RECLAMATION

Managing Water in the West

Water Treatment Plant for Biota Removal and Inactivation Preliminary Design & Cost Estimates

Red River Valley Water Supply Project, North Dakota
Great Plains Region

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, CO

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Red River Valley Water Supply Project, North Dakota
Great Plains Region

Prepared: Steve Dundorf Date
Environmental Engineer, Water Treatment Engineering & Research Group D8230

Prepared: Mike O'Shea, P.E. Date
Structural Engineer, Structural & Architectural Group D8120

Prepared: Steve Robertson Date
Hydraulic Engineer, Water Conveyance Group D8140

Prepared: Bob Baumgarten Date
Engineer, Estimating, Specifications, & Value Program Group D8170

Prepared: John Grass Date
Mechanical Engineer, Mechanical Equipment Group D8410

Prepared: Bob Zelenka Date
Hydraulic Engineer, Hydraulic Equipment Group D8420

Prepared: Mike Schuh Date
Electrical Engineer, Electrical Plants Group D8430

Prepared: Doug Crawford Date
Electrical Engineer, Electrical Systems Group D8440

Prepared: Bob Talbot Date
Hydraulic Engineer, Water Supply, Use, and Conservation Group D8520

Checked: Robert A. Jurenka, P.E. Date
Environmental Engineer, Water Treatment Engineering & Research Group D8230

Peer Review: Glenn Howard, P.E. Date
Environmental Engineer, Water Treatment Engineering & Research Group D8230

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Acronyms and Abbreviations

ac-ft	acre feet
$CaCO_3$	calcium carbonate
CaO	calcium oxide or quicklime
cfs	cubic feet per second
cfm	cubic feet per minute
CIP	clean-in-place
CT	free chlorine residual, mg/L x time, min
CWS	community water system
DBP	disinfection by-products
DOC	dissolved organic carbon
EPA	United States Environmental Protection Agency
FBRR	filter backwash recycling rule
ft	foot
gal	gallon
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
HP	horsepower
hr	hour
IESWTR	Interim Enhanced Surface Water Treatment Rule
kW	kilowatt
L&CR	Lead & Copper Rule
lb	pound
LT1ESWTR	Long Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MF	microfiltration
MGD	million gallons per day
mg/L	milligrams per liter (parts per million)
min	minute
MRDL	maximum residual disinfectant level
NF	nanofiltration
NTU	nephelometric turbidity units
O&M	operation and maintenance
PNR	Public Notification Rule
PWS	public water system
Reclamation	U.S. Bureau of Reclamation
RO	reverse osmosis
RPM	revolutions per minute
sec	second
SDWA	Safe Drinking Water Act

SOP	standard operating procedure
Stg 1 D/DBPR	Stage 1 Disinfectants/Disinfection By-Products Rule
Stg 2 D/DBPR	Stage 2 Disinfectants/Disinfection By-Products Rule
SWTR	Surface Water Treatment Rule
TDH	total dynamic head
TOC	total organic carbon
UF	ultrafiltration
USBR	U.S. Bureau of Reclamation
USEPA	U.S. Environmental Protection Agency
μg/L	micrograms per liter (parts per billion)
UV	ultraviolet
yd	yard
yr	year

Executive Summary

In the fall of 2004, the Dakotas Area Office of the Great Plains Region requested the design and cost analysis for a variety of treatment options for the Red River Valley Water Supply Project. This report provides an Appraisal level design and cost analysis for four types of water treatment systems for biota removal and inactivation over a variety of flow rates and at two intake sites. Concerns over the transfer of non-native biota in the proposed trans-basin import alternatives, from the Missouri River watershed to the Red River watershed, has lead to the development of treatment alternatives to address this issue. There are no regulations in place that govern the removal of biota. USEPA drinking water standards provide the best reference point for biota removal, but should not be considered the regulatory standard. The use of USEPA drinking water standards was used in this report, but they can only be directly applied to the one alternative that produces potable water.

