

APPENDIX C - UNIT PIPE PRICES

C.1 Introduction and Summary

This appendix summarizes unit pipe prices and their derivation. The cost of constructing pipelines is the largest single cost in the project, accounting for \$65 million of the total project cost as presented in Table 7-1 (Volume I). Project costs are sensitive to the unit prices of pipe. Tables C-1a and C-1b summarize the selected unit pipe prices in October 1998 values. Table C-2 compares selected unit pipe prices with Bureau of Reclamation estimates for this project. Comparison with bid prices received by the State in the project region in August 2000 is also presented.

The methodology of arriving at unit pipe prices involved examination of bidding on projects in South Dakota, namely the Mni Wiconi and Mid-Dakota Projects. The chief difference between projects building in South Dakota and projects in Montana, however, is the difference in prevailing wage rates in the two states. It will be shown that prevailing wage rates in South Dakota for labor classifications used in a rural water project of the type proposed for Fort Peck and Dry Prairie are half (or less than half) of the prevailing wage rates in Montana.

As shown in Tables C-1a and C-1b, different unit prices were derived for the Fort Peck Indian Reservation and Dry Prairie. Experience in South Dakota demonstrates that contractors are bidding at higher rates on the Indian reservations than outside them. Part of the price difference is due to wage rate differences on South Dakota reservations as contrasted with the rest of the State, part is due to remoteness of the reservations, part is due to preference provisions in construction contracts and part is due to lack of competition between a smaller set of contractors bidding on the reservations than on comparable projects outside the reservations. Contractor perceptions of risk related to dispute resolution and tribal courts and perceptions regarding the availability of qualified labor force may also contribute to higher prices. While many of the reasons for differences in unit pipe prices on and off the South Dakota Indian reservations may be dissipated with experiences of contractors on the large projects underway in that State, the historic differences have been applied here to insure conservatism. In actual practice, the Fort Peck Tribes have been strong advocates of the proposed project, the major project components are to be built along U.S. Highway 2 with access to rail for material deliveries, and the cooperation among sponsors in the project area has been a positive factor. The tribal council has taken steps throughout project planning to insure the integrity of the project for its membership and has also taken steps to accommodate Dry Prairie and federal and state guidance as necessary for project implementation. There may be little if any actual difference in pipe prices between Fort Peck and Dry Prairie in the course of this project.

TABLE C-1a

WEIGHTED UNIT PIPE PRICE BY DIAMETER
FORT PECK INDIAN RESERVATION

		Total Costs Per Foot								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal	Ductile	100	165	235	150	200	160	200	250	Selected
Diameter		2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00	Price
1.5	--	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	2.21	2.48	2.80	2.61
3	--	--	--	--	--	--	2.99	3.42	3.98	3.28
4	--	--	--	--	5.77	7.02	4.07	4.70	5.46	4.40
6	--	--	--	--	9.52	11.60	6.83	7.98	9.33	7.40
8	--	--	--	--	12.63	15.52	8.73	10.29	12.19	10.28
10	--	--	--	--	18.16	22.26	12.78	15.07	17.84	16.19
12	--	--	--	--	21.70	26.74	15.06	17.87	21.28	19.50
14	--	15.68	23.66	31.31	--	--	--	--	--	27.49
16	34.53	30.47	40.55	51.22	--	--	--	--	--	34.53
18	41.27	--	--	--	--	--	--	--	--	41.27
20	46.30	--	--	--	--	--	--	--	--	46.30
24	58.09	--	--	--	--	--	--	--	--	58.09

TABLE C-1b

WEIGHTED UNIT PIPE PRICE BY DIAMETER
DRY PRAIRIE

		Total Costs Per Foot								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal	Ductile	100	165	235	150	200	160	200	250	Selected
Diameter		2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00	Price
1.5	--	--	--	--	--	--	--	0.00	0.00	--
2	--	--	--	--	--	--	1.40	1.56	1.77	1.65
3	--	--	--	--	--	--	1.90	2.17	2.52	2.08
4	--	--	--	--	3.65	4.45	2.58	2.98	3.46	2.79
6	--	--	--	--	6.07	7.40	4.36	5.09	5.95	4.72
8	--	--	--	--	8.08	9.93	5.59	6.59	7.81	6.58
10	--	--	--	--	11.59	14.20	8.16	9.62	11.38	10.33
12	--	--	--	--	13.89	17.11	9.64	11.43	13.61	12.48
14	--	10.13	15.28	20.22	--	--	--	--	--	17.75

In order to reflect the difference between Montana and South Dakota prevailing wage rates, it was necessary to separate unit pipe prices into basic components. Those components included material prices, equipment costs for excavating or trenching, labor costs for installing pipe and operating excavation equipment and overhead and profit. These basic costs were derived for pipe diameters ranging from 2 inches to 24 inches and for pressure classes ranging from 150 to 350 pounds per square inch (psi). Specifications for ASTM, AWWA and welded steel or ductile iron were considered. Following a trial division of pipe prices into its

components, each pipe cost was calibrated to experience in South Dakota on-Reservation and off-Reservation. Part of the calibration process involved application of prevailing wage rates to basic assumptions on labor and productivity. Assumptions were also made with respect to reductions in material, equipment, and overhead and profit rates to match the experience in South Dakota. Following calibration to South Dakota pipe prices, all assumptions respecting material prices, equipment costs and overhead and profit were maintained, and Montana wage rates were applied to arrive at Montana unit pipe prices.

Selected pipe sizes were derived through a process of optimization designed to minimize the present value of pipeline and pumping station construction, operation, maintenance and replacement costs. The methodology is described further in Chapter 4.

In addition to the selected prices presented in Table C-1a and C-1b, Bureau of Reclamation estimates for this project are presented for comparison in Table C-2. Bureau of Reclamation derived estimates based, in part, on experience from bid prices received in communities in the project region. In general, selected prices and Bureau of Reclamation estimates are in reasonably close agreement. Reclamation unit prices are generally less than selected unit pipe prices presented in Table C-1 for all Dry Prairie pipe prices. Reclamation unit prices are higher than Fort Peck Indian Reservation prices for 18 inch through 24 inch diameters and lower for all smaller diameters.

TABLE C-2
COMPARISON OF UNIT PIPE PRICES
FROM DIFFERENT SOURCES

Nominal Diameter (in)	Selected		USBR Recommended		Average "Little" Fort Peck
	ASRWS	DPRWS	ASRWS	DPRWS	
2	\$2.61	\$1.65	\$2.48	\$1.59	\$4.01
3	3.28	2.08	3.00	1.92	4.66
4	4.40	2.79	4.02	2.57	5.70
6	7.40	4.72	6.47	4.14	6.79
8	10.28	6.58	8.72	5.58	9.44
10	16.19	10.33	11.40	7.30	10.28
12	19.50	12.48	14.42	9.22	--
14	27.49	17.75	28.02	17.93	--
16	34.53	19.08	34.16	--	--
18	41.27	--	44.40	--	--
20	46.30	--	49.95	--	--
24	58.09	--	62.16	--	--
30	75.30	--	--	--	--

Bid prices for the “little” Fort Peck Rural Water Project (near Fort Peck Dam, not the Fort Peck Assiniboine and Sioux Rural Water System) received by the State of Montana in August 2000 were also reviewed as presented in Table C-2. Prices were adjusted downward to reflect October 1998 prices based on cost trends¹ and to reflect a deduction available from the low bidder for award of two bid schedules. After the adjustment, prices bid were significantly higher for the smaller diameters than either the selected unit prices or Bureau of Reclamation estimates. Pipe bid was generally class 160 and class 200, comparable to the pipe classes that reflect the selected prices. The State bid prices were noticeably higher than the selected unit prices for the Assiniboine and Sioux Rural Water System for diameter classes 2 through 4 inches but less for larger diameters. State bid prices were noticeably higher than the selected unit prices for Dry Prairie in all diameters through 10 inch. The State bid prices, however, were for two small schedules with combined pipe value of \$931,000. Moreover, crude oil prices reached \$34.83 per barrel at the end of August 2000, as compared with \$11.13 to \$14.78 per barrel in the third quarter 1998², and PVC pipe (manufactured from petroleum-based resin) was in short supply and high demand. Cost indices only reflected a 6% difference between periods and are too imprecise to properly reflect differences in unit pipe prices. The State bid prices were not considered representative of prices to be received by the Assiniboine and Sioux or Dry Prairie Rural Water Systems.

(Those not seeking to review the detailed cost derivations following this summary may advance to section C.6. Considerable detail was provided in the following subsections of Appendix C for the reason that (1) pipe costs are the highest major cost item and (2) experience from South Dakota is not only extensive but discloses differences in pricing factors that must be considered here).

C.2 South Dakota Bidding Experience: 1.5 through 12 Inches in Diameter

Table C-3 summarizes actual bid prices received for 1 through 12 inch PVC pipe by the Oglala Sioux Rural Water Supply System (OSRWSS) in South Dakota from FY 1993 through FY 1998. As discussed above, these prices were considered relevant to the cost estimating for the Project because they represent the greatest number of bid openings on an Indian Reservation in the Northern Great Plains, and the prices reflect labor rates that can be adjusted for the current Project. The names and dates of the bid openings are provided in Table C-3.

Site conditions are reasonably comparable. OSRWSS is constructed on soils derived from the underlying Pierre shale, comparable to the Fort Union formation underlining northeastern Montana. Weather conditions are not radically different as they relate to construction. The mean frost free period is 120 days in the OSRWSS area and nearly the same in northeastern Montana. Precipitation averages 16 inches annually in OSRWSS and between 12 and 14 inches in northeastern Montana³, perhaps contributing to more wetland in OSRWSS, but that effect is offset in northeastern Montana by presence of glacial potholes and the abandoned

¹U.S. Bureau of Reclamation, April 2000, Construction Cost Trends, <www.usbr.gov/tsc/cost-trend>

²<www.eia.doe.gov/oil_gas/petroleum/info_glance/petroleum.html>, Brent Crude, August 31, 2000.

³Missouri Basin Inter-Agency Committee, December 1971, *Missouri River Basin Comprehensive Framework Study, Hydrologic Analyses*, Volume 6, p. 9, et seq.

TABLE C-3

ACTUAL OGLALA SIOUX RWSS LOW BID PIPE PRICES (\$/lineal feet)
SOUTH DAKOTA

Diameter/Class	Project and Bid Date										
	White Clay 7/13/93	Kyle North 6/ 1/94	Slim Buttes 6/ 1/94	Kyle to Sharps 1 10/ 1/94	Kyle to Sharps 2 10/ 1/94	West Boundary 3/22/95	Mand I 5/30/96	Mand II 5/30/96	Mand III 5/21/97	Mand IV 8/13/98	
12											
CL200/C900					20.00						
CL200/D2241		17.00			14.40						
CL160/D2241					12.75						
10											
CL200/C900										11.20	
CL150/C900										9.84	
CL200/D2241										8.77	
CL160/D2241										7.97	
8											
CL250/D2241								10.60			
CL200/D2241								9.85			
CL160/D2241	6.50	9.00	9.60						8.33		
6											
CL200/C900											
CL250/D2241			7.90				5.70				
CL200/D2241		7.40	7.20		5.60	6.97					
CL160/D2241	4.95	7.00	6.70		5.25	6.48	5.20		6.16		
4											
CL250/D2241							4.75	5.65	4.89		
CL200/D2241							4.55		4.71		
CL160/D2241	1.75		5.00				4.35		4.53		
3											
CL250/D2241							3.35	4.40		2.65	
CL200/D2241		2.30	2.60						3.25	2.47	
CL160/D2241	1.35	2.10							3.10		
2											
CL250/D2241					2.10		2.10	4.00	2.10	2.18	
CL200/D2241	1.35	2.10	2.00	2.05	1.90	2.24	2.05		1.93	2.09	
1.5											
CL250/D2241		2.40	2.25	2.00			2.00	4.00	1.89	2.14	
CL200/D2241	1.20	2.40	1.90				1.98		1.82	2.02	

Missouri River channel through the Medicine Lake area. In both projects avoidance of wetlands is the construction policy, and little impact of wetland differences is expected between areas.

