

FEATURE 5: OFF-STREAM STORAGE NEAR FARGO

Description

Ring dike reservoirs are earth dikes used to create a surface holding reservoir. These can be used for terminal storage and regulation of a pipeline supply, or surface storage for high spring flows. Ring dike use was estimated based on dike designs previously made by the U.S. Army Corps of Engineers (USACE). The general site work included stripping to remove organic soils and loose debris up to 1 foot deep. Additional excavated quantities were matched to the dike embankment fill quantities as much as possible. Slopes were set at 3:1 on both the internal and external sides. Riprap over a sand and gravel bedding was used on the internal slopes to prevent erosion. General sites were assumed to be between the Red and Sheyenne Rivers and were assumed to be constructed on flat topography. A geotextile liner could be used on the bottom and sides of the reservoir to minimize seepage losses as protect the water supply from other infiltration sources that could cause contamination.

Water supplies for these surface reservoirs has been estimated from two sources, import from the Missouri River, and/or diversion and storage of in-basin high river flows. The ring dike has been used with import water from the Missouri River near Bismarck as a means of “optimizing” the import flow in conjunction with storage to meet peak demands. Using this combination of import and storage (HYDROSS model run RIFMRNG) the import flow could be reduced.

Pumping diversion of high river flows has been estimated for use in filling the surface storage reservoir. This spring flow water would then be released when river flows are small and shortages could be met. Operation of this diversion, storage, and release has been simulated with the HYDROSS model for diversions of high river flows (flows above all other water right permits) for the Red River only, the Sheyenne River only, and the combination of the Red and Sheyenne Rivers.

The ring dikes have not been located in any specific place, except that they would be between the Red and Sheyenne rivers and in the vicinity of the Fargo/West Fargo area. This location provides proximity to the greatest shortages, and also provides the shortest distance for both diversion and release. Releases from the ring dike storage are expected to be back to the river in times of shortage. Existing municipal diversions are expected to be adequate to capture and retrieve this water for treatment and distribution through existing facilities.

For cost estimating purposes, the material for construction of the dikes is expected to be available from within the storage site area. This will result in a “sump” area within the ring dike. The dikes are to be constructed using compacted earthfill with gravel and riprap protection. A cost for a reservoir liner of geotextile has been included, though, it was not calculated as part of the total because the liner is not considered necessary at this time for the purpose of seepage control. This will require further study. HYDROSS model simulations include a component of evaporation loss but none for seepage loss. Diversions are assumed to be by high volume, low head pumping from the river (high flow only) with gated pipe releases back out of the reservoir. Maximum capacity pumping plants have been estimated from the flow available. Spring flows on the Red River near Fargo can fill the largest ring dike in one month at a pumping rate of 400

cfs. Sheyenne River spring flows can be diverted at a maximum rate of 200 cfs. No estimate has been made for changes in water quality (i.e. algae growth, sedimentation, etc) for the time the water is in storage.