Water Quality - Water quality results show the water from the Missouri River and McClusky Canal intake options are typical for surface water and are similar to each other. The water, especially at the Missouri River site, is characterized by occasional high turbidity spikes, mainly occurring during the summer time, and is considered hard. The water will freeze in the winter. McClusky Canal water has total dissolved solids and sulfate concentrations slightly above USEPA Secondary standards for potable water. The water from the Missouri River and McClusky Canal is similar in water quality to the Red River, with turbidity and total suspended solids concentrations being significantly lower, but still elevated requiring treatment.

Intake Pumping Plant – Intake pumping plants were designed and cost estimated for two flow rates and two locations. The intake at the Missouri River is a horizontal collector well. The intake at the McClusky Canal is an open water intake. The cost results show a final "Construction Cost" of $21 to $30 million for the Missouri River intake and $13 to $29 million for the McClusky Canal intake.

Water Treatment – Six treatment systems were evaluated for their ability to treat for biota and for one alternative, to treat for potable water. Four treatment systems that spanned the full range of likely designs were cost estimated. These include basic coagulation and sedimentation, microfiltration, lime softening, and microfiltration followed by nanofiltration. Due to concentrate disposal requirements and limitations, nanofiltration was only evaluated for the Missouri River alternatives. A detailed design and Appraisal level cost estimate was performed for lime softening at one flow rate. The cost results were used to calibrate a cost model to estimate lime softening at other flow rates and to calibrate the model for other treatment processes. Final "Construction Costs" ranged from $18 million for basic coagulation and sedimentation at the lowest flow rate to $341 million for lime softening at the highest flow rate.

1.0 Introduction

This report provides an Appraisal level design and cost analysis for a water treatment system within the Missouri River (interbasin) transport option of the Red River Valley Water Supply Project (RRVWSP) in North Dakota (**Figure 1.1**). This includes four types of water treatment systems for biota removal and inactivation over a variety of flow rates and two intake options.

