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will provide comments before final. in 2wks.

Value Study Presentation Report

(Not for Distribution)

Proposals for More Efficient Management of Lower Republican River Water Supplies

September 4, 2002

Conducted in Cooperation with Great Plains Region, Nebraska-Kansas Area Office

Bureau of Reclamation, Technical Service Center, Denver, Colorado

complete appraisal 03 - have $ to proceed next year.
Congress - leg in early 04 but would get $ 1.1 later.

Feasibility study star Oct 04
$1.25 million

State 7/04
$600,000 over 2 years
can be in Kind in part

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Executive Summary

The participants involved in the negotiations to resolve the lawsuit among Kansas, Nebraska, and Colorado concerning the flows in the Republican River asked that a study be done to analyze flow augmentation alternatives. The goal of the study was to analyze the alternatives is such a manner that a comparison of the alternatives and/or combination of the alternatives could be made that would enable the negotiators to identify proposals for further study.

The Bureau of Reclamation was asked to form a Value Study Team to perform this work. The team began work on April 2, 2002. During a series of meetings, which concluded August 19, 2002, 13 proposals were developed by the team and are summarized below. The "Disposition of Alternatives" table near the end of this report lists alternatives which were evaluated but not developed further into proposals by the team. The "Proposal Cost Estimate" section contains detailed total project, annual power, and annualized (rounded) 25-year life expectancy costs. Normal O & M costs are typically not estimated for this level of planning study and are therefore not included.

Proposal Combinations: More efficient management of Lower Republican River water supplies can be accomplished with a combination of the proposals listed below. An example of how proposals can be combined is presented later in this report.

Proposal A1A. Wells to Courtland Canal. The total estimated project cost of this proposal is $1,050,000. The annual power cost is $1200/yr and the annualized replacement cost (25 year span) is $2600/yr. This proposal has the potential to supply 900 acre-feet (AF) of water per year.

Proposal A1B. Wells to Superior Canal. The total estimated project cost of this proposal is $3,000,000. The annual power cost is $3600/yr and the annualized replacement cost (25 year span) is $7900/yr. This proposal has the potential to supply 2700 AF of water per year.

Proposal A2. Subsurface Drains to Courtland Canal. The total estimated project cost of this proposal is $730,000. The annual power cost is $720/yr and the annualized replacement cost (25 year span) is $2700/yr. This proposal has the potential to supply 1000 AF of water per year.

Proposal A3. Infiltration Gallery to Superior Canal. The total estimated project cost of this proposal is $690,000. The annual power cost is $4500/yr and the annualized replacement cost (25 year span) is $2,300/yr. This proposal has the potential to supply 3600 AF of water per year.

Proposal B. Courtland Canal Automation Reshape Canal Prism, Design for Winter Operation. The total estimated project cost of this proposal is $3,900,000. This proposal has the potential to supply 10,000 AF of water per year.

Proposal C1. Increase Lovewell Capacity - 16,000 Acre-feet. The total estimated project cost of this proposal is $1,050,000. This proposal has the potential to store 16,000 AF of water per year.

Proposal C2. Increase Lovewell Capacity - 35,000 Acre-feet. The total estimated project cost of this proposal is $6,100,000. This proposal has the potential to store 35,000 AF of water per year.

Proposal D1. Courtland Canal Membrane Lining - Full Prism. The total estimated project cost of this proposal is $24,000,000. The estimated annualized replacement cost (25 year span) is $242,200 per year. This proposal has the potential to supply < 20,000 AF of water per year.

Proposal D2. Courtland Canal Membrane Lining - Bottom Only. The total estimated project cost of this proposal is $13,000,000. This proposal has the potential to supply < 10,000 AF of water per year.

Proposal E. Off-Stream Storage - Thompson Creek. The total estimated project cost of this proposal is $24,000,000. This proposal has the potential to store 24,000 AF of water per year.

Proposal F1. Off-stream Storage - South Dam Enlargement, Jamestown Waterfowl Management Area. The total estimated project cost of this proposal is $14,500,000. This proposal has the potential to store 20,000 AF of water per year.

Proposal F2. Off-stream Storage - North Dam Enlargement, Jamestown Waterfowl Management Area. The total estimated project cost of this proposal is $6,400,000. This proposal has the potential to store 10,300 AF of water per year.

Proposal G. Off-Stream Storage - Kansas Tributaries, Beaver Creek. The total estimated project cost of this proposal is $12,000,000. This proposal has the potential to store 8500 AF of water per year.

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Acknowledgment of Project Coordination Assistance

The Value Study Team wishes to express their thanks and appreciation to Mr. Mike Kube, and the staff at the Nebraska Kansas Area Office, who fully and cordially provided all requested information and consultation on the project. The team would not have been as successful without this cooperation and assistance.

The goal of the value method is to achieve the most appropriate and highest value solution for the project. It is only through the effort of a diverse, high performing team, including all those involved, that this goal can be achieved. This study is the product of such an effort.

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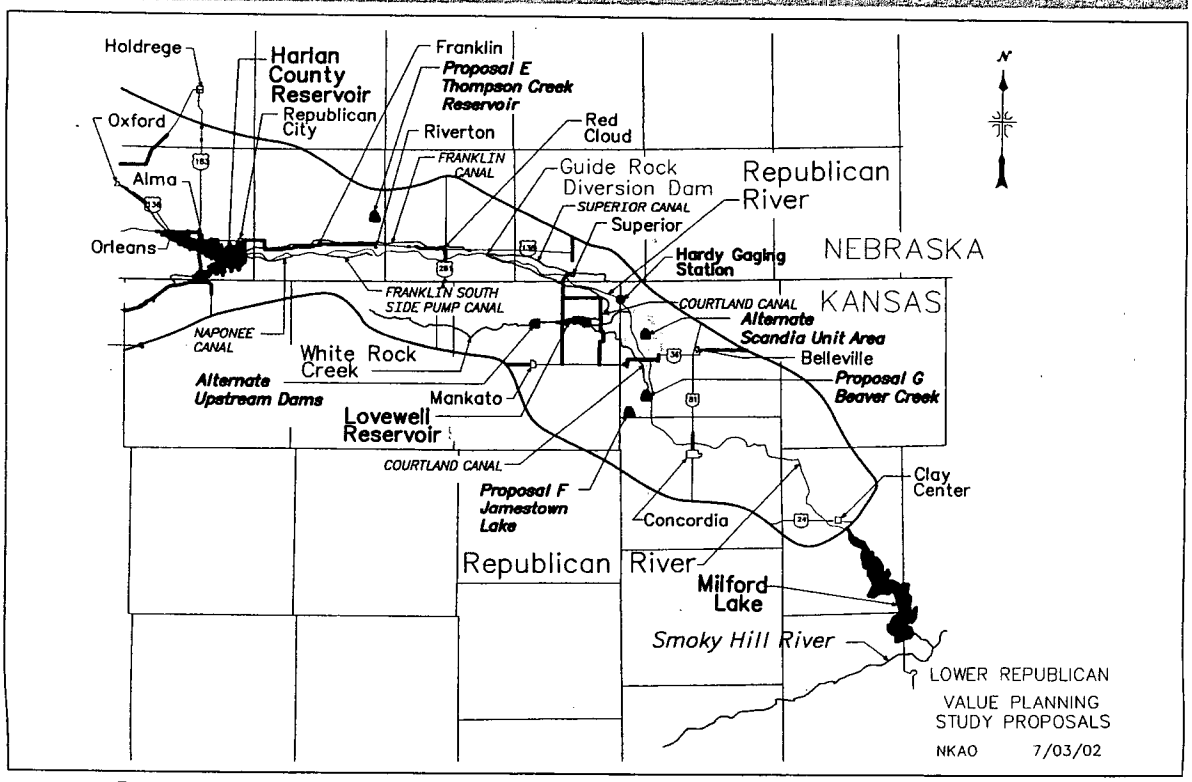
Current Description

The Republican Valley suffered from severe droughts and floods in the 1930s. Following these events the Bureau of Reclamation and the U.S. Army Corps of Engineers began construction of a series of dams and storage reservoirs and related surface-water irrigation projects in the valley. These projects reduce flooding and provide for irrigation among other benefits. Two of the valley's major projects are located in the lower portion of the valley. These are Reclamation's Bostwick Division and the Corps of Engineers Harlan County Dam and Lake. The projects are inter-related as the Bostwick Division utilizes storage space in Harlan County Lake for irrigation. Harlan County Dam has provisions for releasing water directly to two of the Bostwick Division's canals as well as releasing water back to the river for diversion further downstream to the other canals. In addition to irrigation and flood control, the projects provide benefits for sediment control, fish and wildlife enhancement, and recreation. The Bostwick Division serves lands located in both Nebraska and Kansas. The Nebraska Bostwick Irrigation District (NBID) provides service in Nebraska and the Kansas Bostwick Irrigation District No. 2 (KBID No. 2) provides service in Kansas.

The first irrigation deliveries from the NBID began in 1952. The district is divided into two units, the Franklin Unit and the Superior-Courtland Unit. The Franklin Unit is served by the Franklin and Naponee Canals which divert water directly from Harlan County Lake and the Franklin South Side Pump Canal which diverts water directly from the river through a pumping plant 17 miles downstream of the dam. The Superior-Courtland Unit is served by the Superior and Courtland Canals which divert water from the river at the Superior-Courtland Diversion Dam, located 50 miles downstream of Harlan County Dam. The Nebraska Bostwick Irrigation District has service available for about 23,000 acres. The Superior-Courtland Diversion Dam, through the Courtland Canal, also provides irrigation water into Kansas for KBID No. 2.

The first irrigation deliveries from KBID No. 2 began in 1955. The KBID No. 2 receives most of its water from requested releases from Harlan County Lake in Nebraska and by storage of White Rock Creek runoff in Lovewell Reservoir. The remainder is provided by direct diversion of Republican River gains between Harlan County Dam and the Superior-Courtland Diversion Dam. Harlan County Dam was closed in 1951 and storage began in 1952. Releases from the Lake are not generally made unless requested by one of the irrigation districts or precipitation is abundant and flood releases are necessary. The releases for KBID No. 2 flow down the Republican River and are diverted at Guide Rock, Nebraska, by the Superior-Courtland Diversion Dam (completed in 1952) into the Courtland Canal, which provides irrigation service to lands in Kansas and transports water to Lovewell Reservoir in Kansas. Lovewell Reservoir, which was completed in 1957, generally does not release water unless it is required for irrigation to district lands or precipitation is abundant. The KBID No. 2 has service available for about 42,000 acres of which about 13,550 are located above Lovewell Reservoir and 28,350 are located below. Water released from Lovewell Reservoir for use by the KBID No. 2 is distributed by a network of canals that begin at the dam.

Figure 1. Location Map



Criteria and Study Objectives

The table presented below lists the criteria used by the Value Study Team for basic understanding of the Republican River Stream Flow Augmentation Objectives. All Criteria assume existing laws, standard operating procedures, proven technology and sound engineering practices are followed. The criteria and weights were developed by representatives on the Value Study Team from the states of Kansas, Nebraska, and Colorado. It was used as an orientation for the team and a general guide in evaluating proposals.

#	**Technical Viability Criteria** Measure for each criteria is listed in *italics*.	**Weight**
1	Irrigation of crops - acre-feet of water delivered/irrigated acre during time of irrigation demand (Both surface and ground water). *Minimum acceptable 10 ½ inches. Maximum possible 18 inches.*	45
2	Flexibility of Facilities - Ability of system to accommodate multiple needs. *Ratio: Cost or water/ # of additional needs met*	25
3	In-stream use below Hardy - water quality and fish. *MDS 100-250 cfs at Concordia and Clay Center*	20
4	Conservation - Maximum storage of water in conservation pool for all uses. *Ratio: Amount of water delivered to beneficial use / Amount of water needed by project to deliver*	10

#	**Implementation Criteria**	**Weight**
1	Minimize cost*. $/AF A. Capitol cost B. O & M/annual cost	30
2	Public Acceptability.	25
3	Availability of funds. A. Lump sum B. Annual Payments C. Cost split	25
4	Minimize length of construction project and time to realize benefits of project.	10
6	Quick reaction time - responsiveness of system during operation.	10

* See Cost Benefit Summary Table after Proposal Descriptions in this report

Some points to consider on all proposals:

1. A cultural resource survey will have to be completed prior to the initiation of any construction activities. In the event that cultural resources are located, mitigation could be required.

2. If there is any Federal involvement (direct or by providing funding) in the implementation of any proposal, a NEPA document will be prepared. The type of NEPA compliance document required (e.g., Environmental Assessment/Finding of No Significant Impact, Environmental Impact Statement) will depend on the extent of the action proposed. Existing environmental resource issues and public input will assist Reclamation in determining the level of NEPA compliance that would be required.

3. Elevated selenium levels have been documented in the Kansas Bostwick Irrigation District (KBID). If detailed water quality information is not available at a water quality site characterization would be conducted to determine if any adverse impacts might occur by importing water from the KBID.

4. It will be necessary to coordinate with the U.S. Fish and Wildlife Service to determine if there are any adverse impacts to threatened and/or endangered species that might occur in the project area.

5. It will be necessary to coordinate the planning process with each State Department of Game/Wildlife and Parks to determine if any significant wildlife and recreational impacts might occur. Once the impacts are determined, a mitigation plan would be developed.