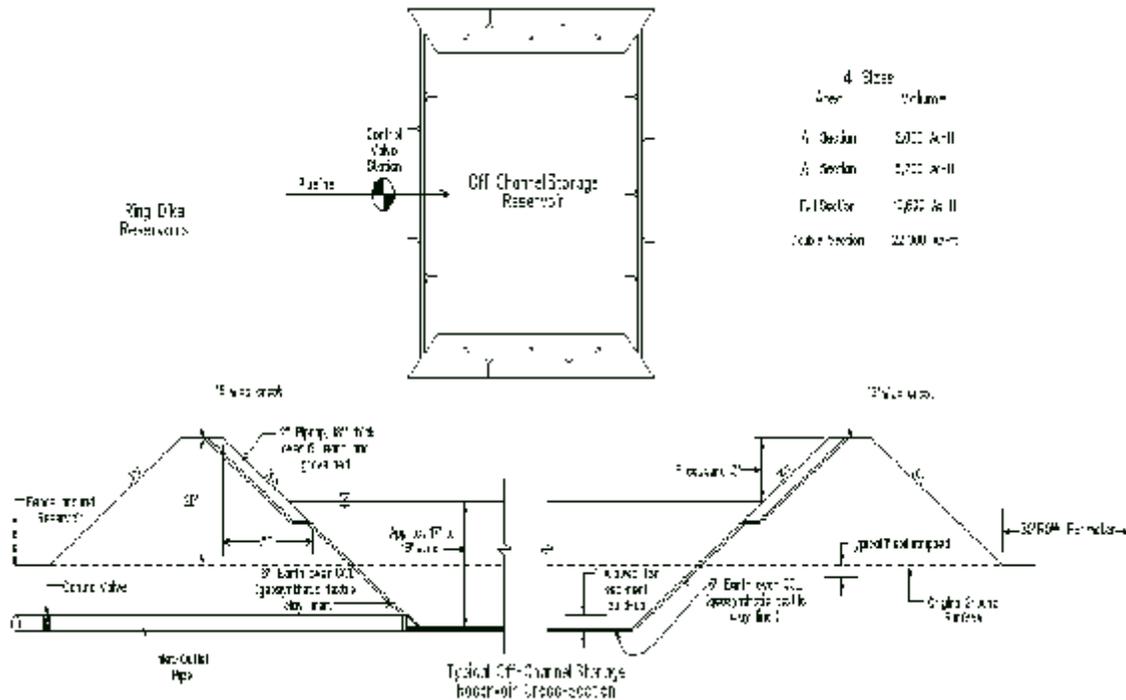


Figure 17
Typical cross section sketch for ring dike reservoirs

Ring dike sizes of 160 acres, 320 acres, 640 acres, and 1280 acres have been used for cost estimates. Land area purchase is included at \$1500 per acre. Relocation cost has been estimated for building removals, utility relocation, etc, at \$50,000 per 160 acres. This relocation cost is in addition to land purchase. The relocation cost may be low considering the density of population around the Fargo/West Fargo area. Additional relocation cost may also be needed for removal and relocation of telephone, gas, and electric utilities, however, without an exact location, this estimate is beyond the appraisal level.

References

[1] US Army Corps of Engineers, St. Paul District, "General Reevaluation and Environmental Impact Statement for Flood Control and Related Purposes," Sheyenne River, North Dakota, August 1982

[2] United States Department of Interior, Bureau of Reclamation, "Design of Small Dams," Second Edition, 1977

[3] United States Department of Interior, Bureau of Reclamation, ACER Technical Memorandum No. 3, "Criteria and Guidelines for Evacuating Storage Reservoir and Sizing Low-Level Outlet Works," 1990

[4] United States Department of Interior, Bureau of Reclamation, Design Standards No. 3, Water Conveyance Systems, Chapter 11, "General Hydraulic Considerations," draft 1992

[5] United States Department of Interior, Bureau of Reclamation, "Pumps and Drivers," 1975

ESTIMATE WORKSHEET

FEATURE: Feature 5 Fargo off-stream reservoir Ring dike storage Half section Capacity = 5,200 Ac-ft	14-Dec-99	PROJECT: Red River Study, North Dakota
		DIVISION:
		FILE: D:\RRVALLEY\FINAL\F5-COSTS.WK4

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Stripping, 1' over area		500,000	CY	\$1.90	\$950,000
		Excavation, common		1,100,000	CY	\$1.65	\$1,815,000
		Embankment, including compaction, 95%		925,000	CY	\$2.40	\$2,220,000
		Concrete inlet/outlet pipe structure (includes F&I cement .28 ton/cy, F&P rebar 100#/cy)		100	CY	\$500.00	\$50,000
		40 mil HDPE Geotextile Liner (Optional)		1,370,000	SY	\$3.50	
		Sand and gravel, 6" bedding for riprap		8,350	CY	\$15.00	\$125,250
		Riprap, 12 inch		25,000	CY	\$30.00	\$750,000
		Fencing, 6' chain link about reservoir area		15,600	LF	\$10.00	\$156,000
		Mobilization (+/- 5%)					\$303,313
		SUBTOTAL					\$6,369,563
		Unlisted Items (+/- 20%)					\$1,273,913
		CONTRACT COST					\$7,643,475
		Contingencies (+/- 25%)					\$1,910,525
		FIELD COST					\$9,554,000
		USBR Invest., Mitig., Engr. & Constr. Mgt. (+/- 33%)					\$3,156,000
		TOTAL ESTIMATE					\$12,710,000