Sandstone is encountered in OSRWSS, but infrequently. Greater rockiness is expected in northeastern Montana as a by-product of glaciation. Neither sandstone nor rockiness are expected to significantly impact construction costs.

Soils in OSRWSS are highly conducive to corrosion based, at least in part, on their derivation from the Pierre shale, a marine deposit from an ancient sea. The Fort Union formation is expected to contribute to comparable corrosiveness in northeastern Montana, although the length of metal pipe subject to corrosion in northeastern Montana is significantly less than in OSRWSS.

Pipe diameters 1.5 through 4 inches generally reflect pressure classes 160 through 250 psi (SDR-26, 160 psi; SDR-21, 200 psi and SDR-17, 250 psi), defined by ASTM D-2241, which has a 2:1 long-term hydrostatic design safety factor. The pipe uses an internal gasket joint design meeting the requirements of ASTM D-3139 for joints. The gaskets are reinforced with a steel band and conform to the requirements of ASTM F-477. Standard laying length is 20 feet.⁴

In pipe diameters 6 through 12 inches, AWWA C-900 PVC water pipe is included with pressure classes ranging from 150 to 200 psi. The primary difference in this type of pipe is a working pressure rating with a 2.5: 1 long-term hydrostatic design safety factor⁵.

All pipeline in Table C-3 is manufactured with PVC compound meeting the requirements of cell class 12454-B as defined by ASTM D-1784 with a hydrostatic design basis rating of 4,000 psi for water at 73.4 degrees Fahrenheit.

C.2.1 Cost Indexing Factors

Table C-4 summarizes cost trends⁶ for PVC distribution pipelines and steel pipelines used to convert prices received on the various bid dates to October 1998 prices.

⁴ASTM, June 10, 2000, *Designation: D 2241 – 00, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)*; North American Pipe Company, <www.northamericanpipe.com/PSPEC/2241>.

⁵AWWA, 1997, C900-97: *Chloride (PVC) Pressure Pipe, and Fabricated Fittings, for a inch Through 12 in. (100 mm through 300 mm), for Water Distribution*; North American Pipe Company, <www.northamericanpipe.com/PSPEC/2241>.

⁶U.S. Bureau of Reclamation, April 2000, *Construction Cost Trends*, <www.usbr.gov/tsc/cost-trend>

C.2.2 October 1998 Prices

Table C-5 presents the conversion of bid prices on the dates received to October 1998 prices. For 12 inch pipeline, for example, the original bid price for ASTM D-2241, class 200 pipe

TABLE C-4⁷

PRICE TRENDS
DISTRIBUTION AND STEEL PIPELINES

Date	Distribut Index	Steel Index
7/31/92	179	196
10/31/92	181	198
1/30/93	181	199
5/ 1/93	182	200
7/31/93	183	201
10/31/93	184	202
1/30/94	184	203
5/ 1/94	185	204
7/31/94	185	204
10/31/94	187	206
1/30/95	188	209
5/ 1/95	190	211
7/31/95	192	212
10/31/95	193	213
1/30/96	193	214
4/30/96	195	217
7/30/96	195	219
10/30/96	198	222
1/29/97	198	229
4/30/97	201	229
7/30/97	203	231
10/30/97	204	232
1/29/98	206	233
4/30/98	207	233
7/30/98	210	236
10/30/98	211	237

was \$17.00 per foot on June 1, 1994, for the Kyle North project. Later that same year (October 1, 1994) a second bid opening for the knee been been insame type of pipe resulted in prices of \$14.40 per foot. When converted to October 1998 prices, the first price received was equivalent to \$19.39 per foot, and the second price was equivalent to \$16.25. The average price (Table C-5) was \$17.82 per foot.

The "average" column in Table C-5 was considered a reasonable *basis* for estimating unit prices on the Fort Peck Indian Reservation, subject to adjustments that better reflect conditions in the current Project. Other adjustments to eliminate the anomalies as depicted on Figure C-2 were also needed. As shown in Figure C-2, unit prices for 6 and 8 inch pipe appear high when compared to 10 and 12 inch pipe.

⁷U.S. Bureau of Reclamation, April 2000, Construction Cost Trends, <www.usbr.gov/tsc/cost-trend>

TABLE C-5

INDEXED OGLALA SIOUX RWSS LOW BID PIPE PRICES (\$/lineal feet)
SOUTH DAKOTA

Diameter/Source	Project and Bid Date											Maximum	Average	
	White Clay 7/13/93	Kyle North 6/ 1/94	Slim Buttes 6/ 1/94	Kyle to SharpsI 10/ 1/94	Kyle to SharpsII 10/ 1/94	West Boundary 3/22/95	Mand I 5/30/96	Mand II 5/30/96	Mand III 5/21/97	Mand IV 8/13/98				
12														
CL200/C900				22.57									22.57	22.57
CL200/D2241		19.39		16.25									19.39	17.82
CL160/D2241				14.39									14.39	14.39
10														
CL200/C900											11.25	11.25	11.25	11.25
CL150/C900											9.89	9.89	9.89	9.89
CL200/D2241											8.81	8.81	8.81	8.81
CL160/D2241											8.01	8.01	8.01	8.01
8														
CL250/D2241										11.47		11.47	11.47	11.47
CL200/D2241										10.66		10.95	10.80	10.80
CL160/D2241	7.54	10.26	10.95	10.26							8.74	10.26	9.20	9.20
6														
CL200/C900														
CL250/D2241			9.01				6.17					9.01	7.59	7.59
CL200/D2241		8.44	8.21		6.32	7.82						8.44	7.70	7.70
CL160/D2241	5.74	7.98	7.64		5.92	7.27	5.63			6.47		7.98	6.66	6.66
4														
CL250/D2241							5.14	6.11	5.13			6.11	5.46	5.46
CL200/D2241			5.70				4.92		4.94			5.70	5.19	5.19
CL160/D2241	2.03		5.42		3.67		4.71		4.76			5.42	4.12	4.12
3														
CL250/D2241							3.62	4.76			2.66	4.76	3.68	3.68
CL200/D2241		2.62	2.97		2.60				3.41	2.48	3.41	3.41	2.82	2.82
CL160/D2241	1.57	2.40			2.48				3.25		3.25	3.25	2.42	2.42
2														
CL250/D2241				2.37			2.27	4.33	2.20	2.19	4.33	4.33	2.67	2.67
CL200/D2241	1.57	2.40	2.28	2.31	2.14	2.51	2.22		2.03	2.10	2.51	2.51	2.17	2.17
1.5														
CL250/D2241		2.74	2.57	2.26			2.16	4.33	1.98	2.15	4.33	4.33	2.60	2.60
CL200/D2241	1.39	2.74	2.17		2.09		2.14		1.91	2.03	2.74	2.74	2.07	2.07

FORT PECK UNIT PRICE COMPARISON BY DIAMETER AND CLASS

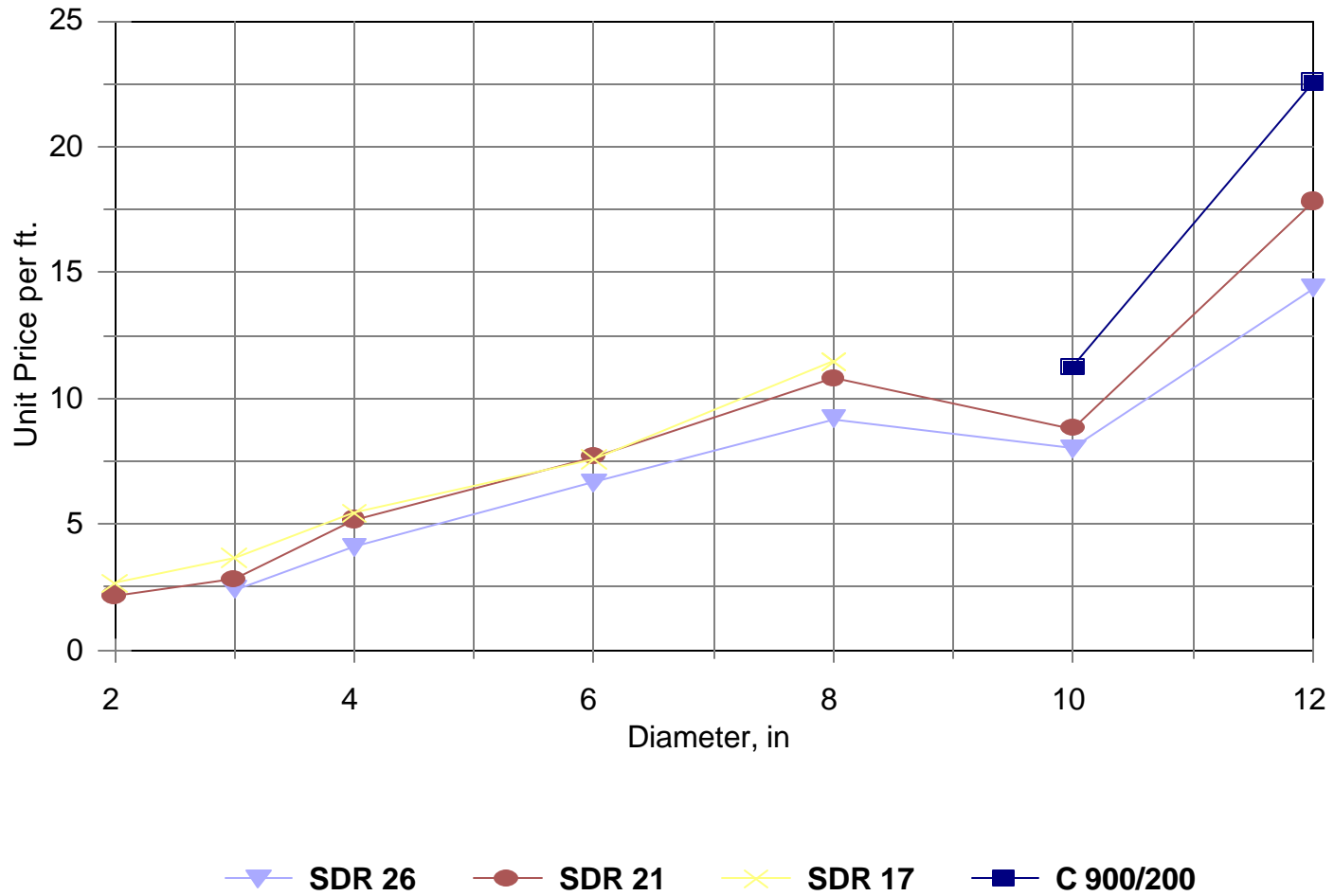


FIGURE C-1

C.3 South Dakota Prices Bidding Experience: 10 through 24 Inches in Diameter

The Bureau of Reclamation has conducted a comprehensive investigation of rural water project costs in South Dakota. The following narrative is based on findings from the investigation.⁸

Actual bid prices of other Indian and non-Indian projects in South Dakota are presented in Table C-6⁹. Pipe sizes range from 10 through 30 inches for pressure classes from 160 through 300 psi. Prices are for the Pine Ridge Indian Reservation (OSRWSS), Rosebud Indian Reservation (RST), Lower Brule Indian Reservation (LBST) and the Mid-Dakota Project, not involving an Indian Reservation on the east side of the Missouri River. Prices from the Final Engineering Report for the Mni Wiconi Project (FER) are also presented for comparison. Prices on the Pine Ridge Indian Reservation are from the same project (OSRWSS) described in the previous section but represent different segments of the project. Where a second project segment was included in Table C-6, two lines of information are presented. Only PVC pipe is presented for diameters 10 through 14 inches, and only metal pipe is presented for diameters 20 through 30 inches.