6.There could be acceptability issues associated with the innundation of any existing wildlife/recreation area that could make any project difficult to implement. It will be necessary to develop a public involvement plan. Any impacts to surface wetlands might require a US Army Corps of Engineers 404 permit. There are a number of public stakeholders that have an interest in potential projects and it will be critical to keep them involved during any process. Other critical items may be identified during the public involvement process.

7. Some level of hydrology study will be needed early to better determine the hydrologic consequences of implementing various proposals.

8. Water rights issues may need to be addressed for all proposals.

9. The estimated costs are sub-appraisal level estimates and should be used for comparison of proposals only.

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Proposal A1A

Description

Proposal A1A. Wells to Courtland Canal.

- Proposal Description: Under this proposal, wells would be developed in the Nebraska Bostwick lands served by the Courtland Canal. Water recovered from the local alluvium would be used to supply irrigation water to lands in this portion of the project area either by direct application to irrigated fields or by conveyance to and through the Courtland Canal and the associated network of laterals. About ten recovery wells with associated piping could be established in this area with a projected yield during the irrigation season of 900 acre-feet.
- Critical Items to Consider: To be most effective, wells should be located far enough from the river so that the cone of depression does not intersect the river. Pumping should be done during periods when the river has adequate flows because the aquifer is so limited in extent, that almost any pumping will temporarily deplete accretions to the river from the aquifer. Stream Depletion Factors (SDF) as published in Techniques of Water Resource Investigations of the United States Geological Survey - Computation of Rate and Volume of Stream Depletion by Wells should be used to determine impacts on the river resulting from pumping.
- Ways to Implement: Install wells in the most favorable locations between the Canal and the river. Pump the water into the Courtland Canal because few if any of the wells will be sufficient capacity to use for irrigation. In this case, the power drop and the discharge pipe to the Courtland Canal will both be minimized by keeping the wells close to the Canal because the public power lines are near the Canal.

The cost estimate below assumes wells are 30 feet in depth and 12 inches in diameter (Consider PVC casing and screens). Each site will require 2500 feet of 6-inch pipeline, and 2500 feet of power line.

Advantages	Disadvantages
• Relatively simple to implement. • Pumping can be accomplished during non-irrigation season.	• Continuous OM&R costs for power, maintaining wells and replacement of pumps and wells. • Twenty to thirty year maximum life of project facilities. • Pumps only have 20-25 year life.

Proposal A1A

Potential Risks

- May interfere with domestic or private irrigation wells.

Cost Items

Total Estimated Project Cost	$ 1,050,000
Annual Power Cost	$ 1,200/yr
Annualized Replacement Cost (25 Year Span)	$ 2,600/yr

Proposal A1B

Description

Proposal A1B. Wells to Superior Canal.

- Proposal Description: Under this proposal, wells would be developed in the Nebraska Bostwick lands served by the Superior Canal. Water recovered from the local alluvium would be used to supply irrigation water to lands in this portion of the project area either by direct application to irrigated fields or by conveyance to and through the Superior Canal and the associated network of laterals. About 30 recovery wells with associated piping could be established in this area with a projected yield during the irrigation season of 2,700 acre-feet.

- Critical Items to Consider: To be most effective, wells should be located far enough from the river so that the cone of depression does not intersect the river. Pumping should be done during periods when the river has adequate flows because the aquifer is so limited in extent, that almost any pumping will temporarily deplete accretions to the river from the aquifer. Stream Depletion Factors (SDF) as published in Techniques of Water Resource Investigations of the United States Geological Survey - Computation of Rate and Volume of Stream Depletion by Wells should be used to determine impacts on the river resulting from pumping.

  There is some geologic indication that only isolated areas may be able to support production wells with sufficient capacity to make the proposal feasible.

- Ways to Implement: Install wells in the most favorable locations between the Canal and the river. Pump the water into the Superior Canal because few if any of the wells will be of sufficient capacity to use for irrigation. The discharge pipe to the Superior Canal can be minimized by keeping the wells close to the Canal. Existing power lines are located along public roads. Therefore, the cost of power drops will need to be weighed against the cost of discharge pipe when selecting an actual site for well installation. The system will include 2500 feet of 6-inch pipeline, and 2500 feet of power line.

Advantages	Disadvantages
• Relatively simple to implement.	• Continuous OM&R costs for power, maintaining wells and replacement of pumps and wells. • 20 to 30 year maximum life of project facilities. • Pumps only have 20-25 year life.

Proposal A1B

Potential Risks

- May interfere with domestic or private irrigation wells.
- Aquifer may not be capable of supporting the estimated 30 production wells.

Cost Items

Total Estimated Project Cost	$	3,000,000
Annual Power Cost	$	3,600
Annualized Replacement Cost (25 Year Span)	$	7,900

Proposal A2

Description

Proposal A2. Subsurface Drains to Courtland Canal.

- Proposal Description: Under this proposal, the existing system of agricultural drains in the Nebraska Bostwick lands served by the Courtland Canal will be used in the recovery of the local groundwater. Water recovered from the drains would be used to supply irrigation water to lands in this portion of the project area by conveyance to and through the Courtland Canal and the associated network of laterals. About five to six recovery pumps with associated sumps and piping could be established in this area with a projected yield during the irrigation season of 1,000 acre-feet.
- Critical Items to Consider: Pumping the drains to the Courtland Canal during irrigation season could reduce flow in the river. Therefore pumping may be limited to fall and spring. Drain flows are greatest in fall and least in spring.
- Ways to Implement: Construct open bottom vaults adjacent to selected manholes in the existing subsurface drains. The vaults would be composed of 6-foot-diameter reinforced concrete pipe placed on end to a depth of 15 feet. Place 1-foot of gravel filter material in the bottom to eliminate floatation effect. Install pumps and discharge pipe to the Courtland Canal. The manholes will be connected to the vaults so the water will flow first to the pumps but would continue down the drain as normal when pumps are not operating.

Advantages	Disadvantages
• Relatively simple to implement.	• Basic facilities have a life expectancy of 50 years. • Pumps will require maintenance and replacement.

Potential Risks

- None identified.

Cost Items

Total Estimated Project Cost	$	730,000
Annual Cost	$	720
Annualized Replacement Cost (25 Year Span)	$	2,700

Proposal A3

Description

Proposal A3. Infiltration Gallery to Superior Canal.

- Proposal Description: Under this proposal an infiltration gallery would be developed under the Republican River near Superior, Nebraska. One potential location is about 3,000 feet from the Superior Canal. Up to 3,600 acre-feet of water could be pumped during the irrigation season from this location.
- Critical Items to Consider: Construction in the channel of the Republican River may require a design to ensure channel stability. How much supplemental water can be used by Superior Canal diverters?
- Ways to Implement: Construct gallery in most favorable location given the proximity of Superior Canal and river channel characteristics. The cost estimate below is based on 200 feet of gallery, 450-horsepower pump, 3,000 feet of 20-inch pipeline, and the infiltration gallery will be constructed in-the-wet.

Advantages	Disadvantages
• Allows Nebraska to use its allocation below Guide Rock. • An equivalent amount of water is available for storage and sharing in Harlan County Reservoir.	• Continuous OM&R costs for power, maintaining gallery and replacement of pumps. • River stabilization OM&R costs could be required.

Potential Risks

- Low flow conditions may restrict the usability of the infiltration gallery.
- Flood protection may be required for the facility and is not included in the cost estimate below.

Cost Items

Total Estimated Project Cost	$	690,000
Annual Cost	$	45,000
Annualized Replacement Cost (25 Year Span)	$	2,300

Proposal B

Description

Proposal B. Courtland Canal Automation Reshape Canal Prism, Design for Winter Operation.

- Proposal Description: Currently there is a flow over Guide Rock Diversion Dam during periods of high turnout flows into Courtland Canal. This is due to restrictions in the canal system that prevent the required flow from entering the canal unless there is excess head at the diversion dam. This proposal is to reshape Courtland Canal and remove the restrictions. This would increase the capacity of the canal from 400 cfs to 600 cfs. Operational flexibility would be increased during irrigation periods allowing more water into the system when availability occurs. This proposal enables water that was previously passed downstream to be utilized by the system.

  By automating the radial gates at the diversion dam and at the 11 check structures on Courtland Canal and placing a reliable flow measurement structure downstream of the inlet structure(e.g. ,a long throated flume), the fluctuations in river water level could be accommodated by changing the gate opening. This will result in a decrease in water lost over the diversion dam during flows when the Courtland Canal can divert the entire river flow. By collecting excess flows from thunderstorms or other river fluctuations this could result in an increase of up to 10,000 acre-feet per year of water in the canal system.

  The advantage to winterizing the canal would be to allow the winter flows to be captured and stored in Lovewell Reservoir decreasing the amount of water required in the spring to fill the reservoir. Based on review of flow data this could amount to 10,000 acre-feet in approximately 120 days.

- Critical Items to Consider: If power is brought to each radial gate structure site for automation, the cost to winterize is very low. Flow impediments need to be removed at four locations along the canal alignment. This would require removal of existing pipe crossing structures and replacement with bridges that allow more flow capacity in the canal. Tractive forces may cause sloughing and localized scouring of the side slopes at higher flows.
- Ways to Implement: This option would involve the furnishing and installing of a Remote Terminal Unit (RTU) for the control of the radial gates at the inlet structure and 11 check structures, radio communications with an existing SCADA system, construction of power lines to each site, stilling wells and long throated flume for flow measurement. This option would also involve the reshaping of the Courtland Canal to the original shape in areas where sloughing has occurred reducing the capacity of the canal section. Winterization would require placing bubblers at the existing 11 check structures on Courtland Canal and at the Guide Rock diversion dam to de-ice the structures during the winter. The existing master station at McCook would be modified to accommodate the additional RTUs.

Proposal B

Advantages	Disadvantages
• Increased operational flexibility. • Ability to operate in the winter. • Ditch rider trips are reduced.	• Tractive forces may cause erosion in the canal side slopes.

Potential Risks

None identified.

Cost Items

Total Estimated Project Cost	$ 3,900,000
Annual Power Cost	N/A
Annualized Replacement Cost (25 Year Span)	N/A

Proposal C1

Description

Proposal C1. Increase Lovewell Capacity - 16,000 Acre-feet.

- Proposal Description: The existing Lovewell Reservoir has an active conservation capacity of 24,022 acre-feet (1571.7 to 1582.6), flood control space of 50,465 acre-feet (1582.6 to 1595.3), and surcharge space of 123,882 acre-feet (1595.3 to 1614.0). Elevation 1614.0 is the crest elevation of the dike section on the left end of the dam. The dam crest elevation is 1616. This proposal is to raise the crest elevation of the dike section to match the dam crest elevation of 1616.

  The proposal would provide additional reservoir storage capacity that could be used to increase the active conservation capacity. The top of active conservation pool can be increased between 5 and 10 feet without major impacts to the Courtland Canal inlet from the feeder canal. A 5-foot increase in the top of active conservation to elevation 1587.3 would provide an additional 15,711 acre-feet of conservation storage. Maintaining the existing flood control capacity and surcharge space would require raising the crest of the dike section only to match the existing dam crest at elevation 1616. The left end of the existing dike would have to be extended about 400 feet for the new crest elevation. Relocation of the existing railroad line would not be necessary. Modifications to the spillway gates may be necessary for the higher flood control pool elevation and maximum reservoir water surface.

  Water supply would be obtained from excess Republican River flows delivered to Lovewell Reservoir via Courtland Canal. Water supply may be available during irrigation and non-irrigation season.

- Critical Items to Consider: Potential dam safety deficiency with regard to overtopping and failure during flood events exists at Lovewell Dam. Any modifications to existing structures will need to (at a minimum) maintain the existing flood control and surcharge capacities so that risks to public are not increased. Any modifications to the existing structures that would increase the risks to the public would be unacceptable. Relocation of recreation facilities will be needed. The cost for this relocation is not included in the estimates below.

- Ways to Implement: Other improvements to the diversion structures and/or Courtland Canal may be necessary to allow diversions.

Have been able to encroach 2 -6000 AF
- what happens here?
COE has discretion to go up 5% total volume

additional water rights would be junior in Kansas system.

Proposal C1

Advantages	Disadvantages
• Provides 16,000 Acre-feet of additional storage capacity, part of the additional storage could be used for flood surcharge. • Less design required compared to design and construction of new facilities.	• Raising pool elevation will have impacts to wildlife in area. • Recreation facilities will need to be relocated.

Potential Risks

- Dam safety studies to identify potential change in risks to downstream public need to be completed before implementation.

Cost Items

Total Estimated Project Cost	$1,050,000
Annual Power Cost	N/A
Annualized Replacement Cost (25 Year Span)	N/A

Haven't compromised flood capability.

Proposal C2

Description

Proposal C2. Increase Lovewell Capacity - 35,000 Acre-feet.

- Proposal Description: The existing Lovewell Reservoir has an active conservation capacity of 24,022 acre-feet (1571.7 to 1582.6), flood control space of 50,465 acre-feet (1582.6 to 1595.3), and surcharge space of 123,882 acre-feet (1595.3 to 1614.0). Elevation 1614.0 is the crest elevation of the dike section on the left end of the dam. The dam crest elevation is 1616. This proposal is to raise the crest elevation of the dam and dike sections to provide additional reservoir storage capacity.