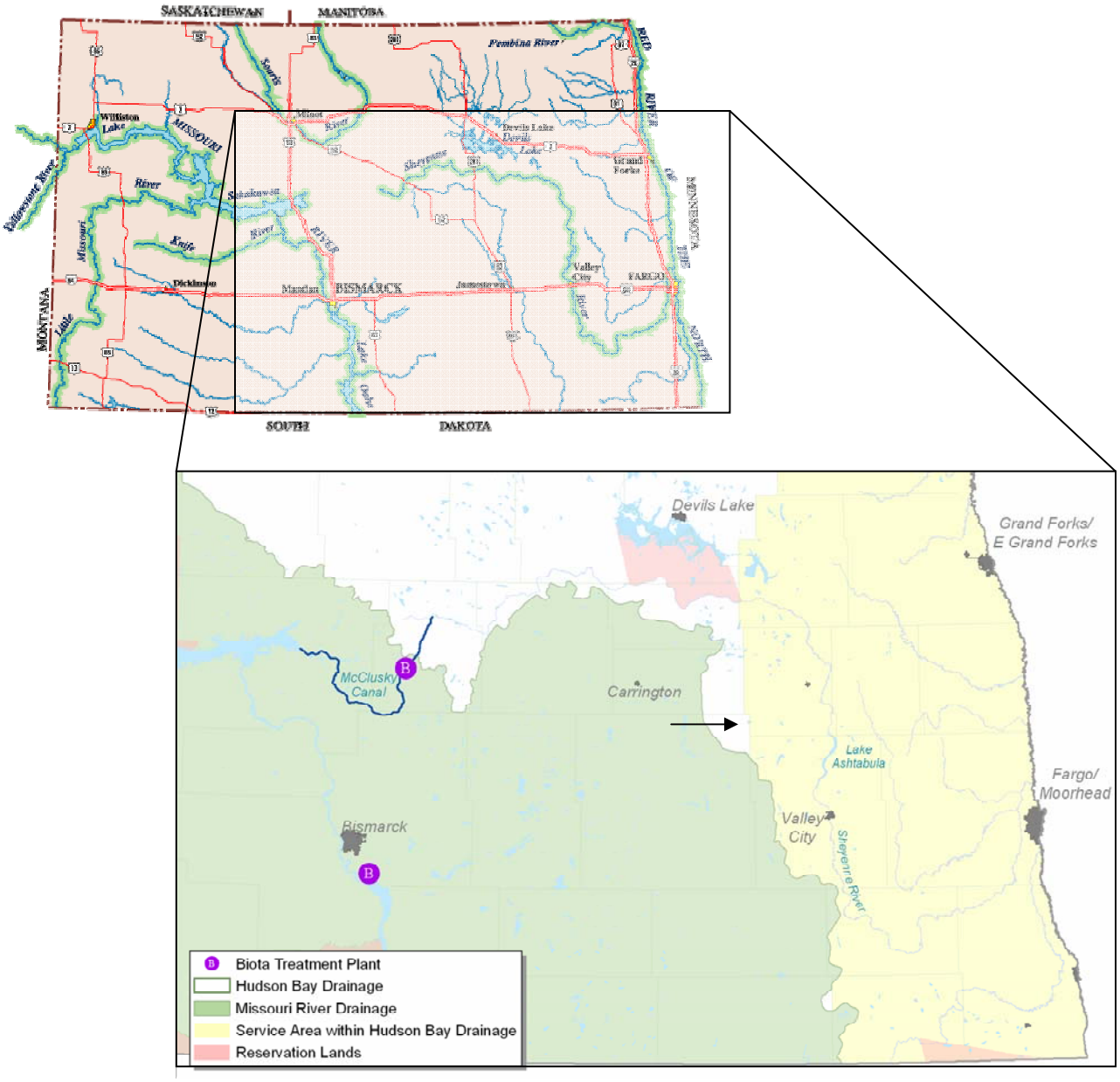


Figure 1.1: Overview map of North Dakota and the delineation of the Missouri River and Red River watersheds used in the proposed trans-basin water transfer options.

An Appraisal level design determines if there is a solution that appears to be economically and environmentally sound and compares relative costs of alternatives. This level of report uses existing or limited new data and does not go into detailed design or detailed cost analysis. A "Feasibility Study" is the subsequent step to develop the design of the favored alternative(s) and to estimate a funding appropriation.

In August 2004, a Reclamation report was developed "Water Treatment System Design Evaluation", to evaluate the proposed treatment systems for the RRVWSP and take a fresh look at treatment options (Reclamation 2004). This report established the basis for design options in this report. In November 2004 members from the Technical Service Center (TSC) made a site visit to the proposed intake and treatment plant locations near Bismarck, ND. The TSC was tasked with developing an Appraisal level design and cost analysis for a matrix of intake location, treatment and flow options. These options are shown in **table 1.1**.

To obtain costs for the various flow rates, existing cost models and new cost curves were used for the water intake and water treatment components. To calibrate and improve the accuracy of the existing model results and create new cost curves, a detailed Appraisal level design and cost estimate was performed. This included the design of intake pumping structures at the Garrison Diversion Unit (McClusky Canal) and Missouri River locations for two flow rates and a lime softening water treatment plant for one flow rate. The detailed design and cost estimates for the intake pumping plants and lime softening treatment plant entail a more detailed level of effort than a typical Appraisal design, but are short of a "Feasibility Study". The combined intake and water treatment plant is termed the "water treatment system".

		Treatment Alternative [1]								Units
		A		C		E1		E2		
Project Alternative	Discharge Location	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	
GDU Import to Sheyenne River	Sheyenne River	50.2	77.4	50.2	77.4		[2]			Product Flow (MGD)
Missouri River Import to Red River Valley	Distribution System & Reservoir	28.5	40.7	28.5	40.7	28.5	40.7	28.5	40.7	
GDU Import Pipeline	Distribution System	103.3	130.0	103.3	130.0	103.3	130.0			
GDU Water Supply Replacement Pipeline	Distribution System	219.9	265.3	219.9	265.3	219.9	265.3			
GDU Import to Sheyenne River	Sheyenne River	77.7	119.8	77.7	119.8		[2]			Product Flow (cfs)
Missouri River Import to Red River Valley	Distribution System & Reservoir	44.1	63.0	44.1	63.0	44.1	63.0	44.1	63.0	
GDU Import Pipeline	Distribution System	159.8	201.1	159.8	201.1	159.8	201.1			
GDU Water Supply Replacement Pipeline	Distribution System	340.2	410.5	340.2	410.5	340.2	410.5			