Table C-7 provides the bid dates for each of the prices presented in Table C-6, and Table C-8 presents the adjusted price in October 1998 dollars. For example, the 10 inch, class 160 pipe bid on the Rosebud Indian Reservation on December 17, 1997, had a bid price of \$8.47 per foot at the time of bidding. When adjusted for construction cost trends to October 1998, the bid price had an estimated value of \$8.76 per foot.

Table C-8 provides a basis for estimating costs of larger pipeline diameters than Table C-5 and also permits a basis for comparing costs of 10 and 12 inch pipelines for areas other than OSRWSS. In 10 inch pipelines, for example, OSRWSS prices of \$8.01 and \$8.81 per foot are slightly lower than estimates at the time of the Mni Wiconi Project FER (October 1992 prices). They are also lower than prices received by the Rosebud Sioux Tribe. The OSRWSS prices are higher, however, than prices received by the Lower Brule Sioux Tribe and Mid-Dakota for 12 inch pipeline. Mid-Dakota had the lowest unit price for 10 inch pipe but only slightly lower than the Lower Brule Sioux Tribe.

For 12 inch pipe OSRWSS received significantly higher prices than in other areas except in the September 17, 1998, bidding, where prices were comparable to Mid-Dakota.

In 14 inch pipe OSRWSS received prices of \$13.21 per foot (indexed to October 1998) as contrasted with FER estimates of \$12.97 and Mid-Dakota bidding of \$15.12 (indexed to October 1998). Finally, in 24 inch pipe sizes, OSRWSS received bid prices of \$51.34 per foot for class 250 pipe, slightly less than the \$55.62 estimated in the FER and more than the \$47.62 and \$45.90 per foot in bid prices received by Mid-Dakota.

⁸U.S. Bureau of Reclamation, October 1999, *Mni Wiconi Rural Water Supply Project, Cost Containment Report – Final*, Dakotas Area Office.

⁹*Ibid*, p 108 through 110.

TABLE C-6

ACTUAL SOUTH DAKOTA LOW BID PRICES (\$/lineal ft)
MNI WICONI AND MID DAKOTA

Diameter/Sourc	Pipe Class											
	D1784 SDR 26 160	D2241 SDR 21 200	D2241 SDR 17 250	C900 DR-18 150	C900 DR-14 200	C900 -- 250	C905 DR-25 165	150	175	200	250	300
10												
FER	6.85	8.10										
OST	7.97	8.77		9.84	11.20							
RST	9.00	11.00										
RST	8.47	9.38										
LBST	7.06	8.50										
MD	6.75											
12												
FER	9.25	10.90										
OST	12.75	10.65	12.65		20.00							
OST	18.32	14.40										
RST	10.00	11.50		14.00	17.24							
RST	10.17	11.64		13.23								
LBST												
MD		10.27			15.48	12.53						
14												
FER							11.00					
OST							13.15					
RST												
LBST												
MD							14.40					
20												
FER											36.00	
OST												
MD										35.00		
24												
FER											46.00	
OST								50.26	59.13	50.26	50.26	50.26
MD									43.20		43.00	45.51
MD									42.00		41.45	44.00
30												
FER											58.00	
OST												
MD										52.00	49.08	

TABLE C-7

SOUTH DAKOTA BID DATES
MNI WICONI AND MID DAKOTA

Diameter/Sourc	Pipe Class											
	D1784 SDR 26 160	D2241 SDR 21 200	D2241 SDR 17 250	C900 DR-18 150	C900 DR-14 200	C900 -- 250	C905 DR-25 250	150	175	200	250	300
10												
FER	10/ 1/92	10/ 1/92										
OST	8/13/98	8/13/98		8/13/98	8/13/98							
RST	8/21/98	8/21/98										
RST	12/17/97	12/17/97										
LBST	10/31/97	10/31/97										
MD	6/19/97											
12												
FER	10/ 1/92	10/ 1/92										
OST	11/30/94	9/17/98	9/17/98		11/30/94							
OST	8/13/98	11/30/94										
RST	8/21/98	8/21/98		8/21/98	12/17/97							
RST	12/17/97	12/17/97		12/17/97								
LBST												
MD		6/19/97			6/19/97	6/19/97						
14												
FER							10/ 1/92					
OST							9/17/98					
RST												
LBST												
MD							6/19/97					
20												
FER										10/ 1/92		
OST												
MD									9/ 3/98			
24												
FER										10/ 1/92		
OST							11/21/97	11/21/97	11/21/97	11/21/97	11/21/97	11/21/97
MD								9/ 3/98		3/14/96	3/14/96	3/14/96
MD								3/14/96		3/14/96	3/14/96	3/14/96
30												
FER										10/ 1/92		
OST												
MD									3/14/96	3/14/96		

TABLE C-8

INDEXED SOUTH DAKOTA LOW BID PRICES (\$/lineal ft)
MNI WICONI AND MID DAKOTA

Diameter/Sourc	Pipe Class											
	D1784 SDR 26 160	D2241 SDR 21 200	D2241 SDR 17 250	C900 DR-18 150	C900 DR-14 200	C900 -- 250	C905 DR-25 165	150	175	200	250	300
10												
FER	8.07	9.55										
OST	8.01	8.81		9.89	11.25							
RST	9.04	11.05										
RST	8.76	9.70										
LBST	7.30	8.79										
MD	7.09											
12												
FER	10.90	12.85										
OST	14.39	10.70	12.71		22.57							
OST	18.41	16.25										
RST	10.05	11.55		14.07	17.83							
RST	10.52	12.04		13.68								
LBST												
MD		10.78			16.25	13.15						
14												
FER							12.97					
OST							13.21					
RST												
LBST												
MD							15.12					
20												
FER											43.53	
OST												
MD									35.15			
24												
FER											55.62	
OST								51.34	60.40	51.34	51.34	51.34
MD									43.38		47.62	50.40
MD									46.51		45.90	48.73
30												
FER											70.13	
OST												
MD										56.85	54.35	

The foregoing discussion discloses that OSRWSS bid prices compare reasonably well with other Indian and non-Indian projects in South Dakota for all but the 12 inch pipe size. Other Indian projects have experienced higher bid prices than OSRWSS (in the 10 inch pipe size), and Mid-Dakota experienced a higher bid price in 14 inch pipe size. For the most part, Mid-Dakota had lower bid prices than the better experience of the Indian projects, ranging from 5 to 10 percent lower, but there were exceptions.

C.4 Derivation of Pipe Prices for Fort Peck Indian Reservation

In the following narrative, the pipe prices discussed above will be divided into components including materials, excavation, labor and overhead and profit. Separation into these components permits an assessment of differences between projects and application of price factors unique to the Fort Peck Indian Reservation and Dry Prairie portion of the Project.

C.4.1 Material Costs

Table C-9 presents an analysis of *material* costs for pipe diameters ranging from 1.5 to 20 inches, for C-905, C-900 and D-2241 PVC pipe specifications and for pressure classes ranging from 100 to 250 psi. Weight per foot was taken from AWWA and ASTM pipe specifications. Material costs per foot were derived from heavy construction cost guides. The shaded area of Table C-9 contains information that is proprietary and not subject to reproduction. Estimates of material costs per pound were applied to weight per foot data to calculate material costs per foot as presented in Table C-9. For 12 inch diameter pipe, for example, AWWA C-900 pipe has costs of \$21.34 and \$26.95 per foot for DR-18 and DR-14 or 150 and 200 psi, respectively. ASTM SDR-26, 21 and 17, with pressure ratings of 160, 200 and 250 psi have costs per foot of \$13.95, \$17.07 and \$20.87, respectively.

The estimates of material costs decline from \$3.00 per pound for 2 inch pipe to \$1.10 per pound for 12 inch pipe (Table C-9).

C.4.2 Excavation Costs

Table C-10 presents generalized costs of equipment for excavation in the project area, both on the Fort Peck Indian Reservation and in the Dry Prairie area. Costs are provided for all pipe diameters ranging from 1.5 to 24 inches. For pipe diameters from 1.5 through 4 inches, trenching or plowing are reasonable methods of excavation. For pipe diameters from 6 through 14 inches, vertical trenching and assembly of pipeline above the trench are reasonable means of excavation and construction. For pipe diameters from 16 through 24 inches, excavation will be required to permit workers in the trench during construction. These factors were taken into account in the preparation of cost estimates for excavating equipment as presented in Table C-10. Costs range from \$0.13 per foot for 4 inch pipe to \$3.17 per foot for 24 inch pipe.