  The additional capacity could be used to increase the active conservation capacity. Increasing the active conservation capacity by 35,820 acre-feet would result in the top of active conservation at elevation 1592.0; 9.4 feet higher than the current elevation. The top of active conservation pool can be increased between 5 and 10 feet without major impacts to the Courtland Canal inlet structure. For this proposal, modifications to the inlet would probably not be necessary, or would be minor.

  Modifications to the dam would be similar to Proposal No. C1, except that the dam and dike would both need to be raised. Maintaining the existing flood control capacity and surcharge space would require raising the crest of the dam and dike section to elevation 1619. The left end of the existing dike would have to be extended about 1,000 feet for the new crest elevation. Relocation of the existing railroad line will be necessary. The spillway bridge deck and hoisting equipment would have to be raised to the new dam crest elevation. Modifications to the spillway gates would also be necessary for the higher flood control pool elevation and maximum reservoir water surface.

  Water supply would be obtained from excess Republican River flows delivered to Lovewell Reservoir via Courtland Canal. Water supply may be available during irrigation and non-irrigation season. Other improvements to the diversion structures and/or Courtland Canal may be necessary to allow diversions.

- Critical Items to Consider: Potential dam safety deficiency with regard to overtopping and failure during flood events exists at Lovewell Dam. Any modifications to existing structures will need to (at a minimum) maintain the existing flood control and surcharge capacities so that risks to public are not increased. Any modifications to the existing structures that would increase the risks to the public would be unacceptable. Relocation of recreation facilities will be needed. The cost for this relocation is not included in the estimates below.

Proposal C2

- Ways to Implement: Other improvements to the diversion structures and/or Courtland Canal may be necessary to allow diversions.

Includes left dike.

Advantages	Disadvantages
• Provides additional storage capacity; part of additional storage could be used for flood surcharge. • Less design required compared to design and construction of new facilities.	• May require railroad relocation. • Raising pool elevation will have impacts to wildlife in area. • Recreation facilities will need to be relocated.

Potential Risks

- Dam safety studies to identify potential change in risks to downstream public need to be completed before implementation.

Cost Items

Total Estimated Project Cost	$ 6,100,000
Annual Power Cost	N/A
Annualized Replacement Cost (25 Year Span)	N/A

Proposal D1

Description

Proposal D1. Courtland Canal Membrane Lining - Full Prism.

- Proposal Description: If Courtland Canal was reshaped to the original design dimensions and then lined with an exposed geomembrane, the capacity of the canal could be increased from 400 cfs to 750 cfs. This would increase operational flexibility during irrigation periods allowing more water into the system when availability occurs. The geomembrane lining would reduce seepage for the Courtland Canal by almost 20,000 acre-feet per year (AF/yr).
- Critical Items to Consider: The exposed geomembrane is required to reduce seepage. An exposed membrane would most likely only have a 25-year life and would need repair and/or replacement after that time span. The original canal side slopes were designed at 1.5:1 which is steeper than what is typically used in the design of membrane liners with an earth cover. The earth cover would protect the membrane and give a longer service life, perhaps doubling the service life. Due to the cost of reshaping the canal to a flatter side slope and placing the earth cover over the membrane, the decision was made to use an exposed geomembrane. Flow impediments would be required to be removed at four locations along the canal alignment. This would require removal of existing pipe crossing structures and replacement with bridges that allow more flow capacity in the canal. The 20,000 AF/yr was determined from ponding tests done in the mid 1980s and a calculation of the seepage rate through typical soils of the area. Seepage loss estimate may not be an accurate representation of water savings. Actual water savings available for storage at Harlen County Reservoir may be significantly less.
- Ways to Implement: This option would involve the reshaping of the Courtland Canal and furnishing and installing exposed 60-mil geomembrane with 9-inch gravel invert. No changes are expected to the existing check structures along the canal.

Advantages	Disadvantages
• Reduce seepage to 0.05 $ft^3/ft^2/day$. • Restore original canal capacity.	• Requires liner replacement after 25 years. • May take a year of continuous construction to complete • If contract demands for water during the irrigation season (May-September) impact construction, the relining could only be done a few months at a time taking at least 3 years to complete.

Proposal D1

Potential Risks

- None identified.

Cost Items

Total Estimated Project Cost	$ 24,000,000
Annual Power Cost	N/A
Annualized Replacement Cost (25 Year Span)	$243,200

Proposal D2

Description

Proposal D2. Courtland Canal Membrane Lining - Bottom Only.

- Proposal Description: If Courtland Canal was reshaped to increase capacity and then the bottom lined with a membrane, the capacity of the canal could be increased from 400 cfs to 600 cfs. This would increase operational flexibility in the irrigation periods allowing more water into the system when availability occurs. The geomembrane lining would reduce seepage for the Courtland Canal by almost 10,000 acre-feet per year.

- Critical Items to Consider: Membrane placed in the invert of the canal will reduce the seepage rate by about 50 percent compared to a full prism lining for the type of soils in the area. The service life of the covered membrane would be around 50 years. The geomembrane is required to reduce seepage. The original canal side slopes were designed at 1.5:1 which is steeper than what is typically used in an earth lined canal. There may be sloughing of the canal side slopes in the future which will require maintenance. Flow impediments would need to be removed at four locations along the canal alignment. Existing pipe crossing structures and a bridge will need to be replaced to allow for the additional flow. Tractive forces may cause sloughing of the side slopes during higher flows. Seepage loss estimate may not be an accurate representation of water savings. Actual water savings available for storage at Harlen County Reservoir may be significantly less.

- Ways to Implement: This option would involve the reshaping of the Courtland Canal and furnishing and installing a 40-mil geomembrane with 9-inch gravel invert. The 40-mil liner placed in the bottom of the canal would be covered with gravel to ensure a 50-year life. No changes are expected to the existing check structures along the canal.

Advantages	Disadvantages
• Reduce seepage by half. • Increase canal capacity.	• The canal cannot be used at full capacity because without covering the side slopes with a membrane the tractive forces associated with the full design flow will cause sloughing of the canal side slopes. • May take a year of continuous construction to complete. • If contract demands for water during the irrigation season (May-September) impact construction, the relining could only be done a few months at a time taking at least 3 years to complete.

Proposal D2

Potential Risks

- None identified.

Cost Items

Total Estimated Project Cost	$ 13,000,000
Annual Power Cost	N/A
Annualized Replacement Cost (25 Year Span)	N/A

Proposal E

Description

Proposal E. Off-Stream Storage - Thompson Creek.

- Proposal Description: Several small streams enter the Republican River from the north side between Harlan County Dam and the Stateline. Several of these streams have USGeological Survey (USGS) flow data available. Of the streams with USGS data available, preliminary evaluations indicated that potential damsites could theoretically be found on these streams, and those potential dam sites could provide storage in the tens of thousands of acre-feet range.

  To further evaluate the viability of this type of proposal, the potential of one of the more promising sites was investigated in greater detail. Several sizes of dams were evaluated to develop a cost-curve reflecting the potential range of costs to develop a facility. The site selected for this evaluation was on Thompson Creek near Riverton, Nebraska. Studies in 1947 identified a potential dam site in Section 35, Township 2 North, Range 13 West. This same site was evaluated based on a dam structure 68 feet above the streambed. It was identified by members of the lawsuit negotiating team as being the size of most interest.

  Data from the 1947 study were used to estimate quantities and estimate appraisal level costs for the 68-foot high structure. This structure would have a crest length of 2,650 feet (at elevation 1840 feet) and a maximum area-capacity of 24,000 acre-feet. The estimated Total Project Cost of the dam is $24,000,000. The cost per acre-foot of storage created is estimated to be $1,000.

- Critical Items to Consider: While Thompson Creek typically has the highest annual flow of any of the gaged streams on the north side of the Republican River, the amount of water that could be retained for storage during the non-irrigation season or through flows surplus to the diversions at Guide Rock during the irrigation season is unknown. An operational study would be needed to evaluate the actual amount of water potentially available for storage.

  The theoretical site evaluated in this analysis overlies a segment of the existing Franklin Canal. The canal invert at this point is at elevation 1843 feet. The Franklin Canal could, therefore, theoretically be used to fill the reservoir behind the dam.

  The geological suitability of the Thompson Creek site for the development of a dam is unknown. No subsurface investigations were conducted for the 1947 evaluations, and none were performed for these current evaluations. Available data indicates that extensive sand and gravel deposits underlie much of the area. Numerous gravel pits are identified in the uplands and along the sideways of many northside tributaries to the Republican River. The

Proposal E

potential for seepage is certainly present. Since this site would probably need to store substantial quantities of water to be carried over from year to year, such seepage loses could decrease the viability of this facility.

The 1947 evaluation assumed that the Niobrara chalk would form the bedrock foundation.

Advantages	Disadvantages
• Can provide additional storage. • In the example of the Thompson Creek site, the reservoir can potentially be filled (or partially filled) by the Franklin Canal.	• The geological suitability of this site is unknown. • Developing an entirely new site would likely involve higher investigation costs than those associated with expanding existing facilities.

Potential Risks

- Depending on the size of the dam constructed, there may not be enough surplus water in Thompson Creek to fill the reservoir. Non-irrigation season inflow (October through May) is estimated to be 10,000 acre-feet (based on hydrology data from 1948 to 1994). However, the available hydrology data may underestimate current flow levels as Platte River irrigation in recent years has developed a ground water mound to the northwest of the Thompson Creek basin, and it is suspected that ground water from the mound is moving into the Republican River tributaries.
- It is unknown as to whether the Thompson Creek site is geologically suitable for a dam/reservoir.

Cost Items

Total Estimated Project Cost	$ 24,000,000
Annual Power Cost	N/A
Annualized Replacement Cost (25 Year Span)	N/A

Proposal F1

Description

Proposal F1. Off-stream Storage - South Dam Enlargement, Jamestown Waterfowl Management Area

- Proposal Description: The State Lake - Jamestown Waterfowl Management Area, also known as Sportsman Lake, is located approximately 7 miles south of Courtland, Kansas. The existing lake is relatively shallow with an estimated storage of 2,000-3,000 acre-feet. By raising the existing dam about 10 feet, it is theorized that an additional 20,000 acre-feet of storage could be provided. The expanded area-capacity was not calculated for this analysis; the 20,000 acre-feet is assumed to be correct.

  An appraisal level estimate was prepared for a dam with a crest elevation at 1400 feet. The maximum dam height is estimated to be 20 feet. The design assumed a 20-foot-wide dam crest that was 8,000 feet long. The upstream slope was assumed to be 3:1 and the downstream slope 2:1.

  The appraisal level analysis indicated a Total Project Cost for the dike structure of $9,400,000.

  The 20,000 acre-feet of water could potentially be delivered through the Courtland West Canal. The Courtland West Canal has a capacity of at least 80 cfs until a point in the middle of Section 33, Township 4 S. and Range 5 W. From that point a 4-mile-long pipeline would drop the water to Marsh Creek just above where it flows into Jamestown Reservoir. An 80 cfs continuous flow would deliver the 20,000 acre-feet in 126 days - which would be expected to be allowed within the irrigation off-season. An appraisal level cost of the pipeline was estimated at $4,400,000.

  Total Project Cost for the dike and pipeline is estimated to be $13,800,000. The cost per acre-foot of storage created is estimated to be $700.

- Critical Items to Consider: Over the years, the Jamestown Waterfowl Management Area has developed problems with siltation of the marshes and the establishment of cattails throughout the marshes. An increased water level and an increased ability to control water levels could benefit the operation of Jamestown. The Kansas Department of Wildlife and Parks is receptive to this proposal. Actual benefits to the Waterfowl Management Area would depend upon the water levels and releases required to help meet the MDS, versus the water levels and releases desired to enhance the waterfowl habitat. The cost for habitat development and mitigation that will be needed is not included in the estimated costs detailed below.

Proposal F1

Advantages	Disadvantages
• Relative to Proposal E, the reservoir is expected to have fairly low seepage rates. • Relative to most of the Proposal E sites, the dam height is relatively low. • Relative to the Proposal E sites, the cost per acre-foot of storage is low. • There could be a benefit to the Waterfowl Management Area by enlarging the dam and raising the water level.	• Raising the dam would inundate an existing wildlife/recreation area.

Potential Risks

- The estimated costs are appraisal level at best. Actual cost of construction could be significantly different.
- There could be acceptability issues associated with the inundation of the existing wildlife area that could make this project difficult to implement.

Cost Items

Total Estimated Project Cost	$ 14,500,000
Annual Power Cost	N/A
Annualized Replacement Cost (25 Year Span)	N/A

Proposal F2

Description

Proposal F2. Off-stream Storage - North Dam Enlargement, Jamestown Waterfowl Management Area

- Proposal Description: The State Lake - Jamestown Waterfowl Management Area, also known as Sportsman Lake, is located approximately 7 miles south of Courtland, Kansas. The existing lake is created by two small structures, a "south dam" and a "north dam." Both sections of the lake are relatively shallow, with a total estimated storage of 2,000-3,000 acre-feet. By raising the existing north dam about 10 feet, it is theorized that an additional 10,300 acre-feet of storage could be provided.

  An appraisal level estimate was prepared for a dam with a crest elevation at 1400 feet. The maximum dam height is estimated to be 10 feet. The design assumed a 20-foot-wide dam crest that was 2,400-foot long. The upstream slope was assumed to be 3:1 and the downstream slope 2:1.