- GDU = Garrison Diversion Unit (canal)
- MGD = million gallons per day
- cfs = cubic feet per second
- Shaded areas not included in the final costs

[1] Treatment Method A = Basic Treatment (sedimentation & disinfection)
Treatment Method C = Microfiltration Treatment (coagulation, MF & disinfection)
Treatment Method E1 = Chemical Softening Treatment (lime softening, MF & disinfection)
Treatment Method E2 = Membrane Softening Treatment (coagulation, MF, nanofiltration & disinfection)

[2] Detailed Lime Softening Treatment Plant design used 77.4 MGD

Table 1.1: Matrix of location, treatment and product flow rates (peak flow). There are two flow scenarios per treatment alternative.

2.0 Water Quality Regulations

There currently are no federal water quality regulations for biota treatment for ecological protection prior to inter-basin transfer, with the exception of *Giardia lamblia, Cryptosporidium* and viruses, which are regulated as human health pathogens. USEPA standards do not apply and there are no standards under the Boundary Waters Treaty, Invasive Species Act, etc. for biota. The "GDU Water Supply Replacement Pipeline Alternative" provides potable water that meets USPEPA National Drinking Water Regulations under the Safe Drinking Water Act (SDWA). The other alternatives do not have a potable water requirement, but may have such a requirement in the future. In the absence of standards for treatment of non-native biota associated with potential interbasin water transfers, minimum treatment levels are compared to existing Primary standards for *Giardia lamblia, Cryptosporidium,* and viruses. Secondary standards are also considered, but only relate to compatibility issues and the GDU Water Supply Replacement Pipeline Alternative. Contaminants can be broken down into two categories:

- biological contaminants
- organic and inorganic contaminants

EPA regulations require certain levels of log inactivation / removal for biological contaminants. Depending on the delivery option, treatment for the remaining Primary standards, Secondary standards, and water compatibility may also be considered.

Delivery options involving river discharge consider compatibility with the receiving stream. An example of a concern involving a primary pollutant would be a stream with high arsenic content discharging into a stream with a low arsenic content. An example with a non-regulated constituent would be water with high dissolved solids content discharging into water with low dissolved solids content.

3.0 Water Quality

The Missouri River intake and McClusky Canal intake sites have the same initial source water, the Missouri River (**Figure 3.1**). This causes the water quality to be similar at both sites. The McClusky Canal intake site receives water from Lake Audubon via the Snake Creek Pumping Plant. The pumping plant takes water from the Missouri River on Lake Sakakawea and moves it across to Lake Audubon. The Missouri River intake receives water from the Missouri River at the headwaters of lake Oahe.