TABLE C-9

MATERIAL COST BASIS FOR PVC PIPE

		Weight Per Foot							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter		2.0	2.0	2.0	2.5	2.5	2.0	2.0	2.0
1.5		--	--	--	--	--	--	0.35	0.42
2		--	--	--	--	--	0.45	0.54	0.65
3		--	--	--	--	--	0.95	1.15	1.41
4		--	--	--	2.5	3.2	1.56	1.91	2.33
6		--	--	--	5.2	6.6	3.39	4.16	5.07
8		--	--	--	9.0	11.4	5.77	7.06	8.64
10		--	--	--	13.7	17.3	8.98	10.99	13.42
12		--	--	--	19.4	24.5	12.68	15.52	18.97
14		11.9	19.1	26.0	--	--	--	--	--
16		16.1	24.7	33.8	--	--	--	--	--
18		--	31.1	42.5	--	--	--	--	--
20		--	38.4	52.6	--	--	--	--	--

		Material Cost per Foot							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter		2.0	2.0	2.0	2.5	2.5	2.0	2.0	2.0
1.5		--	--	--	--	--	--	--	--
2.0		--	--	--	--	--	--	1.62	1.95
3.0		--	--	--	--	--	--	2.60	3.19
4.0		--	--	--	4.73	6.05	--	3.61	4.41
6.0		--	--	--	8.44	10.71	--	6.75	8.23
8.0		--	--	--	12.09	15.31	--	9.48	11.60
10.0		--	--	--	17.13	21.63	11.23	13.74	16.78
12.0		--	--	--	21.34	26.95	13.95	17.07	20.87
14.0		--	24.64	33.54	--	--	--	--	--
16.0		--	30.30	41.46	--	--	--	--	--
18.0		--	--	--	--	--	--	--	--
20.0		--	--	--	--	--	--	--	--

		Material Cost per lb							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter		2.0	2.0	2.0	2.5	2.5	2.0	2.0	2.0
1.5		--	--	--	--	--	--	--	--
2.0		--	--	--	--	--	3.00	3.00	3.00
3.0		--	--	--	--	--	2.26	2.26	2.26
4.0		--	--	--	1.89	1.89	1.89	1.89	1.89
6.0		--	--	--	1.62	1.62	1.62	1.62	1.62
8.0		--	--	--	1.34	1.34	1.34	1.34	1.34
10.0		--	--	--	1.25	1.25	1.25	1.25	1.25
12.0		--	--	--	1.10	1.10	1.10	1.10	1.10
14.0		1.29	1.29	1.29	--	--	--	--	--
16.0		1.23	1.23	1.23	--	--	--	--	--
18.0		--	--	--	--	--	--	--	--
20.0		--	--	--	--	--	--	--	--

TABLE C-10

GENERALIZED EQUIPMENT, TOTAL LABOR, OVERHEAD AND PROFIT

Type/ Diameter (in)	6-10 Excavation Equipment (\$/ft)	Total Labor (\$/ft)	Overhead and Profit (%)
AWWA C900, SDR 26, 160			
1.5	0.13	1.76	38.8
2	0.13	2.04	37.2
3	0.13	2.21	33.2
4	0.13	3.01	33.5
6	0.61	3.72	27.7
8	0.62	3.73	24.6
AWWA C900, SDR 18, 150			
10	0.85	5.33	26.9
12	0.86	5.34	24.7
14	0.88	5.36	18.3
Class 50 Ductile, 18'			
16	2.82	24.68	34.3
18	2.91	27.24	32.0
20	3.00	28.29	31.4
24	3.17	32.39	29.3

Cost estimates for excavation were based on heavy soil conditions found in the Bearpaw shale of the region. Estimates were based on construction depths to 10 feet, which is generally adequate for the seven feet of cover required in the project area. These excavation costs are higher than would be expected in the South Dakota region, where 5.5 to 6 feet of cover is adequate. Guides for depth of cover in northeastern Montana recommend 6.5 to 7 feet of cover.¹⁰

Costs of equipment for excavation do not vary with the pressure class of the pipe.

The costs of excavation are generalized in that they do not reflect the rate of progress in rural water projects but are more reflective of rates of progress in other types of pipeline construction, mainly construction in existing communities. A significant difference between construction in rural water projects and community projects is the openness along the construction route, which permits excavation and other construction activities to proceed at a faster pace. The generalized estimates will be adjusted to more properly reflect the rural water project in subsequent sections of this narrative.

C.4.3 Total Labor Costs

Table C-10 also presents total labor cost per foot ranging from \$1.76 to \$32.39 per foot for 1.5 through 24 inch pipe sizes, respectively. Total labor costs include labor costs for (1) excavation and (2) installing pipe. As in the case of equipment excavation costs, labor costs are generalized and reflect a slower pace of construction than in rural water projects.

¹⁰Fair, Gordon M., John Geyer and Daniel Okun, 1966, *Water and Wastewater Engineering*, John Wiley and Sons, New York, p. 12-19.

Important in the use of prices from South Dakota as a basis for estimating construction costs in the current project is the difference in wage rates between the two areas. Table C-11 provides generalized, federal and tribal wage rates for project crews typical of rural water projects. Two pipe installation crews are presented for (1) smaller PVC pipe (2 through 14 inches) and (2) larger metal pipe (16 through 24 inches). One crew for excavation is presented in Table C-11. A laborer 3 has a generalized wage rate of \$23.45 per hour, which is higher than federal wage rates in Montana and on the Fort Peck Indian Reservation of \$19.33 per hour for the same labor classification. The Fort Peck Tribes have adopted federal Davis-Bacon wage rates for its tribal employment rights ordinance (TERO). Therefore, federal and tribal wage rates are the same.

TABLE C-11

FEDERAL AND TRIBAL WAGE RATES FOR PROJECT CREWS
BY STATE AND PROJECT

Labor Composition	Pipe Size	Generalized \$/hr	MT \$/hr	SD \$/hr	OSRWSS \$/hr
Pipe Installation Crew #1	2 to 14"				
Laborer 3		23.45	19.33	10.02	10.42
Laborer 4		28.05	20.05	11.61	12.01
Laborer 1		21.45	16.41	7.74	8.60
Total		72.95	55.79	29.37	31.03
Pipe Installation Crew #2	16 to 20"				
Laborer 3		23.45	19.33	10.02	10.42
Laborer 4		28.05	20.05	11.61	12.01
Laborer 1		21.45	16.41	7.74	8.60
Equipment		14.68	11.86	5.94	7.13
Operator 5					
Total		87.63	67.65	35.31	38.16
Excavation Crew	16 to 20"				
Equipment		29.35	23.71	11.88	14.25
Operator 5					
Equipment		24.05	21.69	9.27	11.80
Operator 1					
Total		53.40	45.40	21.15	26.05

Federal wage rates in Montana and on the Fort Peck Indian Reservation are considerably higher than in South Dakota (\$10.02 per hour) and on the Pine Ridge Indian Reservation (\$10.42 per hour) for the laborer 3 classification. Table C-11 also shows that the total cost of crews in Montana and on the Reservation are nearly double the cost of crews in South Dakota.

Table C-12 further addresses wage rates by comparing federal and tribal wage rates for all "heavy construction" crafts for the OSRWSS project, which is being used, in part, as a basis for

comparing prices between South Dakota and the Fort Peck Indian Reservation and Dry Prairie (the same as Montana). The wage rates in both states are prevailing wage rates and are the same as federal Davis-Bacon wage rates published by the U. S. Department of Labor.¹¹ Wage rates on the Fort Peck Indian Reservation range from as low as 1.57 to as high as 1.99 times wage rates on the Pine Ridge Indian Reservation. Similarly, wage rates in Montana range from a low of 1.71 to a high of 2.44 times the wage rates in South Dakota (Table C-12). The difference in wage rates between Montana and South Dakota is based on "right to work" statutes in South Dakota that do not exist in Montana. It is noteworthy, however, that Montana wage rates are more closely aligned with national wage rates than South Dakota as reflected in the differences between the "generalized" and Montana wage rates in Table C-11.

TABLE C-12

FEDERAL AND TRIBAL WAGE RATES FOR STATE AND PROJECT(1998)

	OSRWSS (\$/hr)	SD	Mont	Mont/ OSRWSS Ratio	Mont/ SD Ratio
		Davis Bacon (\$/hr)	Davis Bacon (\$/hr)		
Craft					
Laborer 1	8.60	7.74	16.41	1.91	2.12
Laborer 2	9.64	9.00	19.19	1.99	2.13
Laborer 3	10.42	10.02	19.33	1.86	1.93
Laborer 4	12.01	11.61	20.05	1.67	1.73
Carpenter	14.20	11.61	21.03	1.48	1.81
Electrician	16.11	13.24	27.38	1.70	2.07
Truck Driver 1	12.16	10.22	18.01	1.48	1.76
Truck Driver 2	12.37	9.02	21.98	1.78	2.44
Truck Driver 3	12.73	9.99	--	--	--
Equipment Operator 1	11.80	9.27	21.69	1.84	2.34
Equipment Operator 2	12.41	10.22	22.11	1.78	2.16
Equipment Operator 3	12.59	10.22	22.48	1.79	2.20
Equipment Operator 4	13.98	11.61	22.73	1.63	1.96
Equipment Operator 5	14.25	11.88	23.71	1.66	2.00
Concrete Finisher	12.65	11.61	19.83	1.57	1.71

Table C-13 uses generalized production rates to arrive at total labor costs per foot of pipeline ranging from \$1.76 to \$32.39 between 1.5 and 24 inch pipelines, respectively. The same rates of production were applied to wage rates for the Fort Peck Indian Reservation and the State of Montana in the second column of Table C-13 to arrive at labor costs for the Project area. Similarly, the same production rates were applied to South Dakota and OSRWSS wage rates to arrive at labor costs in those areas. The labor costs reflect the labor composition presented in Table C-11.

¹¹Montana Department of Labor and Industry, October 9, 1998, *Prevailing Wage Rates, Heavy and Highway Construction*, p. i.

TABLE C-13

LABOR COSTS FOR CONSTRUCTED PIPE
BY STATE AND PROJECT

Diameter (in)	General (\$/ft)	Fort Peck/ Montana (\$/ft)	South Dakota (\$/ft)	OSRWSS (\$/ft)
1.5	\$1.76	\$1.35	\$0.71	\$0.75
2	2.04	1.57	0.82	0.87
3	2.21	1.70	0.89	0.94
4	3.01	2.31	1.21	1.28
6	3.72	2.88	1.49	1.61
8	3.73	2.89	1.50	1.62
10	5.33	4.13	2.14	2.31
12	5.34	4.14	2.15	2.32
14	5.36	4.16	2.15	2.32
16	24.68	19.19	9.93	10.84
18	27.24	21.16	10.96	11.95
20	28.29	21.98	11.39	12.41
24	32.39	25.16	13.04	14.20

C.4.4 Overhead and Profit

The final column in Table C-10 presents derivation of overhead and profit percentages by pipe diameter using heavy construction estimating guides for the types of pipeline construction shown in the table. Clearly, there is no relationship between pipe size and overhead and profit as a percentage of total construction cost for excavating and installing pipeline. Generalized estimates range from 18.3 percent for 14 inch pipe to 38.8 percent for 1.5 inch pipe. The average overhead and profit for all pipe sizes was estimated at slightly more than 30 percent.

C.5 Calibration to OSRWSS Pipe Prices

Narrative in the foregoing sections provide the background for the methodology of deriving pipe prices for the Fort Peck Indian Reservation. Table C-14 uses generalized estimates as presented in the previous sections to arrive at total pipe prices and to compare those prices with actual bid prices received in the OSRWSS Project. The purpose of the detailed presentation was to make adjustments to the prices received in OSRWSS to reflect labor cost differences on the Fort Peck Indian Reservation. Absent the segregation of pipe prices into the separate components as presented above, there was no reasonable method for accounting for differences in pipe prices between the Pine Ridge and Fort Peck Indian Reservations or between South Dakota and Montana. Experience with rural water projects is also available from North Dakota but on a more limited basis than in South Dakota. Wage rates in North Dakota are reportedly more aligned with South Dakota than Montana, and a similar methodology would have been required to adjust prices from North Dakota to project prices in Montana.