  The 10,300 acre-feet of water could potentially be delivered through the Courtland West Canal. The Courtland West Canal has a capacity of at least 80 cfs until a point in the middle of Section 33, Township 4 South and Range 5 West. From that point a 4-mile-long pipeline would drop the water to Marsh Creek just above where it flows into Jamestown Reservoir. A 40 cfs continuous flow would deliver the 10,300 acre-feet. in 126 days - which would be expected to be allowed within the irrigation off-season.

  Total Project Cost for the dike and pipeline is estimated to be $6,400,000. The cost per acre-foot of storage created is estimated to be $621.

- Critical Items to Consider: Over the years, the Jamestown Waterfowl Management Area has developed problems with siltation of the marshes and the establishment of cattails throughout the marshes. An increased water level and an increased ability to control water levels could benefit the operation of Jamestown. The north lake/marsh is currently used as the "storage pool" by the Waterfowl Management Area, and the south lake/marsh is currently used as the "food pool". By increasing the storage of the north marsh, the operation of the south marsh may be significantly enhanced. The Kansas Department of Wildlife and Parks is receptive to this proposal. Actual benefits to the Waterfowl Management Area would depend upon the water levels and releases required to help meet the MDS, versus the water levels and releases desired to enhance the waterfowl habitat. The cost for habitat development and mitigation that will be needed is not included in the estimated costs detailed below.

Proposal F2

Advantages	Disadvantages
• Relative to Proposal E, the reservoir is expected to have fairly low seepage rates. • Relative to most of the Proposal E sites, the dam height is relatively low and the cost per acre-foot of storage is low.	• Raising the dam would inundate an existing wildlife/recreation area.

Potential Risks

- The estimated costs are appraisal level at best. Actual cost of construction could be significantly different.
- There could be acceptability issues associated with the innundation of the existing wildlife area that could make this project difficult to implement.

Cost Items

Total Estimated Project Cost	$ 6,400,000
Annual Power Cost	N/A
Annualized Replacement Cost (25 Year Span)	N/A

Proposal G

Description

Proposal G. Off-Stream Storage - Kansas Tributaries, Beaver Creek.

- Proposal Description: Potential storage sites on tributaries to the Republican in Kansas have been identified. As an example, a site on Beaver Creek, in Section 12, Township 6 South, Range 4 West was identified that could hold an estimated 8,500 acre-feet. The dam structure associated with this size impoundment would be approximately 40-foot high with a 2400-foot crest length.

  The site has a drainage area of approximately 36 square miles. No streamflow data are available for this site, but a preliminary estimate using hydrologic data for White Rock Creek would indicate inflow to the Beaver Creek site would be approximately 3,200 acre-feet per year. Water could also be delivered to the reservoir by the Courtland Canal. The Courtland Canal passes the reservoir site about a ½ mile to the east.

  Based on the cost estimates listed below the cost per acre-foot of storage created is estimated to be $1,400.

- Critical Items to Consider: The geology of the site considered in this proposal is unknown.

Advantages	Disadvantages
• Provides flexibility for Kansas.	• There may not be water available in Beaver Creek to fill the reservoir.

Potential Risks

- .None identified.

Cost Items

Total Estimated Project Cost	$ 12,000,000
Annual Power Cost	N/A
Annualized Replacement Cost (25 Year Span)	N/A

Proposal Cost and Benefit Comparison

Proposal	Total Project Cost	Annual Power Cost	Annualized Replacement Cost (25-Yr Span)	Estimated AF/yr of Water Supply	AF/yr of Storage
A1A - Wells to Courtland Canal	$1,050,000	$1200/yr	$2600/yr	900 AF	—
A1B - Wells to Superior Canal	$3,000,000	$3600/yr	$7900/yr	2700 AF	—
A2 - Subsurface Drains to Courtland Canal	$730,000	$720/yr	$2700/yr	1000 AF	—
A3 - Infiltration Gallery to Superior Canal	$690,000	$45,000/yr	$2300/yr	3600 AF	—
B - Courtland Canal Automation, Reshape Prism, Winter Operations	$3,900,000	N/A	N/A	10,000 AF	—
C1 - Increase Lovewell Capacity (16K)	$1,050,000	N/A	N/A	—	16,000 AF
C2 - Increase Lovewell Capacity (35K)	$6,100,000	N/A	N/A	—	35,000 AF
D1 - Courtland Canal Membrane Lining Full Prism	$24,000,000	N/A	$243,200/yr	< 20,000 AF	—
D2 - Courtland Canal Membrane Lining Bottom Only	$13,000,000	N/A	N/A	< 10,000 AF	—
E - Off Stream storage Thompson Creek	24,000,000	N/A	N/A	—	24,000 AF
F1 - Off Stream storage Jamestown Waterfowl Management Area	$14,500,000	N/A	N/A	—	20,000 AF
F2 - North Dam Enlargement Jamestown Waterfowl Management Area	$6,400,000	N/A	N/A	—	10,300 AF
G - Off-Canal Storage - Kansas Tributaries, Beaver Creek	$12,000,000	N/A	N/A	—	8500 AF

Proposal Combinations:

A number of scenarios are possible using a combination of proposals detailed in this report. The following lists an example of a scenario which combines proposals into a system for water supply/storage facility enhancement which will augment stream flow in the Lower Republican River.

This combination of proposals B and C1 or C2 would create a system with more efficient management of Lower Republican River water supplies. This system includes modifications to the existing Guide Rock Diversion structure and Courtland Canal upstream from Lovewell Reservoir (Proposal B) to obtain the water supply, in combination with increasing the capacity of Lovewell Reservoir to provide storage space (Proposal C1 or C2).

Courtland Canal automation in conjunction with winterization of the facilities would allow excess flows that would normally continue downstream of Guide Rock Diversion Dam to be captured and diverted into Lovewell Reservoir. Diversion of excess flows could occur during the irrigation season as runoff from storm events or irrigation return flows, or during the non-irrigation season when there currently are excess flows passing Guide Rock Diversion Dam. Up to an additional 20,000 acre-feet, could potentially be diverted to Lovewell Reservoir through the Courtland Canal System. Proposal B provides the modifications to the canal system, i.e., automation, increased canal capacity, and winterization, to allow efficient/effective diversion of any available excess water at Guide Rock. Automation and increased canal capacity may also provide the necessary canal system flexibility to utilize available water supply more efficiently to meet downstream requirements, with the "saved" water being held in storage at Harlan County.

Modifications to Lovewell Dam to provide additional storage capacity for excess water diversions through the Courtland Canal include raising the dam and dike crest elevations and necessary modifications to the appurtenant structures for higher reservoir levels. Proposal C1 provides about 16,000 acre-feet of additional conservation storage, while Proposal C2 would provide up to 35,000 acre-feet of additional storage. Revisions to the allocated active conservation, flood control, and surcharge space in Lovewell Reservoir will be necessary. For Proposal C2, a portion of the 35,000 acre-feet of additional storage capacity could be allocated to provide additional active conservation storage, with the remaining space providing additional surcharge for passing flood flows (potentially helping to mitigate dam safety concerns for potential overtopping of the dam during flood events.)

Disposition of Alternatives

Summary of Alternatives Considered as Potential Proposals and Their Disposition. Details of each are provided in Appendix of this report.	
Alternative	**Disposition**
1. Rehabilitation and Betterment (R&B) Program for Bostwick Irrigation Districts.	Alternative was considered by the team. It was determined that it would likely be implemented by the Districts in the future. No additional action was required.
2. Canal Lining, Information from February 1985 Special Report, Republican River Basin:	Under Proposal D1, Courtland Canal re-lining was proposed because this canal has the largest seepage rates and greatest potential savings. This was the only option explored for returning Courtland Canal to full design capacity. This option will almost eliminate leakage, saving approximately 20,000 AF/yr. All the other options will only supply a reduced flow over the long term of the project. By membrane lining the 1.5:1 side slopes and bottom of the canal, the velocity can be increased without fear of tractive forces causing sloughing of the canal side slopes. Proposal D2 was developed to find a less expensive and longer lasting solution to the leakage problem in Courtland Canal than Proposal D1. Proposal D2 would line the bottom of the canal to (1) increase liner life because it is not 100 percent exposed to the sun, and (2) reduce the leakage rate by up to 50percent or a savings of 10,000 AF/yr. This puts the cost /AF in the same range as Proposal D1.

Disposition of Alternatives

3. Courtland Canal Automation, Information from February 1985 Special Report, Republican Basin. **3A. Modify/Enhance Courtland Diversion Dam Operations.**	Developed into Proposal B. Using canal automation in conjunction with winterization, additional flows could be captured into the canal that would normally continue downstream during the winter months and after thunderstorms in the summer months. By collecting these excess flows, an additional volume of up to 20,000 AF/yr of water could be added to the canal system. The capacity of the canal would also be increased. By doing minimal reshaping and removal of flow impediments the canal capacity can be increased to approximately 600 cfs without causing erosion of the side slopes. This would increase operational flexibility in the irrigation periods allowing more water into the system when availability occurs.
4. Riparian Vegetation Management.	Considered by team and rejected due to potential environmental concerns by the public.
5. Raising Crest of Lovewell Dam and Increasing the Reservoir Storage.	Developed into Proposal C1 and C2. These proposals provide storage space only - water supply is obtained from other Proposals.
6. Increasing Lovewell Dam Spillway Capacity.	Cannot increase spillway sufficiently to pass Probable Maximum Flood (PMF) without significant damage downstream.
7. Enlarging Courtland Canal.	Developed into Proposal D1 by reestablishing Courtland Canal to its original design dimensions.
8. Small Storage Dams Off Channel in Nebraska.	Thompson Creek site developed into Proposal E as representative of the other small off channel storage sites in Nebraska. Other dam structure sizes were considered at the Thompson Creek location. These were height 28 feet and length 1,100 feet (E1), height 48 feet and length 1,600 feet (E2), plus height 88 feet and length 3,320 feet (E4). The estimated total project cost of storage dams were developed as a part of the team analysis and are found in the appendix of this report.

Disposition of Alternatives

9. Storage Dam and Reservoir Above Lovewell Reservoir.	More costly, and no advantage over increasing storage capacity in Lovewell (Proposals C1 and C2.) Unknown availability of water supply from White Rock Creek.
10. State Lake-Jamestown Waterfowl Management Area (Sportsman Lake).	Developed into Proposal F.
11. Off Canal Reservoirs from Superior or Courtland Canals.	Small storage capacities are available. Not viable relative to other proposals that provide more capacity.
12. Raising Conservation Pool in Medicine Creek Reservoir.	Considered and eliminated as Reclamation field studies indicate little potential for increased supply.
13. Use More Wells in Nebraska Bostwick.	Developed into Proposal A1B.
14. Recharge Facility with Pumps from Wells.	Developed into Proposals A1A, A1B, and A2.
15. Off Channel Storage Upstream of Concordia and Downstream of Scandia.	Beaver Creek site developed into Proposal G. This proposal includes the possibility of diverting water from Courtland Canal into reservoir.
16. Republican River surface Diversions below Stateline.	Considered but eliminated due to uncertainty of water availability at site.
17. Flows from Subsurface drains.	Developed partially as Proposal A2. Other drains are likely to happen in the future with District initiatives.
18. Franklin Canal Extension to Superior Canal.	Proposed as part of Proposal E.