QUANTITIES		PRICES	
BY	CHECKED	BY	CHECKED
Jeff Boysinger		K. Copeland	
DATE PREPARED	APPROVED	DATE	PRICE LEVEL
Dec 1, 1998		12/14/99	

ESTIMATE WORKSHEET

FEATURE:		14-Dec-99	PROJECT:				
Feature 5 Fargo off-stream reservoir Ring dike storage Full section Capacity = 10,600 AC-ft			Red River Study, North Dakota				
			DIVISION:				
			FILE:				
			D:\RRVALLEY\FINAL\F5-COSTS.WK4				
PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Stripping, 1' over area		1,000,000	CY	\$1.75	\$1,750,000
		Excavation, common		1,500,000	CY	\$1.60	\$2,400,000
		Embankment, including compaction, 95%		1,250,000	CY	\$2.35	\$2,937,500
		Concrete inlet/outlet pipe structure (includes F&I cement .28 ton/cy, F&P rebar 100#/cy)		100	CY	\$500.00	\$50,000
		40 mil HDPE Geotextile Liner (Optional)		2,850,000	SY	\$3.30	
		Sand and gravel, 6" bedding for riprap		11,000	CY	\$15.00	\$165,000
		Riprap, 12 inch		33,000	CY	\$30.00	\$990,000
		Fencing, 6' chain link about reservoir area		20,900	LF	\$10.00	\$209,000
		Mobilization (+/- 5%)					\$425,075
		SUBTOTAL					\$8,926,575
		Unlisted Items (+/- 20%)					\$1,785,315
		CONTRACT COST					\$10,711,890
		Contingencies (+/- 25%)					\$2,678,110
		FIELD COST					\$13,390,000
		USBR Invest., Mitig., Engr. & Constr. Mgt. (+/- 33%)					\$4,420,000
		TOTAL ESTIMATE					\$17,810,000
QUANTITIES			PRICES				
BY		CHECKED		BY		CHECKED	
Jeff Baysinger				K. Copeland			
DATE PREPARED		APPROVED		DATE		PRICE LEVEL	
Dec 1, 1998				12/14/99			

ESTIMATE WORKSHEET

FEATURE: FEATURE 5 Fargo off-stream reservoir Ring dike storage Double section Capacity = 22,000 Ac-ft		14-Dec-99 PROJECT: Red River Valley Water Supply					
		DIVISION:					
		FILE: D:\RRVALLEY\FINAL\F5-COSTS.WK4					
PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Stripping, 1' over area		2,000,000	CY	\$1.50	\$3,000,000
		Excavation, common		2,300,000	CY	\$1.40	\$3,220,000
		Embankment, including compaction, 95%		1,900,000	CY	\$2.25	\$4,275,000
		Concrete inlet/outlet pipe structure (includes F&I cement .28 ton/cy, F&P rebar 100#/cy)		100	CY	\$500.00	\$50,000
		40 mil HDPE Geotextile Liner (Optional)		5800000	SY	\$3.00	
		Sand and gravel, 6" bedding for riprap		17000	CY	\$15.00	\$255,000
		Riprap, 12 inch		51000	CY	\$30.00	\$1,530,000
		Fencing, 6' chain link about reservoir area		31500.00	LF	\$10.00	\$315,000
		Subtotal					\$12,645,000
		Mobilization (+/- 5%)					\$632,000
		SUBTOTAL					\$13,277,000
		Unlisted Items (+/- 20%)					\$2,655,400
		CONTRACT COST					\$15,932,400
		Contingencies (+/- 25%)					\$3,983,100
		FIELD COST					\$19,915,500
		USBR Invest., Mitig., Engr. & Constr. Mgt. (+/- 33%)					\$6,572,115
		TOTAL ESTIMATE					\$26,490,000
QUANTITIES				PRICES			
BY R. Burnett				BY NDTST K. Copeland		CHECKED	
DATE PREPARED		APPROVED		DATE		PRICE LEVEL Appraisal	