TABLE C-14

COMPUTATION OF PIPE PRICES BASED ON
GENERALIZED ESTIMATES AND OSRWSS WAGE RATES

		Material Cost per Foot								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal		100	165	235	150	200	160	200	250	
Diameter	Ductile	2.0	2.0	2.0	2.5	2.5	2.0	2.0	2.0	
1.5	--	--	--	--	--	--	--	--	--	
2	--	--	--	--	--	--	1.35	1.62	1.95	
3	--	--	--	--	--	--	2.15	2.60	3.19	
4	--	--	--	--	4.73	6.05	2.95	3.61	4.41	
6	--	--	--	--	8.44	10.71	5.50	6.75	8.23	
8	--	--	--	--	12.09	15.31	7.75	9.48	11.60	
10	--	--	--	--	17.13	21.63	11.23	13.74	16.78	
12	--	--	--	--	21.34	26.95	13.95	17.07	20.87	
14	--	15.35	24.64	33.54	--	--	--	--	--	
16	24.00	19.75	30.30	41.46	--	--	--	--	--	
18	30.50	--	--	--	--	--	--	--	--	
20	35.50	--	--	--	--	--	--	--	--	
24	47.00	--	--	--	--	--	--	--	--	

		Excavation Cost per Foot								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal		100	165	235	150	200	160	200	250	
Diameter	Ductile	2.0	2.0	2.0	2.5	2.5	2.00	2.00	2.00	
1.5	--	--	--	--	--	--	--	--	--	
2	--	--	--	--	--	--	0.13	0.13	0.13	
3	--	--	--	--	--	--	0.13	0.13	0.13	
4	--	--	--	--	0.13	0.13	0.13	0.13	0.13	
6	--	--	--	--	0.61	0.61	0.61	0.61	0.61	
8	--	--	--	--	0.62	0.62	0.62	0.62	0.62	
10	--	--	--	--	0.85	0.85	0.85	0.85	0.85	
12	--	--	--	--	0.86	0.86	0.86	0.86	0.86	
14	--	0.88	0.88	0.88	--	--	--	--	--	
16	2.82	2.82	2.82	2.82	--	--	--	--	--	
18	2.91	--	--	--	--	--	--	--	--	
20	3.00	--	--	--	--	--	--	--	--	
24	3.17	--	--	--	--	--	--	--	--	

TABLE C-14 (Cont)

COMPUTATION OF PIPE PRICES BASED ON
GENERALIZED ESTIMATES AND OSRWSS WAGE RATES

		Labor Cost per Foot (OSRWSS)								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal		100	165	235	150	200	160	200	250	
Diameter	Ductile	2.0	2.0	2.0	2.5	2.5	2.00	2.00	2.00	
1.5	--	--	--	--	--	--	--	--	--	
2	--	--	--	--	--	--	0.87	0.87	0.87	
3	--	--	--	--	--	--	0.94	0.94	0.94	
4	--	--	--	--	1.28	1.28	1.28	1.28	1.28	
6	--	--	--	--	1.61	1.61	1.61	1.61	1.61	
8	--	--	--	--	1.62	1.62	1.62	1.62	1.62	
10	--	--	--	--	2.31	2.31	2.31	2.31	2.31	
12	--	--	--	--	2.32	2.32	2.32	2.32	2.32	
14	--	2.32	2.32	2.32	--	--	--	--	--	
16	10.84	10.84	10.84	10.84	--	--	--	--	--	
18	11.95	--	--	--	--	--	--	--	--	
20	12.41	--	--	--	--	--	--	--	--	
24	14.20	--	--	--	--	--	--	--	--	

		Overhead and Profit Cost per Foot								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal		100	165	235	150	200	160	200	250	
Diameter	Ductile	2.0	2.0	2.0	2.5	2.5	2.00	2.00	2.00	
1.5	--	--	--	--	--	--	--	--	--	
2	--	--	--	--	--	--	0.87	0.97	1.10	
3	--	--	--	--	--	--	1.07	1.22	1.41	
4	--	--	--	--	2.06	2.50	1.46	1.68	1.95	
6	--	--	--	--	2.95	3.58	2.14	2.48	2.89	
8	--	--	--	--	3.53	4.32	2.46	2.88	3.41	
10	--	--	--	--	5.46	6.67	3.87	4.55	5.36	
12	--	--	--	--	6.06	7.44	4.23	5.00	5.94	
14	--	3.39	5.09	6.72	--	--	--	--	--	
16	12.92	11.46	15.08	18.91	--	--	--	--	--	
18	14.52	--	--	--	--	--	--	--	--	
20	15.99	--	--	--	--	--	--	--	--	
24	18.86	--	--	--	--	--	--	--	--	

TABLE C-14 (Cont)

COMPUTATION OF PIPE PRICES BASED ON
GENERALIZED ESTIMATES AND OSRWSS WAGE RATES

		Total Costs Per Foot								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal		100	165	235	150	200	160	200	250	
Diameter	Ductile	2.0	2.0	2.0	2.5	2.5	2.00	2.00	2.00	
1.5	--	--	--	--	--	--	--	--	--	
2	--	--	--	--	--	--	3.22	3.59	4.05	
3	--	--	--	--	--	--	4.29	4.89	5.68	
4	--	--	--	--	8.20	9.96	5.82	6.70	7.76	
6	--	--	--	--	13.61	16.51	9.86	11.45	13.34	
8	--	--	--	--	17.86	21.87	12.45	14.61	17.25	
10	--	--	--	--	25.75	31.46	18.25	21.44	25.30	
12	--	--	--	--	30.58	37.57	21.36	25.25	29.99	
14	--	21.94	32.93	43.46	--	--	--	--	--	
16	50.58	44.87	59.04	74.03	--	--	--	--	--	
18	59.88	--	--	--	--	--	--	--	--	
20	66.90	--	--	--	--	--	--	--	--	
24	83.23	--	--	--	--	--	--	--	--	

		Actual OSRWSS Costs Per Foot								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal		100	165	235	150	200	160	200	250	
Diameter	Ductile	2.0	2.0	2.0	2.5	2.5	2.00	2.00	2.00	
1.5	--	--	--	--	--	--	--	--	--	
2	--	--	--	--	--	--	--	2.14	2.86	
3	--	--	--	--	--	--	2.38	2.77	3.70	
4	--	--	--	--	--	--	4.06	5.02	5.47	
6	--	--	--	--	--	--	6.55	7.50	7.46	
8	--	--	--	--	--	--	9.01	10.65	11.52	
10	--	--	--	--	9.93	11.31	8.05	8.85	--	
12	--	--	--	--	--	22.08	14.08	15.90	--	
14	--	--	13.28	--	--	--	--	--	--	
16	--	--	--	--	--	--	--	--	--	
18	--	--	--	--	--	--	--	--	--	
20	--	--	--	--	--	--	--	--	--	
24	51.34	--	--	--	--	--	--	--	--	

TABLE C-14 (Cont)

COMPUTATION OF PIPE PRICES BASED ON
GENERALIZED ESTIMATES AND OSRWSS WAGE RATES

		Ratio OSRWSS Predicted to Means Costs Per Foot							
		AWWA C-905	AWWA C-905	AWWA C-905	AWWA C-900	AWWA C-900	ASTM D2241	ASTM D2241	ASTM D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal Diameter	Ductile	100	165	235	150	200	160	200	250
		2.0	2.0	2.0	2.5	2.5	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2								1.68	1.42
3							1.80	1.77	1.53
4							1.43	1.34	1.42
6							1.51	1.53	1.79
8							1.38	1.37	1.50
10					2.59	2.78	2.27	2.42	
12						1.70	1.52	1.59	
14			2.48						
16									
18									
20									
24	1.62								

C.5.1 Step 1: Generalized Estimates

Table C-14 presents the first of three steps to derive unit pipe prices for the Fort Peck Indian Reservation and Montana from experience on the Pine Ridge Indian Reservation and in South Dakota. The first section of Table C-14 presents generalized material costs as previously presented in Table C-9. Generalized material costs for metal pipe in 16 through 24 inch diameters have been added to Table C-14. The column is entitled "ductile" to represent metal pipe but is equally reflective of steel pipe. It was assumed that PVC pipe would be used for 2 through 14 inch diameter pipelines and that metal pipe would be used for 16 through 24 inch diameter pipelines. In final design, consideration may be given to the use of PVC pipe for diameters as large as 20 inches.

Each section of Table C-14 provides for metal pipe classes with pressure ratings of 250 psi or greater and PVC pipe for AWWA C-905, AWWA C-900, and ASTM D-2241 specifications with pressure ratings from 100 through 250 psi. This generally covers the full range of pipeline materials, specifications and pressure classes expected in the project. Any additional material types, specifications or pressure classes would be used only in the event that project quality would not be sacrificed and a cost savings would result.

The second section of Table C-14 presents equipment excavation costs as presented in Table C-10. It was assumed that excavation costs will not vary with pressure class but only with pipe diameter. The third section of Table C-14 (second page of table) presents total labor cost per foot of pipe based on OSRWSS wage rates. The total labor costs were based on the values for OSRWSS as presented in Table C-13. As discussed previously, total labor costs include labor for operating equipment in trenching and excavating operations and for installing pipeline. Labor costs are reflective of the composition of crews as presented in Table C-11. As with excavation cost, it was assumed that labor costs would not vary with pressure class but only with diameter. This assumption is more valid for excavation than for pressure class for the reason that labor costs for installation of pipe will be somewhat dependent on the weight of pipe. Refer to Table C-9 for variations in the weight of PVC pipe for any given diameter based upon specification and pressure class. Joints for PVC pipe are generally the same for all specifications; and, therefore, do not represent a source of variation in labor costs for a given diameter.

The fourth section of Table C-14 (bottom of second page of table) estimates overhead and profit by the contractor as a percentage of material, excavation and labor cost totals. The percentages for overhead and profit as given in Table C-10 were applied to the subtotals with differentiation by diameter but not by specification or pressure class of pipe.

The fifth section of Table C-14 (top of third page of table) presents the totals of material, excavation, labor and overhead and profit costs. The sixth section of Table C-14 (bottom of third page of table) presents actual bid prices in the OSRWSS Project on the Pine Ridge Indian Reservation adjusted to October 1998 prices as presented in Tables C-5 and C-8. Finally, the last section of Table C-14 presents the ratio of actual OSRWSS bid prices to the total prices predicted by using the generalized estimates for materials, excavation equipment, overhead and profit and OSRWSS labor costs. If the predictions had equaled the bid experience in the OSRWSS Project, the ratio of predicted to actual prices would have been 1.00; but the average of the ratios was 1.55. This suggests that the predictions produce unit pipe prices that, on the average, are 55 percent greater than actual bid prices received by OSRWSS.

C.5.2 Step 2: Calibration Based on OSRWSS Wage Rates

Table C-15 is in the same format as Table C-14. Table C-15, however, embraces new assumptions. First, it was assumed that material prices in rural water projects may be lower than generalized material prices. The most significant reason in support of the assumption is the large quantity of pipeline required for rural water projects. It was assumed that the generalized material prices could be reduced by 25 percent. These prices are reflected in the first section of Table C-15 (top of page 1 of table).

It was further assumed that contractors in the Northern Great Plains might assign less risk and profit to rural water projects due to the ease of construction and below average economic conditions in the states of the region. It was assumed that contractors would be willing to reduce overhead and profit from generalized estimates by as much as 20 percent. This assumption is reflected in the fourth section of Table C-15 (bottom of page 2 of table).

