3 Comparison of Alternatives. It is in Table 4-3 that the scoping concerns were further reviewed to see if they were pertinent to the individual alternatives. Those pertinent concerns were then evaluated for that alternative in Chapter 5, Environmental Consequences. Those noted as “No” in the “Relevant to the Proposed Action” column were not discussed further in this EA.

The KS-CPA-52 and the associated Evaluation Procedure Guide Sheets are included in Appendix E – Supporting Information. These represent the EE process in living, field-type, and documentation form.

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