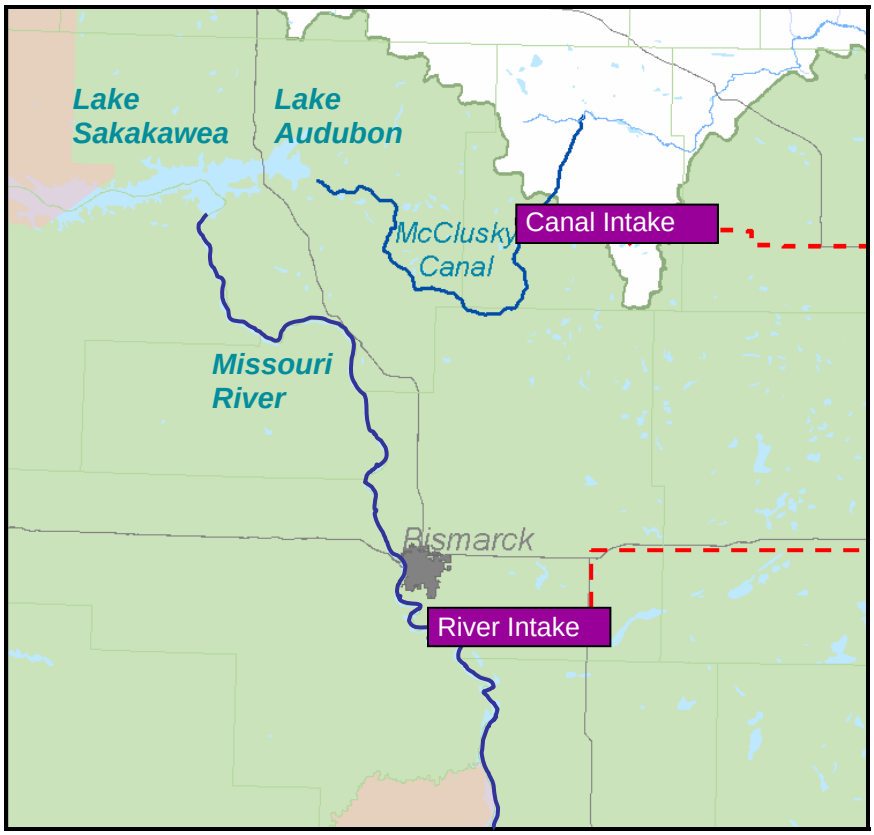


Figure 3.1: Proposed intake locations

Water quality data from the Missouri River at Bismarck (1969 – 2004) and Lake Audubon and Lake Sakakawea (1990 – 2003) were analyzed for trends over time and absolute values. The water quality data from the USGS online database and the USGS draft report "Quality of Streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota" report (Tornes) were combined to form a table of water quality data (**Attachment A**). Graphed data to determine trends over time can be found in the Reclamation "Water Treatment System Design Evaluation" report (Reclamation 2004). The USGS draft report "Quality of Streams in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota" on the Red River water quality was reviewed for water compatibility

(Tornes). The City of Bismarck was contacted to obtain information of raw water quality in the Missouri River. This data was supplemented with data from the USGS. The available data and expected values for data that were not available were sufficient for the level of detail of this Appraisal study. Therefore, additional water quality data were not collected. Data that was not available consisted primarily of Primary contaminants for which the expected values were below regulatory limits due to the source water type and rural location.

3.1 Primary Standards

The available data for the McClusky Canal and Missouri River do not show any values that exceed Primary standards with the exception of turbidity. Data on some regulated contaminants were not available; however, communication with the City of Bismarck and available data did not indicate problems with any other Primary contaminants. Upstream wastewater treatment plant discharges are likely, but should not be contributing elevated levels of regulated non-biological primary contaminants. Elevated biological contaminants may exist, but data such as *Cryptosporidium* surveys were not readily available at this point. Other pollution sources may exist either downstream of Bismarck prior to the intake for the River option or along Lake Audubon and the McClusky Canal for the Canal option, although such sources are unlikely. If a Feasibility level study occurs, we recommend that data for all regulated contaminants be obtained at that point.

3.2 Secondary Standards

The available data show the exceedance of some Secondary standards (TDS, sulfate, color). Data were not available from the exact intake sites, but are not expected to differ significantly from the locations sampled.

McClusky Canal Site

The pH was slightly below the recommended upper limit, however, treatment may reduce this value. Lake Audubon TDS (577 mg/L average value) exceeded the Secondary standard (500 mg/L), which could be significant in the cost/benefit analysis for this source. Lake Audubon sulfate levels (255 mg/L average) exceeded the Secondary standard (250 mg/L). The water is considered "very hard" with an average hardness of 280 mg/L (**Table 3.1**). .

Degree of Hardness	Concentration mg/L as $CaCO_3$
Soft	0 – 60
Moderately Hard	60 – 120
Hard	120 – 180
Very Hard	180+

Table 3.1: Hardness rating scale

Missouri River Site

The color (16 mg/L average) slightly exceeded the Secondary standard (15 mg/L) for the Missouri River and was unavailable for the canal location. Communication with the City of Bismarck (Bismarck 2005) and the USGS (USGS 2005) showed no problems with expected potential Secondary contaminants. The water is considered "very hard" with an average hardness of 205 mg/L

3.3 Compatibility

Based on the available data, the overall water quality of the Missouri River (Lake Oahe), Lake Audubon, and Lake Sakakawea appear to be similar and compatible with the Red River water quality. The turbidity and total suspended solids (TSS) concentration of the Red River is substantially higher than the Missouri River. The median turbidity over a 3 year period was 74 NTU with a peak of 820 NTU. The median TSS over a 3 year period was 130 mg/L with a peak of 625 mg/L. Therefore, Missouri River water entering the Red River Valley translates to a slight dilution of turbidity and TSS and no negative impact. Nutrients such as phosphates and nitrates are either similar or lower in concentration in the Missouri River than the Red River. Due to the water similarities and improved water quality characteristics of the Missouri River, the only treatment needed for a river discharge scenario would be biota treatment. All treatment alternatives proposed will dampen or eliminate turbidity spikes. In addition, the horizontal collector well intake proposed for the Missouri River option should remove most of the turbidity with minimal impact from turbidity spikes in the river.