TABLE C-15

CALIBRATION OF PIPE PRICES BASED ON
OSRWSS WAGE RATES TO OSRWSS PIPE PRICES

		Material Cost per Foot @75.00 %							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal	Ductile	100	165	235	150	200	160	200	250
Diameter		2.0	2.0	2.0	2.5	2.5	2.0	2.0	2.0
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	1.01	1.22	1.46
3	--	--	--	--	--	--	1.61	1.95	2.39
4	--	--	--	--	3.55	4.54	2.21	2.71	3.30
6	--	--	--	--	6.33	8.03	4.13	5.06	6.17
8	--	--	--	--	9.07	11.48	5.81	7.11	8.70
10	--	--	--	--	12.85	16.22	8.42	10.30	12.58
12	--	--	--	--	16.01	20.21	10.46	12.80	15.65
14	--	11.51	18.48	25.15	--	--	--	--	--
16	18.00	14.81	22.72	31.10	--	--	--	--	--
18	22.88	--	--	--	--	--	--	--	--
20	26.63	--	--	--	--	--	--	--	--
24	35.25	--	--	--	--	--	--	--	--

		Excavation Cost per Foot @45.00 %							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal	Ductile	100	165	235	150	200	160	200	250
Diameter		2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.06	0.06	0.06
3	--	--	--	--	--	--	0.06	0.06	0.06
4	--	--	--	--	0.06	0.06	0.06	0.06	0.06
6	--	--	--	--	0.27	0.27	0.27	0.27	0.27
8	--	--	--	--	0.28	0.28	0.28	0.28	0.28
10	--	--	--	--	0.38	0.38	0.38	0.38	0.38
12	--	--	--	--	0.39	0.39	0.39	0.39	0.39
14	--	0.40	0.40	0.40	--	--	--	--	--
16	1.27	1.27	1.27	1.27	--	--	--	--	--
18	1.31	--	--	--	--	--	--	--	--
20	1.35	--	--	--	--	--	--	--	--
24	1.43	--	--	--	--	--	--	--	--

TABLE C-15 (Cont)

CALIBRATION OF PIPE PRICES BASED ON
OSRWSS WAGE RATES TO OSRWSS PIPE PRICES

		Labor Cost per Foot @45.00 %							
Nominal Diameter	Ductile	AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905 DR 41	C-905 DR 25	C-905 DR 18	C-900 DR 18	C-900 DR 14	D2241 SDR 26	D2241 SDR 21	D2241 SDR 17
		100	165	235	150	200	160	200	250
		2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.39	0.39	0.39
3	--	--	--	--	--	--	0.42	0.42	0.42
4	--	--	--	--	0.58	0.58	0.58	0.58	0.58
6	--	--	--	--	0.72	0.72	0.72	0.72	0.72
8	--	--	--	--	0.73	0.73	0.73	0.73	0.73
10	--	--	--	--	1.04	1.04	1.04	1.04	1.04
12	--	--	--	--	1.04	1.04	1.04	1.04	1.04
14	--	1.04	1.04	1.04	--	--	--	--	--
16	4.88	4.88	4.88	4.88	--	--	--	--	--
18	5.38	--	--	--	--	--	--	--	--
20	5.58	--	--	--	--	--	--	--	--
24	6.39	--	--	--	--	--	--	--	--

		Overhead and Profit@80.00 %							
Nominal Diameter	Ductile	AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905 DR 41	C-905 DR 25	C-905 DR 18	C-900 DR 18	C-900 DR 14	D2241 SDR 26	D2241 SDR 21	D2241 SDR 17
		100	165	235	150	200	160	200	250
		2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.44	0.50	0.57
3	--	--	--	--	--	--	0.56	0.65	0.76
4	--	--	--	--	1.12	1.39	0.76	0.90	1.06
6	--	--	--	--	1.62	2.00	1.14	1.34	1.59
8	--	--	--	--	1.98	2.46	1.34	1.60	1.91
10	--	--	--	--	3.07	3.80	2.12	2.52	3.01
12	--	--	--	--	3.45	4.28	2.35	2.81	3.38
14	--	1.90	2.92	3.89	--	--	--	--	--
16	6.63	5.75	7.92	10.22	--	--	--	--	--
18	7.57	--	--	--	--	--	--	--	--
20	8.43	--	--	--	--	--	--	--	--
24	10.09	--	--	--	--	--	--	--	--

TABLE C-15 (Cont)

CALIBRATION OF PIPE PRICES BASED ON
OSRWSS WAGE RATES TO OSRWSS PIPE PRICES

		Total Costs Per Foot							
Nominal Diameter	Ductile	AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905 DR 41 100	C-905 DR 25 165	C-905 DR 18 235	C-900 DR 18 150	C-900 DR 14 200	D2241 SDR 26 160	D2241 SDR 21 200	D2241 SDR 17 250
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	1.90	2.16	2.48
3	--	--	--	--	--	--	2.65	3.08	3.64
4	--	--	--	--	5.30	6.56	3.61	4.24	4.99
6	--	--	--	--	8.95	11.03	6.26	7.40	8.76
8	--	--	--	--	12.06	14.95	8.16	9.72	11.62
10	--	--	--	--	17.34	21.44	11.96	14.25	17.02
12	--	--	--	--	20.88	25.92	14.24	17.05	20.46
14	--	14.85	22.83	30.49	--	--	--	--	--
16	30.77	26.71	36.79	47.46	--	--	--	--	--
18	37.13	--	--	--	--	--	--	--	--
20	41.99	--	--	--	--	--	--	--	--
24	53.16	--	--	--	--	--	--	--	--

		Actual OSRWSS Costs Per Foot							
Nominal Diameter	Ductile	AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905 DR 41 100	C-905 DR 25 165	C-905 DR 18 235	C-900 DR 18 150	C-900 DR 14 200	D2241 SDR 26 160	D2241 SDR 21 200	D2241 SDR 17 250
1.5	--	--	--	--	--	--	--	0.00	0.00
2	--	--	--	--	--	--	1.90	2.14	2.86
3	--	--	--	--	--	--	2.38	2.77	3.70
4	--	--	--	--	5.30	6.56	4.06	5.02	5.47
6	--	--	--	--	8.95	11.03	6.55	7.50	7.46
8	--	--	--	--	12.06	14.95	9.01	10.65	11.52
10	--	--	--	--	9.93	11.31	8.05	8.85	17.02
12	--	--	--	--	--	22.08	14.08	15.90	20.46
14	--	14.85	13.28	30.49	--	--	--	--	--
16	30.77	26.71	36.79	47.46	--	--	--	--	--
18	37.13	--	0.00	0.00	--	--	--	--	--
20	41.99	--	0.00	0.00	--	--	--	--	--
24	51.34	--	--	--	--	--	--	--	--

TABLE C-15 (Cont)

CALIBRATION OF PIPE PRICES BASED ON
OSRWSS WAGE RATES TO OSRWSS PIPE PRICES

Nominal Diameter	Ductile	Ratio OSRWSS Predicted to Means Costs Per Foot							
		AWWA C-905 DR 41 100	AWWA C-905 DR 25 165	AWWA C-905 DR 18 235	AWWA C-900 DR 18 150	AWWA C-900 DR 14 200	ASTM D2241 SDR 26 160	ASTM D2241 SDR 21 200	ASTM D2241 SDR 17 250
1.5	--	--	--	--	--	--	--	--	
2							1.01	0.87	
3						1.11	1.11	0.98	
4						0.89	0.84	0.91	
6						0.96	0.99	1.17	
8						0.91	0.91	1.01	
10				1.75	1.90	1.49	1.61		
12					1.17	1.01	1.07		
14			1.72						
16									
18									
20									
24	1.04								

It was assumed that any further savings in the generalized prices necessary to calibrate to actual prices received by OSRWSS would derive from an increased pace of construction as reflected in productivity per hour or other appropriate measure. Increased pace of construction or increased productivity would result from the openness and ease of construction in rural water projects as contrasted with generalized projects involving construction in communities and more densely populated areas. It was assumed that an increase in pace of construction would apply equally to the excavation and installment of pipe or, stated differently, that the costs of equipment for excavation and labor for excavation and pipe installation would be reduced at the same rate.

Based on these assumptions, it was determined that unit prices received by OSRWSS could be approximated by applying a factor of 45 percent to generalized excavation and labor costs from Table C-14. The resulting values are presented in the second (bottom of page one of table) and third (top of second page of table) sections of Table C-15, respectively. The assumptions produced prices comparable to OSRWSS and which on the average produced prices that were 98 percent of the actual prices received by OSRWSS (top of page 3 of Table C-15).

While the foregoing method of calibration produced prices generally in agreement with those received by OSRWSS, there were exceptions. The prices predicted for 10 inch diameter pipe were significantly higher than actual prices received by OSRWSS by factors of 1.49 to 1.75, depending on pressure class and specification; and prices predicted for 14 inch diameter pipe were similarly higher than actual prices received by a factor out 1.72. Unit prices for other pipe diameters and classes of pipe were reasonably predicted by the methodology.

Referring again to Figure C-1 and its discussion, it is noteworthy that the 10 inch diameter pipe prices appear lower than might be expected. The discussion of the low price for 14 inch diameter pipe received by OSRWSS in section C.3 is placed in perspective by the results of Table C-15. It would also appear that OSRWSS may have received higher prices than would be expected for 4 inch diameter pipe based on the ratio of .84 to .91 for predicted prices to OSRWSS prices as presented in Table C-15.

C.5.3 Step 3: Predicted Fort Peck Bid Prices

The final step in the derivation of unit pipe prices for the Fort Peck Indian Reservation was the application of Fort Peck labor costs to the calibrated model of Table C-15. The same material and equipment excavation costs were assumed as in Table C-15. Fort Peck total labor costs from Table C-13 were applied, and the pace of construction or productivity assumed for OSRWSS was assumed for Fort Peck. The same percentages of overhead and profit were applied, and the results of predicted unit pipe prices are presented in Table C-16. The average unit price of pipe on the Fort Peck Indian Reservation is 24% higher than the unit price of bids received in OSRWSS reflecting the higher wage rates.

Figure C-2 provides a graphical representation of final unit prices for Fort Peck by diameter and pressure class. Comparison with Figure C-2 demonstrates that the apparent anomalies in bid prices from South Dakota have been removed.

C.6 Selected Pipe Price by Diameter for Fort Peck

In the last column of Table C-17, a weighted price by diameter was derived based upon the distribution of pipe class and specification used in the OSRWSS portion of the Mni Wiconi Project of South Dakota. Selected costs range from \$2.61 per foot for 2 inch pipe to \$58.09 per foot for 24 inch pipe.

Variations in relief or topography between the Fort Peck Indian Reservation, Dry Prairie and OSRWSS are not markedly different in that all are typical of the Northern Great Plains dissected by small tributaries of the Missouri River. Variations in terrain may be more marked on the Pine Ridge Indian Reservation than on the Fort Peck Indian Reservation or within the Dry Prairie region.

The "selected prices" in Table C-17 were used in the cost estimates for pipelines on the Fort Peck Indian Reservation. The hydraulic model of the Reservation predicts less need for ASTM, SDR 17, class 250 pipe and less need for AWWA, C-900 class 200 pipe than used in the computation of the "selected price" in Table C-17. The hydraulic model for the Fort Peck Indian Reservation uses

pumping stations to raise pressures to 250 psi, but most pump stations provide adequate pressure at 250 psi. Under conditions of design flow, pressure will decrease below 200 psi if the topography is level or rising beyond the pump station.