Report for Presentation Meeting - September 4, 2002 - Not for Distribution

Preliminary Cost Estimates - Proposals

Client - Attorney Work Project

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 20-Aug-2002
Client - Attorney Work Product
Lower Republican River

Proposal A1A - Wells to Courtland Canal

PROJECT:
Missouri River Basin

REGION: GP

WOID: 6B284

FILE:
D:\LOTUS\WORK\GP\LOWERR-1\WESTUD-1\FINALR-1\PROPA1-1.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Data:					
		Assume 10 wells are 30 feet deep, 12-inch diameter size					
		Assume gravel pack and PVC screened in lower 1/3 well					
		Wells located in deepest part of alluvial deposits					
	1	Assumed construction cost of 10 wells with pump		10	ea	$9,000.00	$90,000.00
	2	Assumed 1/2 mile of single phase 5kv powerline drop		10	ea	$10,000.00	$100,000.00
	3	Assumed 2,500 feet of above ground 6" diameter		10	ea	$37,500.00	$375,000.00
		PVC discharge pipe at $15/LF. Pipe cost is:					
		$15/LF x 2,500 LF = $37,500/well location					
		Subtotal 1					$565,000.00
		Mobilization (+/- 5% of Subtotal 1)					$28,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$593,000.00
		Unlisted Items (+/- 10% of Subtotal 2)					$57,000.00
		Contract Cost					$650,000.00
		Contingencies (+/- 25% of Contract Cost)					$170,000.00
		Field Cost					$820,000.00
		Non-Contract Costs (+/- 25% of Field Cost)					$230,000.00
		Total Project Cost					**$1,050,000.00**
		Assumed annual power cost per well at $0.06/KWH x 2,000 KWH/well = $120/well x 10 wells = $1,200/year					
		Annual Power Cost for 10 Wells					**$1,200.00**
		Assume a one-time replacement of all 10 well pumps after 25 years (life expectancy).					
		Annualize the present worth (PW) of replacement well pump cost over 25 years at 4% Real Discount Rate.					
		Annualized Replacement Cost for 10 Well Pumps, 25 year life expectancy (Rounded)					**$2,600.00**
		Assume PW cost of one well pump at $4,100, 4% rate 25 years (for A/P, Compound Interest Factor = 0.0640)					

QUANTITIES		PRICES	
BY Joe Lyons D-8520, X2531	CHECKED	BY D. Donaldson DCD	CHECKED RKC 8/21/02
DATE PREPARED 07/08/02	APPROVED	DATE 08/20/2002	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__1__ OF __1__

FEATURE: 20-Aug-2002
Client - Attorney Work Product
Lower Republican River

Proposal A1B - Wells to Superior Canal

PROJECT: Missouri River Basin

REGION: GP **WOID: 6B284**

FILE: D:\LOTUS\WORK\GP\LOWERR~1\WESTUD~1\FINALR~1\PROPA1~1.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Data:					
		Assume 30 wells are 30 feet deep, 12-inch diameter size					
		Assume gravel pack and PVC screened in lower 1/3 well					
		Wells located in deepest part of alluvial deposits					
	1	Assumed construction cost of 30 wells with pump		30	ea	$9,000.00	$270,000.00
	2	Assumed 1/2 mile of single phase 5kv powerline drop		30	ea	$10,000.00	$300,000.00
	3	Assumed 2,500 feet of above ground 6" diameter		30	ea	$37,500.00	$1,125,000.00
		PVC discharge pipe at $15/LF. Pipe cost is:					
		$15/LF x 2,500 LF = $37,500/well location					
		Subtotal 1					$1,695,000.00
		Mobilization (+/- 5% of Subtotal 1)					$85,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$1,780,000.00
		Unlisted Items (+/- 10% of Subtotal 2)					$170,000.00
		Contract Cost					$1,950,000.00
		Contingencies (+/- 25% of Contract Cost)					$450,000.00
		Field Cost					$2,400,000.00
		Non-Contract Costs (+/- 25% of Field Cost)					$600,000.00
		Total Project Cost					**$3,000,000.00**
		Assumed annual power cost per well at $0.06/KWH x 2,000 KWH/well = $120/well x 30 wells = $3,600/year					
		Annual Power Cost for 30 Wells					**$3,600.00**
		Assume a one-time replacement of all 30 well pumps after 25 years (life expectancy).					
		Annualize the present worth (PW) of replacement well pump cost over 25 years at 4% Real Discount Rate.					
		Annualized Replacement Cost for 30 Well Pumps, 25 year life expectancy (Rounded)					**$7,900.00**
		Assume PW cost of one well pump at $4,100, 4% rate 25 years (for A/P, Compound Interest Factor = 0.0640)					

QUANTITIES		PRICES	
BY Joe Lyons D-8520, X2531	CHECKED	BY D. Donaldson DCD	CHECKED RKC 8/21/02
DATE PREPARED 07/08/02	APPROVED	DATE 08/20/2002	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__1__ OF __1__

FEATURE: 20-Aug-2002
Client - Attorney Work Product
Lower Republican River

Proposal A2 - Subsurface Drains to Courtland Canal

PROJECT: Missouri River Basin

REGION: GP **WOID: 6B284**

FILE: D:\LOTUS\WORK\GP\LOWERR~1\WESTUD~1\FINALR~1\PROPA1~1.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Data:					
		Assume six recovery sumps, 6 ft dia concrete pipe placed vertically, 15' deep					
		Assume 1 foot deep gravel filter material in the bottom of the sumps to elimante floatation effect					
		A submersible pump in each recovery sump					
	1	Assumed construction cost of 6 recovery sumps with pun		6	ea	$20,000.00	$120,000.00
	2	Assumed 1/2 mile of single phase 5kv powerline drop		6	ea	$10,000.00	$60,000.00
	3	Assumed 2,500 feet of above ground 6" diameter		6	ea	$37,500.00	$225,000.00
		PVC discharge pipe at $15/LF. Pipe cost is:					
		$15/LF x 2,500 LF = $37,500/sump location					
		Subtotal 1					$405,000.00
		Mobilization (+/- 5% of Subtotal 1)					$20,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$425,000.00
		Unlisted Items (+/- 10% of Subtotal 2)					$45,000.00
		Contract Cost					$470,000.00
		Contingencies (+/- 25% of Contract Cost)					$110,000.00
		Field Cost					$580,000.00
		Non-Contract Costs (+/- 25% of Field Cost)					$150,000.00
		Total Project Cost					**$730,000.00**
		Assumed annual power cost per sump at $0.06/KWH x 2,000 KWH/sump = $120/sump x 6 sumps = $720/year					
		Annual Power Cost for 6 Sumps					**$720.00**
		Assume a one-time replacement of all 6 sump pumps after 25 years (life expectancy).					
		Annualize the present worth (PW) of replacement sump pump cost over 25 years at 4% Real Discount Rate.					
		Annualized Replacement Cost for 6 Sump Pumps, 25 year life expectancy (Rounded)					**$2,700.00**
		Assume PW cost of one sump pump at $7,125, 4% rate 25 years (for A/P, Compound Interest Factor = 0.0640)					

QUANTITIES		PRICES	
BY Joe Lyons D-8520, X2531	CHECKED	BY D. Donaldson DCD	CHECKED RKC 3/21/02
DATE PREPARED 07/08/02	APPROVED	DATE 08/20/2002	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__1__ OF __1__

FEATURE: 20-Aug-2002
Client - Attorney Work Product
Lower Republican River

Proposal A3 - Infiltration Gallery to Superior Canal

PROJECT: Missouri River Basin

REGION: GP **WOID: 6B284**

FILE: D:\LOTUS\WORK\GP\LOWERR~1\VESTUD~1\FINALR~1\PROPA1~1.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Data:					
		Assume a 5' - 12' w x 3' dp x 100' lg gallery dug in the riverbed after cofferdaming w/150' long x 4' deep earth berm.					
		Assume two 100' long x 12" dia s.s well screens placed in the gallery and the gallery then backfilled with gravel.					
		Assume a 10'x10'x6' conc vault structure to house a 450 HP turbine pump (20 cfs, 150' head) and controls.					
		Assume a 50' long x 21" dia steel pipe to be connected to the well screens and to the concrete vault structure.					
		Assume 3,000' of buried 20" dia PVC discharge pipe and outlet structure at Superior Canal					
	1	Cofferdam, earthen type constructed in-the-wet and remo		200	cy	$25.00	$5,000.00
		Say 150' long x 4' w x 4' dp w/ 1:1 slopes. Mat'l within 1 mile.					
	2	Unwatering - Pumping, say 1 month minimum		1	mo	$25,000.00	$25,000.00
	3	Gallery excavated in riverbed		150	cy	$10.00	$1,500.00
	4	Well screens, 12" dia, s.steel, furnish and install		200	lf	$225.00	$45,000.00
	5	Gravel backfill, commercially purchased, 20 mi away		140	cy	$35.00	$4,900.00
	6	Steel pipe, 21" dia to connect with gallery and vault.		50	lf	$165.00	$8,250.00
		Cost includes excavation, bedding, piping and backfill.					
	7	Concrete vault, 12 to 15 cy, with lid to house turbine.		1	ls	$10,000.00	$10,000.00
	8	Turbine pump, 450 H.P., 150' hd, 20 cfs cap, w/controls.		1	ls	$40,000.00	$40,000.00
	9	Assumed 3,000 feet of buried 20" diameter PVC pipe		3,000	lf	$80.00	$240,000.00
		Subtotal 1					$379,650.00
		Mobilization (+/- 5% of Subtotal 1)					$19,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$398,650.00
		Unlisted Items (+/- 10% of Subtotal 2)					$41,350.00
		Contract Cost					$440,000.00
		Contingencies (+/- 25% of Contract Cost)					$110,000.00
		Field Cost					$550,000.00
		Non-Contract Costs (+/- 25% of Field Cost)					$140,000.00
		Total Project Cost					**$690,000.00**
		Assumed annual power cost per turbine pump at $0.06/KWH x 750,000 KWH/pump = $45,000/pump per year					
		Annual Power Cost for Turbine Pump					**$45,000.00**
		Assume a one-time replacement of the turbine pump after 25 years (life expectancy).					
		Annualize the present worth (PW) of replacement turbine pump cost over 25 years at 4% Real Discount Rate.					
		Annualized Replacement Cost for 1 Turbine Pump, 25 year life expectancy (Rounded)					**$2,300.00**
		Assume PW cost of one turbine pump at $36,500, 4% rate 25 years (for A/P, Compound Interest Factor = 0.0640)					

QUANTITIES		PRICES	
BY Joe Lyons/Glen Sanders D-8520, X2531, x 2514	CHECKED	BY D. Donaldson DCD	CHECKED RCC 8/21/02
DATE PREPARED 07/08/02	APPROVED	DATE 08/20/2002	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__1__ OF __2__

FEATURE: 20-Aug-02
CLIENT - ATTORNEY WORK PRODUCT
Lower Republican River

Proposal B - Courtland Canal Automation Reshape Canal Prism, Design for Winter Operation

PROJECT: Missouri River Basin

REGION: GP **WOID: 6B284**

FILE: D:\lotus\WORK\GP\Lower Republican River\VE Study\Final Report\Prop b-d1-d2

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Automate gates at 12 sites:					
	1	Furnishing and Installing Remote Terminal Unit (RTU), PC type box,	D-8140	11	ls	$10,000.00	$110,000.00
		for the control of the existing motorized radial gates					
		including basic RTU software and RTU special function software.					
	2	Furnishing and installing 120V power for RTU from Power drop.	D-8140	11	ls	$4,000.00	$44,000.00
		Assume 250' steel conduit and single phase power cable.					
	3	Furnishing and Installing radio communication (UHF/VHF) system	D-8140	11	ls	$9,000.00	$99,000.00
		between RTU and existing Dam SCADA system- Digital					
		narrowband 12.5 Mhz system (base and field station).					
	4	Furnishing and installing 120V power for radio communication system.	D-8140	11	ls	$4,000.00	$44,000.00
		Assume 250' steel conduit and single phase power cable.					
	5	Furnishing & Installing motor operator w/ combination motor/starter		16	ls	$7,000.00	$112,000.00
		NMA Type 4 enclosure, 240 V single phase					
		Stilling wells at 11 sites:	D-8140				
	6	Furnishing and installing 36B25 RCP installed vertically on conc pad.		286	ft	$350.00	$100,100.00
		Assume 5' dia x 13' deep excavation in soil prior to installation.					
	7	Furnishing and installing 4-inch PVC pipe.		1,325	ft	$24.00	$31,800.00
	8	Furnishing and installing pressure transducer.		22	ls	$2,500.00	$55,000.00
	9	Furnishing and installing buried metallic cable between stilling		5,500	ft	$8.00	$44,000.00
		well and RTU - four wire twisted pairs.					
	10	Furnishing and installing buried power cable to stilling well.		5,500	ft	$16.00	$88,000.00
		Long throated flume at Guiderock only:	D-8140				
	11	Structure excavation		217	cyd	$7.00	$1,519.00
	12	Compacted backfill		80	cyd	$15.00	$1,200.00
	13	Concrete		69	cyd	$625.00	$43,125.00
	14	Reinforcement		7,636	lbs	$1.00	$7,636.00
	15	4-inch PVC pipe		60	ft	$24.00	$1,440.00
	16	Compacted select material for flume foundation.		148	cyd	$55.00	$8,140.00

QUANTITIES		PRICES	
BY J.Keith		BY D. Donaldson DCD	CHECKED RCC 8/21/02
DATE PREPARED 7/3/02	APPROVED F.Tan	DATE 8/20/02	PRICE LEVEL Value Study / Appraisal

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET_2_ OF _2_

FEATURE: 20-Aug-02
CLIENT - ATTORNEY WORK PRODUCT
Lower Republican River

Proposal B - Courtland Canal Automation Reshape Canal Prism, Design for Winter Operation (Continued)

PROJECT: Missouri River Basin

REGION: GP WOID: 6B284

FILE: D:\lotus\WORK\GP\Lower Republican River\VE Study\Final Report\[Prop b-d1-d2

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Furnishing and Installing bubblers at 10 checks and Diversion Dam:	D-8140				
	17	Furnishing and installing 2-inch galvanized steel diffuser pipe		724	ft	$20.00	$14,480.00
		at 10 checks and at Diversion Dam.					
	18	Furnishing and installing 2-inch galvanized steel manifold pipe at		180	ft	$20.00	$3,600.00
		at 10 checks and at Diversion Dam.					
	19	Furnishing and installing air compressor (4 cfm, 5 hp size)		11	each	$1,000.00	$11,000.00
		at 10 checks and Diversion Dam.					
	20	Furnishing and installing single phase 5kv power line (w/wood poles)		10	each	$20,000.00	$200,000.00
		for the bubblers (1 mile pull per location) at 10 checks and at					
		Diversion Dam.					
		County road bridges:	D-8140				
		(Construct 4 new county road bridges)					
	21	Remove & dispose of 14-ft dia steel pipe culvert at road crossings		4	each	$5,000.00	$20,000.00
		Length = 50 ft					
	22	Excavation and dispose of earth material at 4 road crossings.		5,300	cyd	$8.00	$42,400.00
	23	Construct 65 ft span x 24 ft wide county road bridges.		4	each	$150,000.00	$600,000.00
		(BI-48 prestressed concrete beams superstructure w/4"asphalt					
		surfacing, cast-in-place abutments (spread footing or driven piles),					
		wingwalls, and W-beam guardrails)					
		Reshape Courtland Canal (29.6 miles from Guide Rock to Lovewell):					
	24	Canal excavation		60,000	cyd	$3.50	$210,000.00
	25	Canal backfill and compact		170,000	cyd	$1.50	$255,000.00
		Subtotal 1 (Sheets 1 and 2)					$2,147,440.00
		Mobilization (+/- 5% of Subtotal 1)					$105,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$2,252,440.00
		Unlisted Items (+/- 10% of Subtotal 2)					$247,560.00
		Contract Cost					$2,500,000.00
		Contingencies (+/- 25% of Contract Cost)					$600,000.00
		Field Cost					$3,100,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$800,000.00
		Total Project Cost					$3,900,000.00