4.0 Water Treatment Plant Options

Treatment processes vary from basic biological treatment to more complex divalent cation removal to reduce hardness and resulting TDS (**Table 4.1**).

Alternative	Purpose	Purpose of Treatment Plant Components		
		Biological Removal	**Biological Inactivation**	**Hardness Removal**
A) Basic Treatment	- Primary Biological Contaminants	- Coagulation - Settling	- UV - Chloramines	
B) Media Filtration	- Primary Biological Contaminants	- Coagulation - Media Filtration	- UV - Chloramines	
C) Microfiltration	- Primary Biological Contaminants - Natural Organic Matter	- Coagulation - MF	- UV - Chloramines	
D) Ultrafiltration	- Primary Biological Contaminants - Natural Organic Matter	- Coagulation - Ultrafiltration	- UV - Chloramines	
E1) Lime Softening	- Primary Contaminants - Secondary Contaminants	- Precipitation - MF	- UV - Chloramines	- Lime Softening
E2) Nanofiltration	- Primary Contaminants - Secondary Contaminants	- Coagulation - MF	- UV - Chloramines	- NF

Table 4.1: Water treatment plant alternatives and their components

The biological contaminant removal / inactivation for the treatment alternatives is shown below (**Table 4.2** and **Attachment B**). The SDWA and underlying rules (e.g. Surface Water Treatment Rule) set the removal standards for the biological contaminants affecting human health. The upcoming Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) addresses *Cryptosporidium* and in many cases, requires additional removal/inactivation if source water *Cryptosporidium* concentrations exceed certain thresholds or "bins". Data were not available for *Cryptosporidium* concentrations at the two sites to determine the corresponding bin in the LT2ESWTR. However, it is likely that the water quality will result in a bin 1 classification due to the rural nature of the Missouri River and McClusky Canal and regulation of wastewater treatment plant outfalls. A bin 1 classification does not require any additional treatment for *Cryptosporidium*. A *Cryptosporidium* survey will be required for bin classification and permitting and should be conducted if further design work is initiated.

		Treatment Credit									Requirements		
		Coagulation & Sedimentation	Coag., Sed., Media Filtration	MF/UF [1]	Lime Softening	Cartridge Filter	NF [2]	UV	Chloramines Or Chlorine	Total	SDWA	Additional LT2 ESWTR	Total
A – Basic	**Giardia**	0.5						3	2		3.0	N/A	
	Total Credit	0.5						3.5	5.5	**5.5**	3.0	3.0	**3.0**
	Viruses	0.5						0	3.5		4.0	N/A	
	Total Credit	0.5						0.5	4	**4.0**	4.0	4.0	**4.0**
	Cryptosporidium	0.5						3	0		2.0	0	
	Total Credit	0.5						2.5	2.5	**2.5**	2.0	2.0	**2.0**
B – Media	**Giardia**		2.5					3	1		3.0	N/A	
	Total Credit		2.5					5.5	6.5	**6.5**	3.0	3.0	**3.0**
	Viruses		2					0	2		4.0	N/A	
	Total Credit		2					2	4	**4.0**	4.0	4.0	**4.0**
	Cryptosporidium		2					3	0		2.0	0	
	Total Credit		2					5	5	**5.0**	2.0	2.0	**2.0**
C – MF	**Giardia**			4				3	2		3.0	N/A	
	Total Credit			4				7	9	**9.0**	3.0	3.0	**3.0**
	Viruses			0.5				0	3.5		4.0	N/A	
	Total Credit			0.5				0.5	4	**4.0**	4.0	4.0	**4.0**
	Cryptosporidium			4				3	0		2.0	0	
	Total Credit			4				7	7	**7.0**	2.0	2.0	**2.0**
D – UF	**Giardia**			4				3	1		3.0	N/A	
	Total Credit			4				7	8	**8.0**	3.0	3.0	**3.0**
	Viruses			2				0	2		4.0	N/A	
	Total Credit			2				2	4	**4.0**	4.0	4.0	**4.0**
	Cryptosporidium			4				3	0		2.0	0	
	Total Credit			4				7	7	**7.0**	2.0	2.0	**2.0**
E1 – Lime Soft	**Giardia**			4	2.5			3	0.5		3.0	N/A	
	Total Credit			4	6.5			9.5	10	**10.0**	3.0	3.0	**3.0**
	Viruses			0.5	2			0	1.5		4.0	N/A	
	Total Credit			0.5	2.5			2.5	4	**4.0**	4.0	4.0	**4.0**
	Cryptosporidium			4	0.5			3	0		2.0	0	
	Total Credit			4	0.5			3.5	3.5	**3.5**	2.0	2.0	**2.0**
E2 – NF	**Giardia**			4		0	0	3	2		3.0	N/A	
	Total Credit			4		4	4	7	9	**9.0**	3.0	3.0	**3.0**
	Viruses			0.5		0	0	0	3.5		4.0	N/A	
	Total Credit			0.5		0.5	0.5	0.5	4	**4.0**	4.0	4.0	**4.0**
	Cryptosporidium			4		0	0	3	0		2.0	0	
	Total Credit			4		4	4	7	7	**7.0**	2.0	2.0	**2.0**