TABLE C-16

FORT PECK COMPUTATION OF PIPE PRICES

		Material Cost per Foot @75 %							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.0	2.0	2.0	2.5	2.5	2.0	2.0	2.0
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	1.01	1.22	1.46
3	--	--	--	--	--	--	1.61	1.95	2.39
4	--	--	--	--	3.55	4.54	2.21	2.71	3.30
6	--	--	--	--	6.33	8.03	4.13	5.06	6.17
8	--	--	--	--	9.07	11.48	5.81	7.11	8.70
10	--	--	--	--	12.85	16.22	8.42	10.30	12.58
12	--	--	--	--	16.01	20.21	10.46	12.80	15.65
14	--	11.51	18.48	25.15	--	--	--	--	--
16	18.00	14.81	22.72	31.10	--	--	--	--	--
18	22.88	--	--	--	--	--	--	--	--
20	26.63	--	--	--	--	--	--	--	--
24	35.25	--	--	--	--	--	--	--	--

		Excavation Cost per Foot @45.00 %							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.06	0.06	0.06
3	--	--	--	--	--	--	0.06	0.06	0.06
4	--	--	--	--	0.06	0.06	0.06	0.06	0.06
6	--	--	--	--	0.27	0.27	0.27	0.27	0.27
8	--	--	--	--	0.28	0.28	0.28	0.28	0.28
10	--	--	--	--	0.38	0.38	0.38	0.38	0.38
12	--	--	--	--	0.39	0.39	0.39	0.39	0.39
14	--	0.40	0.40	0.40	--	--	--	--	--
16	1.27	1.27	1.27	1.27	--	--	--	--	--
18	1.31	--	--	--	--	--	--	--	--
20	1.35	--	--	--	--	--	--	--	--
24	1.43	--	--	--	--	--	--	--	--

TABLE C-16 (Cont)

FORT PECK COMPUTATION OF PIPE PRICES

		Labor Cost per Foot @ 45.00 % (Based on Fort Peck Wage Rates)							
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.71	0.71	0.71
3	--	--	--	--	--	--	0.77	0.77	0.77
4	--	--	--	--	1.04	1.04	1.04	1.04	1.04
6	--	--	--	--	1.30	1.30	1.30	1.30	1.30
8	--	--	--	--	1.30	1.30	1.30	1.30	1.30
10	--	--	--	--	1.86	1.86	1.86	1.86	1.86
12	--	--	--	--	1.86	1.86	1.86	1.86	1.86
14	--	1.87	1.87	1.87	--	--	--	--	--
16	8.64	8.64	8.64	8.64	--	--	--	--	--
18	9.52	--	--	--	--	--	--	--	--
20	9.89	--	--	--	--	--	--	--	--
24	11.32	--	--	--	--	--	--	--	--

		Overhead and Profit@80.00 %							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.44	0.50	0.57
3	--	--	--	--	--	--	0.56	0.65	0.76
4	--	--	--	--	1.12	1.39	0.76	0.90	1.06
6	--	--	--	--	1.62	2.00	1.14	1.34	1.59
8	--	--	--	--	1.98	2.46	1.34	1.60	1.91
10	--	--	--	--	3.07	3.80	2.12	2.52	3.01
12	--	--	--	--	3.45	4.28	2.35	2.81	3.38
14	--	1.90	2.92	3.89	--	--	--	--	--
16	6.63	5.75	7.92	10.22	--	--	--	--	--
18	7.57	--	--	--	--	--	--	--	--
20	8.43	--	--	--	--	--	--	--	--
24	10.09	--	--	--	--	--	--	--	--

TABLE C-16 (Cont)

FORT PECK COMPUTATION OF PIPE PRICES

		Total Costs Per Foot							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
		100	165	235	150	200	160	200	250
Nominal Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	2.21	2.48	2.80
3	--	--	--	--	--	--	2.99	3.42	3.98
4	--	--	--	--	5.77	7.02	4.07	4.70	5.46
6	--	--	--	--	9.52	11.60	6.83	7.98	9.33
8	--	--	--	--	12.63	15.52	8.73	10.29	12.19
10	--	--	--	--	18.16	22.26	12.78	15.07	17.84
12	--	--	--	--	21.70	26.74	15.06	17.87	21.28
14	--	15.68	23.66	31.31	--	--	--	--	--
16	34.53	30.47	40.55	51.22	--	--	--	--	--
18	41.27	--	--	--	--	--	--	--	--
20	46.30	--	--	--	--	--	--	--	--
24	58.09	--	--	--	--	--	--	--	--

		Actual OSRWSS Costs Per Foot							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
		100	165	235	150	200	160	200	250
Nominal Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	0.00	0.00
2	--	--	--	--	--	--	1.90	2.14	2.86
3	--	--	--	--	--	--	2.38	2.77	3.70
4	--	--	--	--	5.30	6.56	4.06	5.02	5.47
6	--	--	--	--	8.95	11.03	6.55	7.50	7.46
8	--	--	--	--	12.06	14.95	9.01	10.65	11.52
10	--	--	--	--	9.93	11.31	8.05	8.85	17.02
12	--	--	--	--	--	22.08	14.08	15.90	20.46
14	--	14.85	13.28	30.49	--	--	--	--	--
16	30.77	26.71	36.79	47.46	--	--	--	--	--
18	37.13	--	0.00	0.00	--	--	--	--	--
20	41.99	--	0.00	0.00	--	--	--	--	--
24	51.34	--	--	--	--	--	--	--	--

TABLE C-16 (Cont)

FORT PECK COMPUTATION OF PIPE PRICES

		Ratio OSRWSS Predicted to General Costs Per Foot							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2								1.16	0.98
3							1.26	1.24	1.08
4							1.00	0.94	1.00
6							1.04	1.06	1.25
8							0.97	0.97	1.06
10					1.83	1.97	1.59	1.70	
12						1.21	1.07	1.12	
14			1.78						
16									
18									
20									
24	1.13								

If the topography is not falling faster than the hydraulic grade line, then pressures above 200 psi will not be experienced. If, however, the topography is following faster than the hydraulic grade line, then pressures will rise above 200 to 250 psi, and higher pipe classes may be required for at least some of the distance between pumping stations. Under static conditions, more higher class pipe is required in instances where topography drops into valleys or lower areas relative to the elevation of the upstream pumping station. In the case of the hydraulic model for Fort Peck, however, pressures were analyzed downstream from each pumping station, and pressures at the pumping stations were not boosted to the full 200 to 250 psi level if greater pressures were observed downstream from the pumping station. Therefore, the assumptions in Table C-17, which result in a weighting of pipe prices for each diameter by pressure class and specification, were thought to produce a higher price than may be experienced.

The assumptions in the hydraulic model will produce slightly more pumping stations than would be required with a higher pressure class of pipe. In final design, it may be determined that a larger proportion of higher class pipe is desirable, but only if the reduction in number of pumping stations and increase in feet of higher class pipe produces a lower cost for any particular pressure zone. As the assumptions now stand, it is expected that a smaller proportion of higher class pipe than used in the weighting of prices in Table C-17 will actually be utilized, and any change in assumptions would not be adopted unless there were a further savings.

TABLE C-17

WEIGHTED UNIT PIPE PRICE BY DIAMETER
FORT PECK INDIAN RESERVATION

		Total Costs Per Foot								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal		100	165	235	150	200	160	200	250	Selected
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00	Price
1.5	--	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	2.21	2.48	2.80	2.61
3	--	--	--	--	--	--	2.99	3.42	3.98	3.28
4	--	--	--	--	5.77	7.02	4.07	4.70	5.46	4.40
6	--	--	--	--	9.52	11.60	6.83	7.98	9.33	7.40
8	--	--	--	--	12.63	15.52	8.73	10.29	12.19	10.28
10	--	--	--	--	18.16	22.26	12.78	15.07	17.84	16.19
12	--	--	--	--	21.70	26.74	15.06	17.87	21.28	19.50
					--	--	--	--	--	
14	--	15.68	23.66	31.31	--	--	--	--	--	27.49
16	34.53	30.47	40.55	51.22	--	--	--	--	--	34.53
18	41.27	--	--	--	--	--	--	--	--	41.27
20	46.30	--	--	--	--	--	--	--	--	46.30
24	58.09	--	--	--	--	--	--	--	--	58.09

		OSRWSS Lengths									
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM		
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241		
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17		
Nominal		100	165	235	150	200	160	200	250	Total	
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00	Total	
1.5	--	--	--	--	--	--	--	--	--		
2	--	--	--	--	--	--	0	262,300	183,300	445,600	
3	--	--	--	--	--	--	90,060	45,500	27,200	162,760	
4	--	--	--	--	*	*	139,300	37,850	32,150	209,300	
6	--	--	--	--	*	*	207,850	74,500	38,700	321,050	
8	--	--	--	--	*	*	56,300	27,900	45,500	129,700	
10	--	--	--	--	7,850	18,600	26,500	33,900	*	86,850	
12	--	--	--	--	*	23,500	29,800	23,250	*	76,550	
14	--	*	*	*	--	--	--	--	--	0	
16	*	*	*	*	--	--	--	--	--	0	
18	*	--	--	--	--	--	--	--	--	0	
20	*	--	--	--	--	--	--	--	--	0	
24	*	--	--	--	--	--	--	--	--	0	
						7,850	42,100	549,810	505,200	326,850	1,431,810