QUANTITIES		PRICES	
BY J.Keith		BY D. Donaldson DCD	CHECKED RCC 8/21/02
DATE PREPARED 7/3/02	APPROVED F.Tan	DATE 8/20/02	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET_1_ OF _1_

FEATURE: 20-Aug-02
Client - Attorney Work Product
Lower Republican River

Proposal C1 - Increase Lovewell Capacity - 16,000 Acre-feet

PROJECT: Missouri River Basin

REGION: GP WOID: 6B284

FILE: D:\lotus\WORK\GP\Lower Republican River\VE Study\Final Report\[Prop c1.x

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Stripping/excavation 2 ft.		7,500	cy	$2.00	$15,000.00
	2	Furnish and place riprap		3,000	cy	$60.00	$180,000.00
		Riprap haul distance approximately 20-25 miles					
	3	Furnish and place bedding for riprap		1,500	cy	$25.00	$37,500.00
		Bedding haul distance approximately 10 miles					
	4	Furnish and place Zone 1 soil		21,000	cy	$10.00	$210,000.00
		Compact in 6 inch lifts					
		Soil haul distance less than 1 mile					
	5	Furnish and place gravel surfacing		1,500	cy	$25.00	$37,500.00
	6	Modify spillway gates		1	ls	$100,000.00	$100,000.00
		Subtotal 1					$580,000.00
		Mobilization (+/- 5% of Subtotal 1)					$29,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$609,000.00
		Unlisted Items (+/- 10% of Subtotal 2)					$61,000.00
		Contract Cost					$670,000.00
		Contingencies (+/- 25% of Contract Cost)					$170,000.00
		Field Cost					$840,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$210,000.00
		Total Project Cost					$1,050,000.00

QUANTITIES		PRICES	
BY C. Duster D-8313, x2993	CHECKED	BY D. Donaldson DCD	CHECKED RCC 8/21/02
DATE PREPARED 08/20/02	APPROVED	DATE 08/20/02	PRICE LEVEL Value Study / Appraisel Level

CODE:D-8170

ESTIMATE WORKSHEET

SHEET__1__ OF __1__

FEATURE: 20-Aug-02
Client - Attorney Work Product
Lower Republican River

Proposal C2 - Increase Lovewell Capacity - 35,000 Acre-feet

PROJECT: Missouri River Basin

REGION: GP WOID: 6B284

FILE: D:\lotus\WORK\GP\Lower Republican River\VE Study\Final Report\[Prop c2.xls

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Stripping of Upper 3 feet of soil, riprap, bedding		50,000	cy	$2.50	$125,000.00
	2	Furnish and place riprap		13,500	cy	$50.00	$675,000.00
		Riprap haul distance approximately 20-25 miles					
	3	Furnish and place bedding for riprap		6,500	cy	$20.00	$130,000.00
		Bedding haul distance approximately 10 miles					
	4	Furnish and place Zone 1 soil		80,000	cy	$7.50	$600,000.00
		Compact in 6 inch lifts					
		Soil haul distance less than 1 mile					
	5	Furnish and place soil-cement		38,500	cy	$38.00	$1,463,000.00
		Assume 9% cement by dry weight					
		Compact in 9 inch lifts					
		Soil Haul less than 1 mile					
	6	Furnish and place 12 inches of gravel surfacing		9,200	cy	$20.00	$184,000.00
		Gravel Haul distance approximately 10 miles					
	7	Raise spillway bridge deck, walls,		1	ls	$150,000.00	$150,000.00
		and equipment about 3 feet					
	8	Modify spillway gates		1	ls	$100,000.00	$100,000.00
		Subtotal 1					$3,427,000.00
		Mobilization (+/- 5% of Subtotal 1)					$170,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$3,597,000.00
		Unlisted Items (+/- 10% of Subtotal 2)					$403,000.00
		Contract Cost					$4,000,000.00
		Contingencies (+/- 25% of Contract Cost)					$900,000.00
		Field Cost					$4,900,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$1,200,000.00
		Total Project Cost					**$6,100,000.00**

QUANTITIES		PRICES	
BY C. Duster D-8313, x2993	CHECKED	BY D. Donaldson DCD	CHECKED RICC 8/21/02
DATE PREPARED 08/20/02	APPROVED	DATE 08/20/02	PRICE LEVEL Value Study / Appraisal Level

CODE:D-8170

ESTIMATE WORKSHEET

SHEET__1__ OF __1__

FEATURE: 20-Aug-02
CLIENT - ATTORNEY WORK PRODUCT
Lower Republican River

Proposal D1 - Courtland Canal Membrane Lining - Full Prism

PROJECT: Missouri River Basin

REGION: GP WOID: 6B284

FILE: D:\lotus\WORK\GP\Lower Republican River\VE Study\Final Report\[Prop b-d1-d2

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Reshape Courtland Canal (29.6 miles from Guide Rock to Lovewell);	D-8140				
	1	Canal excavation		197,000	cyd	$3.50	$689,500.00
	2	Canal backfill and compact		552,000	cyd	$1.50	$828,000.00
	3	Furnishing and installing exposed geomembrane (60 mils) to invert		1,020,000	syd	$8.00	$8,160,000.00
		and side slopes of Courtland Canal (assume 25 year life expectancy).					
	4	Furnishing and installing 9-inches of gravel for canal invert.		93,000	cyd	$35.00	$3,255,000.00
		County road bridges:					
		(Remove 4 county road bridges)					
	5	Remove & dispose of 14-ft dia steel pipe culvert at road crossings		4	each	$5,000.00	$20,000.00
		Length = 50 ft					
	6	Excavation and dispose of earth material at 4 road crossings.		5,300	cyd	$8.00	$42,400.00
	7	Construct 65 ft span x 24 ft wide county road bridges.		4	each	$150,000.00	$600,000.00
		(BI-48 prestressed concrete beams superstructure w/4"asphalt					
		surfacing, cast-in-place abutments (spread footing or driven piles),					
		wingwalls, and W-beam guardrails)					
		Subtotal 1					$13,594,900.00
		Mobilization (+/- 5% of Subtotal 1)					$680,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$14,274,900.00
		Unlisted Items (+/- 10% of Subtotal 2)					$1,225,100.00
		Contract Cost					$15,500,000.00
		Contingencies (+/- 25% of Contract Cost)					$4,000,000.00
		Field Cost					$19,500,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$4,500,000.00
		Total Project Cost					**$24,000,000.00**
		Assume a one-time replacement of item 3, the 60 mil thick geomembrane (replace sides only), after 25 years (life expectancy).					
		Annualize the present worth (PW) of replacement geomembrane cost over 25 years at 4% Real Discount Rate.					
		Annualized Replacement Cost for Geomembrane, 25 years life expectancy (Rounded)					**$243,200.00**
		Assume PW cost of geomembrane (side slopes only) at $3,800,000, 4% rate, 25 years (For A/P, Compound Interest Factor = 0.0640)					

QUANTITIES		PRICES	
BY J.Keith		BY D. Donaldson DCD	CHECKED RICC 8/21/02
DATE PREPARED 7/3/02	APPROVED F.Tan	DATE 8/20/02	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET 1 OF 1

FEATURE: 20-Aug-02
CLIENT - ATTORNEY WORK PRODUCT
Lower Republican River

Proposal D2 - Courtland Canal Membrane Lining - Bottom Only

PROJECT: Missouri River Basin

REGION: GP WOID: 6B284

FILE: D:\lotus\WORK\GP\Lower Republican River\VE Study\Final Report\[Prop b-d1-d2

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Reshape Courtland Canal (29.6 miles from Guide Rock to Lovewell):	D-8140				
	1	Canal excavation		60,000	cyd	$3.50	$210,000.00
	2	Canal backfill and compact		170,000	cyd	$1.50	$255,000.00
	3	Furnishing and installing exposed geomembrane (40 mils) to bottom of Courtland Canal.		475,900	syd	$6.00	$2,855,400.00
	4	Furnishing and installing 9-inches of gravel for canal invert.		93,000	cyd	$35.00	$3,255,000.00
		County road bridges:					
		(Remove 4 county road bridges)					
	5	Remove & dispose of 14-ft dia steel pipe culvert at road crossings		4	each	$5,000.00	$20,000.00
		Length = 50 ft					
	6	Excavation and dispose of earth material at 4 road crossings.		5,300	cyd	$8.00	$42,400.00
	7	Construct 65 ft span x 24 ft wide county road bridges.		4	each	$150,000.00	$600,000.00
		(BI-48 prestressed concrete beams superstructure w/4"asphalt					
		surfacing, cast-in-place abutments (spread footing or driven piles),					
		wingwalls, and W-beam guardrails)					
		Subtotal 1					$7,237,800.00
		Mobilization (+/- 5% of Subtotal 1)					$360,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$7,597,800.00
		Unlisted Items (+/- 10% of Subtotal 2)					$802,200.00
		Contract Cost					$8,400,000.00
		Contingencies (+/- 25% of Contract Cost)					$2,100,000.00
		Field Cost					$10,500,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$2,500,000.00
		Total Project Cost					**$13,000,000.00**

QUANTITIES | PRICES

BY J.Keith | BY D. Donaldson DCD | CHECKED RLC 8/21/02

DATE PREPARED 7/3/02 | APPROVED F.Tan | DATE 8/20/02 | PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET 1 OF 1

FEATURE: 20-Aug-2002
Client - Attorney Work Product
Lower Republican River

Proposal E - Off-stream Storage - Thompson Creek

PROJECT: Missouri River Basin

REGION: GP WOID: 6B284

FILE: D:\LOTUS\WORK\GP\LOWERR~1\VESTUD~1\FINALR~1\PROPE~1.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Data:					
	a	Earthen Dam w/Concrete Spillway & Outlet Works					
	b	Crest Length = 2,650' (assumed)					
	c	Crest Elevation = 1,840' (assumed)					
	d	Max. Res. Water Surface Elev. = 1834' (assumed)					
	e	Streambed Elev. = 1772' (1947 Design Report)					
	f	Height of Dam = (c - e) = 68'					
	g	Head = (d - e) = 62'					
	h	Max. Spillway Discharge Cap. = 81,000 cfs (1947 Design Report)					
	i	Max. Outlet Works Discharge Cap. = 100 cfs (1947 Design Report)					
	j	Drainage Runoff Area = 160 sq mi (1947 Design Report)					
	k	Flood Momentary Peak Flow = 100,000 cfs (1947 Design Report)					
	l	Max. Res. Storage Cap. = 23,984 ac-ft (1947 Design Report)					
	m	Max. Reservoir Storage Area = 942 acres (1947 Design Report)					
	n	Dam Earthwork Volume * = 634,000 cy (computed)					
	o	Concrete for Spillway & Outlet Works = 21,600 cy (computed)					
	p	Borrow Material = Nearby (say 1 mile or so)					
	q	Dam Foundation Condition = Average (assumed)					
	r	1947 Estimated Cost = NA					
		* Note: For a rough quantities computation, we					
		assumed a dam crest width of 20 feet wide, a					
		3:1 upstream slope and a 2:1 downstream slope.					
		Per two appraisal level methods of determining the					
		total dam field cost (dam, spillway and outlet works)					
		in present worth (year 2002) dollars, both methods					
		resulted in the following estimated cost of the dam:					
		Field Cost includes 35% for unlisted and contingencies:					
		Field Cost		1	LS	$19,500,000.00	$19,500,000.00
		Non-Contract Costs (+/- 25% of Field Cost)					$4,500,000.00
		Total Project Cost					**$24,000,000.00**

BY B. McCaig D-8580, X2708 | CHECKED | BY D. Donaldson DCD | CHECKED RLC 8/21/02

DATE PREPARED 06/10/02 | APPROVED | DATE 08/20/2002 | PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 2

FEATURE: 20-Aug-2002
Client - Attorney Work Product
Lower Republican River

Proposal F1 - Off-stream Storage - South Dam Enlargement, Jamestown Waterfowl Management Area