FORT PECK UNIT PIPE PRICES

Selected Pressure Classes

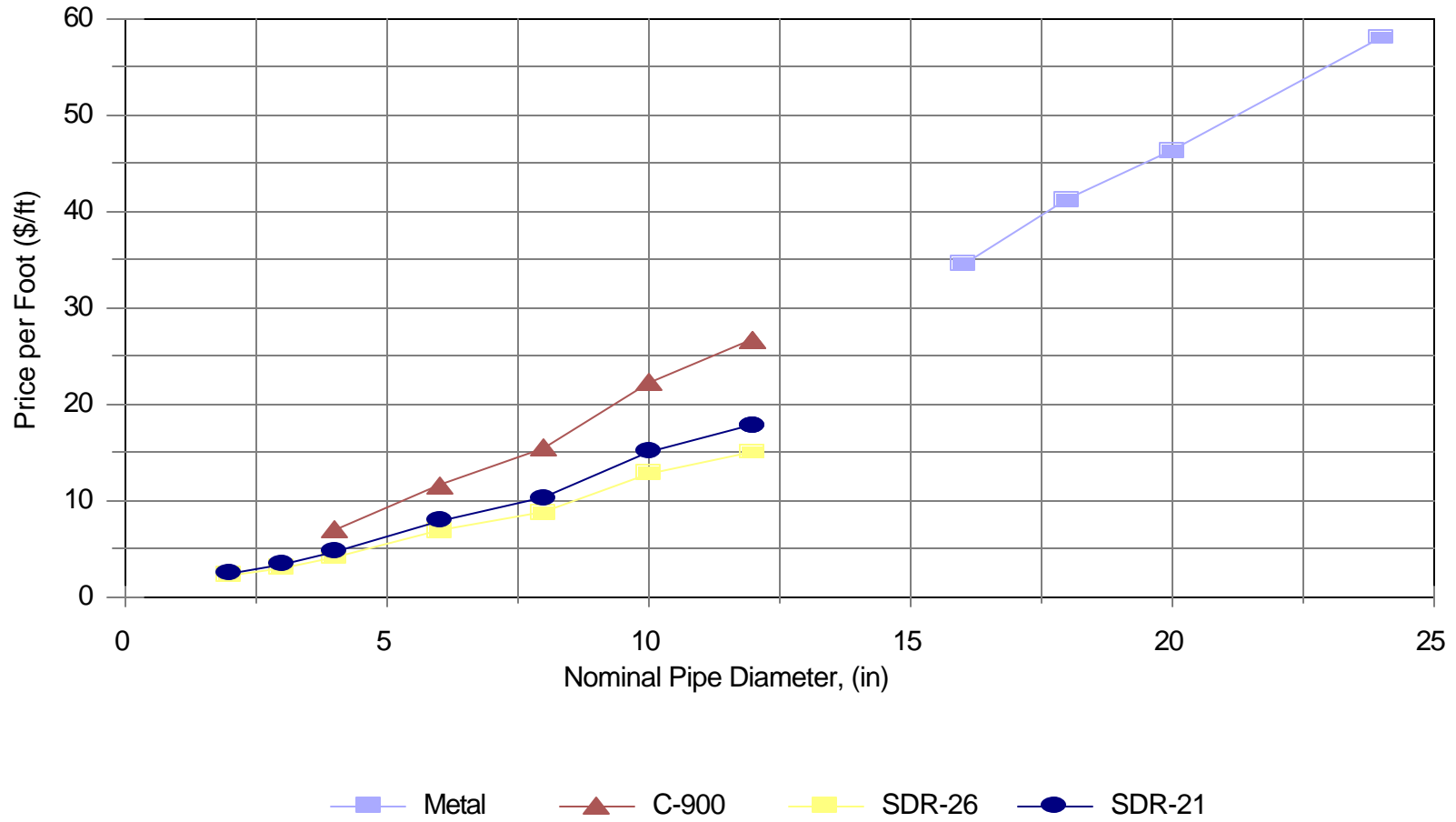


FIGURE C-2

C.7 Unit Pipe Prices for Dry Prairie

The same procedures for deriving unit pipe prices for the Fort Peck Indian Reservation were used to derive unit pipe prices for Dry Prairie. Table C-18 presents the final step in the computation process based on calibration of generalized prices to Mid-Dakota prices, the ongoing project in South Dakota with system boundaries outside an Indian Reservation. The assumption underlying the derivation of prices outside the Fort Peck Indian Reservation is that future construction should be based on bid prices comparable to Mid-Dakota after adjusting for differences in labor rates between South Dakota and Montana. This method was intended to properly reflect differences in unit prices between OSRWSS and Mid-Dakota in South Dakota and to reflect differences between Fort Peck and Dry Prairie in Montana.

In order to match the Mid-Dakota pipe prices, it was necessary to lower the assumptions for material costs, equipment excavation costs, and overhead and profit by approximately one-third from the assumptions used in deriving Fort Peck unit prices. As shown in Table C-18, material costs were assumed at 50 percent of generalized material costs, as contrasted with 75 percent for Fort Peck. Equipment excavation and total labor costs were assumed at 30 percent of generalized costs, as contrasted with 45 percent for Fort Peck. Finally, overhead and profit was assumed at 60 percent of generalized prices, as contrasted with 80 percent for Fort Peck. Total labor costs per foot were based on the same wage rates for both the Fort Peck Indian Reservation and Dry Prairie, but the lowering of labor costs for Dry Prairie reflects a reduction in rates of construction by one-third.

C.7 Selected Pipe Price by Diameter for Dry Prairie

In the last column of Table C-19, the same process described in section C.6 was used to arrive at a unit price per foot for each diameter of pipe in the Dry Prairie portion of the project. Selected prices range from \$1.65 per foot for 2 inch diameter pipe to \$17.75 per foot for 14 inch pipe. There are no pipe sizes in Dry Prairie above 16 inch diameter.

TABLE C-18

DRY PRAIRIE COMPUTATION OF PIPE PRICES

		Material Cost per Foot @50.00 %							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.0	2.0	2.0	2.5	2.5	2.0	2.0	2.0
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.68	0.81	0.98
3	--	--	--	--	--	--	1.08	1.30	1.60
4	--	--	--	--	2.37	3.03	1.48	1.81	2.20
6	--	--	--	--	4.22	5.36	2.75	3.37	4.11
8	--	--	--	--	6.05	7.66	3.88	4.74	5.80
10	--	--	--	--	8.57	10.82	5.61	6.87	8.39
12	--	--	--	--	10.67	13.48	6.97	8.54	10.43
14	--	7.68	12.32	16.77	--	--	--	--	--

		Excavation Cost per Foot @30.00 %							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.04	0.04	0.04
3	--	--	--	--	--	--	0.04	0.04	0.04
4	--	--	--	--	0.04	0.04	0.04	0.04	0.04
6	--	--	--	--	0.18	0.18	0.18	0.18	0.18
8	--	--	--	--	0.19	0.19	0.19	0.19	0.19
10	--	--	--	--	0.26	0.26	0.26	0.26	0.26
12	--	--	--	--	0.26	0.26	0.26	0.26	0.26
14	--	0.26	0.26	0.26	--	--	--	--	--

TABLE C-18 (Cont)

DRY PRAIRIE COMPUTATION OF PIPE PRICES

		Labor Cost per Foot @30.00 %							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.47	0.47	0.47
3	--	--	--	--	--	--	0.51	0.51	0.51
4	--	--	--	--	0.69	0.69	0.69	0.69	0.69
6	--	--	--	--	0.86	0.86	0.86	0.86	0.86
8	--	--	--	--	0.87	0.87	0.87	0.87	0.87
10	--	--	--	--	1.24	1.24	1.24	1.24	1.24
12	--	--	--	--	1.24	1.24	1.24	1.24	1.24
14	--	1.25	1.25	1.25	--	--	--	--	--

		Overhead and Profit@60.00 %							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	0.21	0.24	0.28
3	--	--	--	--	--	--	0.28	0.32	0.38
4	--	--	--	--	0.56	0.69	0.38	0.44	0.52
6	--	--	--	--	0.81	0.99	0.56	0.67	0.79
8	--	--	--	--	0.99	1.22	0.67	0.79	0.95
10	--	--	--	--	1.53	1.89	1.05	1.25	1.50
12	--	--	--	--	1.72	2.13	1.17	1.40	1.68
14	--	0.94	1.45	1.94	--	--	--	--	--

TABLE C-18 (Cont)

DRY PRAIRIE COMPUTATION OF PIPE PRICES

		Total Costs Per Foot							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	1.40	1.56	1.77
3	--	--	--	--	--	--	1.90	2.17	2.52
4	--	--	--	--	3.65	4.45	2.58	2.98	3.46
6	--	--	--	--	6.07	7.40	4.36	5.09	5.95
8	--	--	--	--	8.08	9.93	5.59	6.59	7.81
10	--	--	--	--	11.59	14.20	8.16	9.62	11.38
12	--	--	--	--	13.89	17.11	9.64	11.43	13.61
14	--	10.13	15.28	20.22	--	--	--	--	--

		Actual Mid-Dakota Costs Per Foot							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5									
2									
3									
4									
6									
8									
10							7.09		
12						16.25		10.78	
14			15.12						

TABLE C-18 (Cont)

DRY PRAIRIE COMPUTATION OF PIPE PRICES

		Ratio Mid-Dakota Predicted to Generalized Costs Per Foot							
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17
Nominal		100	165	235	150	200	160	200	250
Diameter	Ductile	2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00
1.5	--	--	--	--	--	--	--	--	--
2									
3									
4									
6									
8									
10							1.15		
12						1.05		1.06	
14			1.01						

TABLE C-19

WEIGHTED UNIT PIPE PRICE BY DIAMETER
 DRY PRAIRIE

		Total Costs Per Foot								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal	Ductile	100	165	235	150	200	160	200	250	Selected
Diameter		2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00	Price
1.5	--	--	--	--	--	--	--	0.00	0.00	
2	--	--	--	--	--	--	1.40	1.56	1.77	1.65
3	--	--	--	--	--	--	1.90	2.17	2.52	2.08
4	--	--	--	--	3.65	4.45	2.58	2.98	3.46	2.79
6	--	--	--	--	6.07	7.40	4.36	5.09	5.95	4.72
8	--	--	--	--	8.08	9.93	5.59	6.59	7.81	6.58
10	--	--	--	--	11.59	14.20	8.16	9.62	11.38	10.33
12	--	--	--	--	13.89	17.11	9.64	11.43	13.61	12.48
14	--	10.13	15.28	20.22	--	--	--	--	--	17.75

		OSRWSS Lengths								
		AWWA	AWWA	AWWA	AWWA	AWWA	ASTM	ASTM	ASTM	
		C-905	C-905	C-905	C-900	C-900	D2241	D2241	D2241	
		DR 41	DR 25	DR 18	DR 18	DR 14	SDR 26	SDR 21	SDR 17	
Nominal	Ductile	100	165	235	150	200	160	200	250	Total
Diameter		2.00	2.00	2.00	2.50	2.50	2.00	2.00	2.00	
1.5	--	--	--	--	--	--	--	--	--	
2	--	--	--	--	--	--	0	262,300	183,300	445,600
3	--	--	--	--	--	--	90,060	45,500	27,200	162,760
4	--	--	--	--	*	*	139,300	37,850	32,150	209,300
6	--	--	--	--	*	*	207,850	74,500	38,700	321,050
8	--	--	--	--	*	*	56,300	27,900	45,500	129,700
10	--	--	--	--	7,850	18,600	26,500	33,900	*	86,850
12	--	--	--	--	*	23,500	29,800	23,250	*	76,550
14	--	*	*	*	--	--	--	--	--	0
16	*	*	*	*	--	--	--	--	--	0
18	*	--	--	--	--	--	--	--	--	0
20	*	--	--	--	--	--	--	--	--	0
24	*	--	--	--	--	--	--	--	--	0
					7,850	42,100	549,810	505,200	326,850	1,431,810

C.8 Corrosion Protection of Large Diameter Pipelines

While nonmetallic pipe is available in diameters up to 24 inches, it was contemplated that welded steel or ductile iron pipe will be competitive in pipe diameters from 16 through 24 inches. Approximately 25 miles of the pipeline between the water treatment plant and Wolf Point will require consideration of welded steel or ductile iron pipe. Soils in the region are extremely corrosive, and metal pipeline will require cathodic protection, including anode beds and induced current. The costs of this protection will average an estimated \$2.00 per foot and is included in the unit pipe prices of Table C-17.

Bidding in June 2001 by OSRWSS resulted in 24" diameter steel pipe with a unit price of \$57.26 per foot (114,000 feet bid) including cathodic protection at \$0.55 per foot. The price adjusted to October 1998 was estimated at about \$53.68 per foot or about \$2.34 per foot (4.6%) higher than used for OSRWSS in Table C-6.