PROJECT: Missouri River Basin

REGION: GP **WOID:** 6B284

FILE: D:\LOTUS\WORK\GP\LOWERR~1\WESTUD~1\FINALR~1\PROPF1~1.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Data:					
	a	Earthen Dam w/Concrete Spillway & Outlet Works					
	b	Crest Length = 8,000' (assumed based on quadrangle topo map)					
	c	Crest Elevation = 1,400' (assumed based on quadrangle topo map)					
	d	Max. Res. Water Surface Elev. = 1394' (assumed based on quadrangle topo map)					
	e	Streambed Elev. = 1380' (assumed based on quadrangle topo map)					
	f	Height of Dam = (c - e) = 20' (assumed based on quadrangle topo map)					
	g	Head = (d - e) = 14'					
	h	Max. Spillway Discharge Cap. = 76,000 cfs (assumed)					
	i	Max. Outlet Works Discharge Cap. = 100 cfs (assumed)					
	j	Drainage Runoff Area = 150 sq mi (Per 6/10/02 e-mail)					
	k	Flood Momentary Peak Flow = 94,000 cfs (Per 6/10/02 e-mail)					
	l	Max. Res. Storage Cap. = (unknown)					
	m	Max. Reservoir Storage Area = (unknown)					
	n	Dam Earthwork Volume * = 210,000 cy (computed)					
	o	Concrete for Spillway & Outlet Works = (unknown)					
	p	Borrow Material = Nearby (say 1 mile or so)					
	q	Dam Foundation Condition = Average (assumed)					
		* Note: For a rough quantities computation, we assumed a dam crest width of 20 feet wide, a 3:1 upstream slope and a 2:1 downstream slope.					
		Per an appraisal level method of determining the total dam field cost (dam, spillway and outlet works) in present worth (year 2002) dollars, the method resulted in a lump sum of:					
		Field Cost includes 35% for unlisted and contingencies:					
	y	Field Cost (Dam Only)		1	LS	$7,500,000.00	$7,500,000.00
		Non-Contract Costs (+/- 25% of Field Cost)					$1,900,000.00
	z	Total Project Cost (Dam Only)					$9,400,000.00

QUANTITIES		PRICES	
BY B. McCaig D-8580, X2708	CHECKED	BY D. Donaldson DCD	CHECKED RKC 8/21/02
DATE PREPARED 06/12/02	APPROVED	DATE 08/20/2002	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 2 OF 2

FEATURE: 20-Aug-02
CLIENT - ATTORNEY WORK PRODUCT
Lower Republican River

Proposal F1 - Off-stream Storage - South Dam Enlargement, Jamestown Waterfowl Management Area (Continued)

PROJECT: Missouri River Basin

REGION: GP **WOID:** 6B284

FILE: D:\lotus\WORK\GP\Lower Republican River\VE Study\Final Report\Prop b-d1-d2

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	42-inch PVC pipe, 100 psi	D-8140	21,120	ft	$120.00	$2,534,400.00
	2	Pipe excavation	D-8140	39,199	cyd	$5.00	$195,995.00
	3	Backfill	D-8140	28,956	cyd	$2.00	$57,912.00
	4	Compacted backfill	D-8140	8,158	cyd	$5.00	$40,790.00
		Inlet structure - Type 7 pipe turnout:	D-8140				
	5	Concrete		3	cyd	$1,500.00	$4,500.00
	6	Reinforcement		130	lbs	$2.00	$260.00
		Outlet structure - Type 7 baffled outlet:	D-8140				
	7	Concrete		16	cyd	$1,250.00	$20,000.00
	8	Reinforcement		1,670	lbs	$1.00	$1,670.00
		Subtotal 1 (Items 1 - 8)					$2,855,527.00
		Mobilization (+/- 5% of Subtotal 1)					$145,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$3,000,527.00
		Unlisted Items (+/- 10% of Subtotal 2)					$299,473.00
		Contract Cost					$3,300,000.00
		Contingencies (+/- 25% of Contract Cost)					$800,000.00
	w	Field Cost (Pipeline & Assoc Structures Only)					$4,100,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$1,000,000.00
	x	Total Project Cost (Pipeline & Assoc Structures Only)					$5,100,000.00
	y	Field Cost (Southern Jamestown Dam Only, from sheet 1 of 2)					$7,500,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$1,900,000.00
	z	Total Project Cost (Southern Jamestown Dam Only, from sheet 1 of 2)					$9,400,000.00
		Field Cost (Pipeline & Assoc Structures + Dam = w+ y)					$11,600,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$2,900,000.00
		Total Project Cost (Pipeline & Assoc Structures + Dam = x + z)					**$14,500,000.00**

QUANTITIES		PRICES	
BY J.Keith		BY D. Donaldson DCD	CHECKED RKC 8/21/02
DATE PREPARED 7/3/02	APPROVED F.Tao	DATE 8/20/02	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__1__ OF __2__

FEATURE: 20-Aug-2002
Client - Attorney Work Product
Lower Republican River

Proposal F2 - Off-stream Storage - North Dam Enlargement, Jamestown Waterfowl Management Area

PROJECT: Missouri River Basin

REGION: GP **WOID:** 6B284

FILE: D:\LOTUS\WORK\GP\LOWERR~1\VESTUD~1\FINALR~1\PROPF2~1.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Data:					
	a	Earthen Dam w/Concrete Spillway & Outlet Works					
	b	Crest Length = 2,400' (assumed based on quadrangle topo map)					
	c	Crest Elevation = 1,400' (assumed based on quadrangle topo map)					
	d	Max. Res. Water Surface Elev. = 1394' (assumed based on quadrangle topo map)					
	e	Streambed Elev. = 1390' (assumed based on quadrangle topo map)					
	f	Height of Dam = (c - e) = 10' (assumed based on quadrangle topo map)					
	g	Head = (d - e) = 4'					
	h	Max. Spillway Discharge Cap. = 76,000 cfs (assumed per 7/29/02 e-mail)					
	i	Max. Outlet Works Discharge Cap. = 100 cfs (assumed per 7/29/02 e-mail)					
	j	Drainage Runoff Area = 150 sq mi (assumed per 7/29/02 e-mail)					
	k	Flood Momentary Peak Flow = (unknown)					
	l	Max. Res. Storage Cap. = (unknown)					
	m	Max. Reservoir Storage Area = (unknown)					
	n	Dam Earthwork Volume * = 20,000 cy (computed)					
	o	Concrete for Spillway & Outlet Works = (unknown)					
	p	Borrow Material = Nearby (say 1 mile or so)					
	q	Dam Foundation Condition = Average (assumed)					
		* Note: For a rough quantities computation, we					
		assumed a dam crest width of 20 feet wide, a					
		3:1 upstream slope and a 2:1 downstream slope.					
		Per an appraisal level method of determining the					
		total dam field cost (dam, spillway and outlet works)					
		in present worth (year 2002) dollars, the method					
		resulted in a lump sum of:					
		Field Cost includes 35% for unlisted and contingencies:					
	y	Field Cost (Dam Only)		1	LS		$2,600,000.00
		Non-Contract Costs (+/- 25% of Field Cost)					$700,000.00
	z	Total Project Cost (Dam Only)					$3,300,000.00

QUANTITIES		PRICES	
BY B. McCaig D-8580, X2708	CHECKED	BY D. Donaldson DCD	CHECKED RKC 8/21/02
DATE PREPARED 06/12/02	APPROVED	DATE 08/20/2002	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170 **ESTIMATE WORKSHEET** SHEET__2__ OF __2__

FEATURE: 20-Aug-02
CLIENT - ATTORNEY WORK PRODUCT
Lower Republican River

Proposal F2 - Off-stream Storage - North Dam Enlargement, Jamestown Waterfowl Management Area (Continued)

PROJECT: Missouri River Basin

REGION: GP **WOID:** 6B284

FILE: D:\lotus\WORK\GP\Lower Republican River\VE Study\Final Report\Prop b-d1-d2

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	20-inch PVC pipe	D-8140	21,120	ft	$80.00	$1,689,600.00
	2	Item 1 includes pipe excavation					
	3	Item 1 includes backfill					
	4	Item 1 includes compacted backfill					
		Inlet structure - Type 7 pipe turnout:	D-8140				
	5	Concrete		2	cyd	$1,500.00	$3,000.00
	6	Reinforcement		90	lbs	$2.00	$180.00
		Outlet structure - Type 7 baffled outlet:	D-8140				
	7	Concrete		8	cyd	$1,250.00	$10,000.00
	8	Reinforcement		835	lbs	$1.00	$835.00
		Subtotal 1 (Items 1 - 8)					$1,703,615.00
		Mobilization (+/- 5% of Subtotal 1)					$85,000.00
		Subtotal 2 (Subtotal 1 + Mobilization)					$1,788,615.00
		Unlisted Items (+/- 10% of Subtotal 2)					$161,385.00
		Contract Cost					$1,950,000.00
		Contingencies (+/- 25% of Contract Cost)					$550,000.00
	w	Field Cost (Pipeline & Assoc Structures Only)					$2,500,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$600,000.00
	x	Total Project Cost (Pipeline & Assoc Structures Only)					$3,100,000.00
	y	Field Cost (Northern Jamestown Dam Only, from sheet 1 of 2)					$2,600,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$700,000.00
	z	Total Project Cost (Northern Jamestown Dam Only, from sheet 1 of 2)					$3,300,000.00
		Field Cost (Pipeline & Assoc Structures + Dam = w+ y)					$5,100,000.00
		Non-Contract Cost (+/- 25% of Field Cost)					$1,300,000.00
		Total Project Cost (Pipeline & Assoc Structures + Dam = x + z)					**$6,400,000.00**

QUANTITIES		PRICES	
BY J.Keith		BY D. Donaldson DCD	CHECKED RKC 8/21/02
DATE PREPARED 7/3/02	APPROVED F.Tan	DATE 8/20/02	PRICE LEVEL Value Study / Appraisal Price Level

CODE:D-8170

ESTIMATE WORKSHEET

SHEET__1__ OF __1__

FEATURE: 20-Aug-2002
Client - Attorney Work Product
Lower Republican River

Proposal G - Off-stream Storage -
Kansas Tributaries, Beaver Creek

PROJECT:
Missouri River Basin

REGION:
GP WOID: 6B284

FILE:
D:\LOTUS\WORK\GP\LOWERR-1\VESTUD-1\FINALR-1\PROPG-1.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Data:					
	a	Earthen Dam w/Concrete Spillway & Outlet Works					
	b	Crest Length = 2,400' (assumed)					
	c	Crest Elevation = 1,460' (assumed)					
	d	Max. Res. Water Surface Elev. = 1454' (assumed)					
	e	Streambed Elev. = 1420' (assumed)					
	f	Height of Dam = (c - e) = 40' (assumed based on quadrangle topo map)					
	g	Head = (d - e) = 34'					
	h	Max. Spillway Discharge Cap. = 76,000 cfs (assumed)					
	i	Max. Outlet Works Discharge Cap. = 100 cfs (assumed)					
	j	Drainage Runoff Area = 36 sq mi (assumed)					
	k	Flood Momentary Peak Flow = (unknown)					
	l	Max. Res. Storage Cap. = 12,400 acre-feet					
	m	Max. Reservoir Storage Area = 1669 acres					
	n	Dam Earthwork Volume * = 110,000 cy (computed)					
	o	Concrete for Spillway & Outlet Works = (unknown)					
	p	Borrow Material = Nearby (say 1 mile or so)					
	q	Dam Foundation Condition = Average (assumed)					
		* Note: For a rough quantities computation, we					
		assumed a dam crest width of 20 feet wide, a					
		3:1 upstream slope and a 2:1 downstream slope.					
		Per an appraisal level method of determining the					
		total dam field cost (dam, spillway and outlet works)					
		in present worth (year 2002) dollars, the method					
		resulted in a lump sum of:					
		Field Cost includes 35% for unlisted and contingencies:					
		Field Cost		1	LS	$9,400,000.00	$9,400,000.00
		Non-Contract Costs (+/- 25% of Field Cost)					$2,600,000.00
		Total Project Cost					**$12,000,000.00**

QUANTITIES		PRICES	
BY B. McCaig D-8580, X2708	CHECKED	BY D. Donaldson	CHECKED RKC 8/21/02
DATE PREPARED 07/08/02	APPROVED	DATE 08/20/2002	PRICE LEVEL Value Study / Appraisal Price Level

Client - Attorney Work Project

APPENDIX

Report for Presentation Meeting - September 4, 2002 - Not for Distribution

May 27, 2002 (7:50PM)
NKAO, USBR

DRAFT: CLIENT- ATTORNEY WORK PRODUCT

POTENTIAL PROJECT LIST
REPUBLICAN RIVER VALUE PLANNING STUDY

JOE/RICHARD-

1. <u>Rehabilitation and Betterment (R&B) Program for Bostwick Irrigation Districts:</u>
   - **Nebraska Bostwick**
     - Study done in early 1980s and rough draft report prepared. No action taken.
     - Potential water savings, 3,100 acre-feet/year.
     - January 1983 cost was $9,600,000.
     - Proposed program consisted of 73 miles of pipe, 12 miles concrete lining, and 6 miles of drains to replace 90 miles of open ditch lateral and 5 miles of end sections of smaller canals.
   - **Kansas Bostwick**
     - No R&B Study has been conducted.
     - Contract renewal required District to improve conveyance system by 6 percent and on-farm systems by 5 percent. These improvements would save 5,000 to 7,000 acre-feet each year.
     - This water could be retained in Lovewell and/or Harlan County for future use.

JOE/RICHARD-

2. <u>Canal Lining, Information from February 1985 Special Report, Republican R. Basin:</u>
   - **Nebraska Bostwick for Full Prism Membrane Lining**
     - Franklin Canal, 39.2 miles with capacity from 230-42 cfs for water savings of 9,900 acre-feet /year.
     - Naponee Canal, nothing.
     - Franklin South Side Canal, 2.0 miles with capacity from 42-36 cfs for water savings of 300 acre-feet/year.
     - Superior Canal, 28.0 miles with capacity from 140-46 cfs for water savings of 4,500 acre-feet/year.
     - Courtland Canal in Nebraska, 15.9 miles with capacity from 754-685 for water savings of 5,500 ac-ft/yr.
       Note: 5 miles were already lined in the 90s.
     - Total water savings would be 20,000 acre-feet/year for lining 85.1 miles of canal.
     - January 1983 cost for full prism membrane lining was $28.6 million
   - **Kansas Bostwick for Full Prism Membrane Lining**
     - Courtland Canal from Stateline to Lovewell Reservoir, 18.7 miles with capacity of 685 cfs for water savings of 5,700 acre-feet/year.
     - North Canal, 2.3 miles with capacity from 50-42 cfs for a water savings of 200 acre-feet/year.

- Ridge canal, 3.8 miles with capacity from 90-36 cfs for a water savings of 300 acre-feet/year.
- Courtland Canal from Reservoir to end, 20.9 miles with capacity from 635-50 cfs for a water saving of 1,700 acre-feet/year.
- Courtland West Canal, 9.9 miles with capacity from 200-45 cfs for a water savings of 4,600 acre-feet/year.
- Miller Canal, 8.2 miles with capacity 190-30 cfs for a water savings of 800 acre-feet/year.
- White Rock Canal, 9.7 miles with capacity from 100-36 cfs for a water savings of 1,000 acre-feet/year.
- Total water savings would be 15,000 acre-feet/year for lining 73.5 miles of canal.
- January 1983 cost for full prism membrane lining was $31 million.

RICHARD

3. **Courtland Canal Automation, Information from February 1985 Special Report, Republican Basin:**
   - Work would include rehab 11 existing checks and adding 3 new ones.
   - Additional water available would be 4,800 acre-feet/year in Harlan County Lake and 1,400 acre-feet/year in Lovewell Reservoir.
   - January 1983 cost was $3.4 million.

RICHARD

3A. **Modify/Enhance Courtland Diversion Dam Operations:**
   - Determine need for minimum by-pass amounts.
     - Prior reports indicated a need of 40 cfs by-pass for health reasons.
     - Designers Operating Criteria states that a minimum sluice gate opening is required at both ends of the diversion dam.
     - Neither of these requirements are currently considered to be in effect.
   - Increase diversion period to 12 months.
     - This would be an additional 5.5 months of operation.
     - Heaters would be required on gates.
     - Some down time would be required for maintenance.
     - Winter operations would likely increase maintenance costs

JILL

4. **Riparian Vegetation Management, Information from February 1985 Special Report, Republican Basin:**
   - The Report noted that if the vegetation was primarily cottonwood and willow trees the consumptive use would be 4.1 acre-feet/ac/year from groundwater.
   - Conversion of this type of vegetation to a grass or other lesser consumptive use plant would not completely eliminate the consumptive use. It is estimated the savings could be around 1.0 acre-feet/ac/year.
   - Conversion of the vegetation from dense trees to grasses could put the lands to a beneficial use such as for livestock production.

Client - Attorney Work Project

- Identified acres of riparian vegetation in the Basin:
  - Entire Republican Basin down to Milford Dam, 68,662 acres.
  - Harlan County Dam to Stateline, 9,920 acres.
  - Stateline to Milford Dam, 5,568 acres.
- Impacts to streamflow difficult to quantify, both amount and timing:
  - Possible water savings: Harlan County Dam to the Stateline could be in the range of 5-10,000 acre-feet/year.
  - Possible water savings: Stateline to Milford Dam could be in the range of 3-6,000 acre-feet/year.
- Continual maintenance of the lands would be required to prevent encroachment of undesirable vegetation.
- No associated costs were estimated. Present experience and on-going research in the Platte Valley could be a source for information.
- One approach could be utilization of conservation easements with the lands remaining on the tax rolls after clearing.

DUSTY

5. **Raising Crest of Lovewell Dam and Increasing the Reservoir Storage:**
   - Dam has no cut-off trench. Underlying the dam is alluvial material (silts, clays, and a lesser amount of sand) with low permeability.
   - The dam has a structural height of 93 feet above the streambed with a 30-foot wide crest.
   - The embankment has a crest length of approximately 4,000 feet. In addition there is a left abutment dike that extends the crest length to a total of 8,500 feet.
   - Raising the conservation pool elevation by:
     - 3 feet would increase storage about 10,000 acre-feet.
     - 5 feet would increase storage 17,000 acre-feet.
     - Raising much more could infringe on the invert elevation of the Courtland Feeder Canal.
     - The inlet transition of the drop inlet structure into Lovewell has a gate that prevents flows from backing into the canal when the reservoir is in flood stage.
   - If raised the crest width would probably remain at 30 feet and the upstream slope would remain at 2:1. A 1:1 reinforced earth slope for the downstream face would probably be considered.
   - Right abutment concerns:
     - Saturated waste materials upstream from the spillway would have to be addressed. It is currently being monitored under the landslide surveillance program.
     - Total failure of the slide would not threaten the spillway but would restrict spillway flows.
     - Increasing the water surface would likely create some additional movement.
     - Possible solutions may be removal of the materials or stabilization of the embankment toe.
   - Left abutment concerns:
     - For a 5-foot raise in the finger dike, the dike would have to be extended about an additional 1,200 feet.
     - An existing railroad grade would have to be raised about 3 feet.

Report for Presentation Meeting - September 4, 2002 - Not for Distribution

- Spillway concerns:
  - The existing spillway is not sized to adequately pass the PMF.
  - The raise would require enlarging the spillway capacity.
- Summary:
  - There appears to be no major structural concern with increasing the embankment.
  - Reservoir shoreline erosion would be a major problem.
  - Existing improvements in park and cabin areas would have to be relocated or protected.

DUSTY

6. Increasing Lovewell Dam Spillway Capacity:

- This could address the PMF concerns:
  - This would decrease flood surcharge amount and allow for an increase in the conservation pool without increasing the crest elevation.
  - This would potentially provide an opportunity to decrease existing flood surcharge volume of 94,000 acre-feet.
  - The exclusive flood control pool of 50,000 acre-feet would remain unchanged.
  - Flood routing would be required.
  - There would be some negative flooding impacts on White Rock Creek between the Dam and the Republican River.

RICHARD

7. Enlarging Courtland Canal:

- Original design capacity was 751 cfs.
  - The actual capacity today is approximately 500 cfs.
  - Actual operations try to stay at 400 cfs or less.
  - Restrictions are at existing bridges and culverts.
  - Required canal capacity is 886 cfs without Lovewell (1943 Planning Report)

BOB

8. Small Storage Dams Off Channel NE:

- In Nebraska:
  - Several small streams enter the Republican River from the north side between Harlan County Dam and the Stateline.
  - USGS Streamflow data is available for some of these such as:
    - Elm Creek at Amboy (10/1/48 to 9/30/94)
    - Beaver Creek near Rosemont (10/1/67 to 9/30/70)
    - Center Creek at Franklin (4/1/48 to 9/30/93)
    - Cottonwood Creek near Bloomington (4/1/48 to 9/30/56
    - Thompson Creek at Riverton (4/1/48 to 9/30/94)
    - Turkey Creek at Naponee (4/1/48 to 9/30/53)
  - The State of Nebraska has continued streamflow data collection on:
    - Thompson Creek at Riverton
    - Elm Creek at Amboy
  - Streamflow today may reflect some increase due to influence from the Central Nebraska Public Power and Irrigation District Project.

Client - Attorney Work Project

  - No dam site investigation information has been discovered but possibly some investigation work was done on Thompson Creek in early basin planning or Bostwick investigations.
  - Storage water from some of these sites could be used to add flows to Franklin/Superior/Courtland Canals.

DUSTY

9. Storage Dam and Reservoir Above Lovewell Reservoir:

- Construct series of small storage dams off channel above Lovewell reservoir.
  - Possible sites have not been reviewed.
- Construct single dam with adequate spillway on White Rock Creek above Lovewell Reservoir and below Burr Oak.
  - Structure would fill during flood event and only released when downstream augmentation is required on the river.
  - Would require longer operational season for Courtland above Lovewell to offset storage of flood flows from White Rock Creek
  - Subsurface conditions should be similar to Lovewell Dam.
  - One possible site would utilize some of the existing reservoir rights of way about 2,000 feet west of Highway 14.
    - A water depth of about 40 feet would provide about 25,000 acre-feet of storage.
    - Downstream slope of the embankment would be partially inundated from Lovewell Dam flood storage.
  - Another possible site would be a structure located about 4 miles west of Highway 14.
    - Site would have a potential for storage of approximately 30,000 acre-feet with about 50 feet of water depth.
  - Inundation of existing improvements and some cultural resources would be a major obstacle.

BOB/JILL

10. State Lake-Jamestown Waterfowl Management Area (Sportsman Lake):

- Located approximately 7 miles south of Courtland, Kansas
- Existing shallow lake with an estimated storage of 2-3,000 acre-feet.
- The drainage area is about 100 square miles.
- Raising the lake about 10 feet could possibly provide an additional 20,000 acre-feet of storage.
- Releases into the lake could be from Courtland West Canal with a 3 mile long pipeline or conveyance ditch. The canal is approximately 100 feet higher than the lake.
- A dike/dam 9,000 feet long would be required.
  - The spillway could be a wide uncontrolled section to allow passing of all the flood flows of Marsh Creek.
- Augmentation flow releases to the Republican River could be made via Marsh Creek into Buffalo Creek and would enter the Republican River 2-3 miles upstream of Concordia.
  - Erosion would likely occur along the creek as a result of the releases.
- Reservoir seepage losses should be minimal.

Report for Presentation Meeting - September 4, 2002 - Not for Distribution

BOB

11. Off Canal Reservoirs from Superior or Courtland Canals:

- Some possible sites exist, but storage volume is likely to be small
- In Kansas:
  - Several possible sites along the Lower Courtland Canal have been map located.
  - Most would have definite limitations due to steep gradient of the drainages.
  - Storage capacities would range from 300 to 1,000 to 3,000 acre-feet.
  - Water supply would be provided primarily by releases from Kansas Bostwick I.D. canals.

DUSTY

12. Raising Conservation Pool in Medicine Creek Reservoir:

- Reservoir fills annually.
- Could possibly be accomplished by increasing spillway capacity.

ANN/RICHARD (ROD TEKRONY)

13. Use More Wells in Nebraska Bostwick:

- Use aquifer for storage and when there is a demand for irrigation water from the canals pump groundwater into the canal.
- If needed, recharge water into the aquifer during non-irrigation season.
- Wells would need to be located close to the river because of boundary conditions.

ANN/RICHARD (ROD TEKRONY)

14. Recharge Facility with Pumps from Wells:

- Water source - pumping from Republican River alluvium, near State Line discharging into the Courtland Canal above Lovewell.
  - River valley has a width of 1 ½ - 2 miles.
  - Alluvium thickness is 35 - 45 feet with shale at the bottom depth.
  - The alluvium is mostly sand and gravel
  - The water table is less than 10 feet.
  - Well yields are 300 to 1,000 gallons per minute with 500 - 600 average. The higher yields might be distorted by owner or driller pride.
  - The valley is entrenched within Cretaceous aged shale and chalk.
  - There is very little hydraulic connection with the uplands, either south or north of the river valley.
  - Recharge is via the river and the numerous side drainages of the valley.
    - The drainages from the north side are, to a large extent, open drains to the southern half of the Central Nebraska Public Power and Irrigation District's (CNPP&ID) project.
  - The uplands north of the river are comprised mostly of Pleistocene silts, clays, and sand and gravel.
  - The uplands south of the river tend to consist of silts, sands, some gravel, and fine grained sandstones of the Ogallala Group.
  - The southern edge of the groundwater mound of the CNPP &ID project could be a source of water away from the valley. In a sense, it is now because of the live streams/small creeks entering the Republican Valley from the north.

- Horizontal wells would need to be installed beneath the river to benefit from the recharge.
  - The channel width might be a restrictive factor.

DUSTY/BOB

15. Off Channel Storage Upstream of Concordia and Downstream of Scandia:

- Three potential reservoir sites were located by visual inspection of USGS quad maps.
  - Reservoir drainage areas were not estimated.
  - Average capacities were not estimated but an average reservoir depth of 10 feet could be expected.
  - Unknown are the geological stability and the ability to successfully pass the inflow design flood.
- Sites were located on:
  - West Creek
  - Salt Creek
  - East Creek

DUSTY/BOB

16. Republican River surface Diversions below Stateline:

- Reclamation released a Reconnaissance Report, April 1966 on the Scandia Unit
  - The Project was an irrigation project with a diversion dam near Scandia, KS with pumping of all water to project lands west and south of Belleville, KS
  - The main pumping plant had a static lift of 131 feet with a capacity of 300 cfs.
  - There were two additional relift pumps of 25 and 32 feet.
- Some of the proposed features could be investigated for pumping water to possible off channel storage sites in the area of the Scandia Unit's proposed project lands such West Creek.

JILL

17. Flows from Subsurface drains

- Vegetation changes
- Selenium concerns

MIKE

18. Franklin Canal Extension to Superior Canal