1 – Determined by the State and specific to the manufacturer. MF shown for Pall filter and UF shown for Zenon Zeeweed 500, both are California DHS approved removal values
2 – Determined by the State and specific to the manufacturer. However, bypass negates credit that would typically be 3 log *Giardia*, 2 log virus, 5 log Crypto.
SDWA = Safe Drinking Water Act
LT2 ESWTR = Long Term 2 Enhanced Surface Water Treatment Rule

Table 4.2: Log inactivation/removal credit provided from a regulatory standpoint

The number of cost estimates for various treatment processes were reduced to provide a reasonable range of potential water treatment processes and costs. This pairing down resulted in four treatment processes which vary in log inactivation/removal credit as shown in the middle column of table 4.2 and which are detailed in **figure 4.1**. A detailed description of alternative E1 – Lime Softening can be found in Section 6.1. The descriptions in this section are of all treatment process alternatives initially considered and are more general due to components of the lime softening process such as sedimentation basins, MF membranes, UV and chloramine systems being included in many of the other alternatives. In addition, the other alternatives were only designed to ensure acceptable log reduction and to obtain the data needed for the cost model.

4.1 Alternative A: Basic Treatment

The Basic Treatment alternative is not intended to meet requirements under the SDWA. The alternative was developed to investigate the efficiency and costs of biota inactivation a cost point lower than SDWA compliant WTPs. The alternative provides limited removal of particles without some type of filtration. Periods where the turbidity spikes in the river may lead to spikes in effluent turbidity. Careful monitoring of coagulant and polymer (if used) would improve overall treatment and in particular, reduce spikes in effluent turbidity. The sedimentation basin effluent is followed by UV and chloramine disinfection.

The coagulation, flocculation, sedimentation step is not commonly used without filtration in a SDWA compliant WTP. Although water treatment regulations show log reduction compliance, this treatment process may not meet SDWA requirements due to the chance of coagulated particles of substantial size escaping the sedimentation basin and biological contaminants in the interior of the coagulated particle being shielded from the UV light. However, a 2000 American Water Works Association (AWWA) journal article showed that the basic treatment alternative will achieve some log inactivation of *Cryptosporidium*, even in high turbidity water (Clancy, 2000). The only protection remaining would be chloramines which are not effective at inactivating *Cryptosporidium*. In this sense, the coagulation step could have a negative impact. Therefore, this treatment process is not recommended for potable water use. Natural organic matter (NOM) removal could also be increased with a filtration step. Lower NOM values in the effluent will lead to decreased disinfection by-product (DBP) formation. If this process is preferred for potable water use, the removal of coagulant would be recommended. This process would then be similar to a settling pond with the advantage of reduced potential for particle shielding.

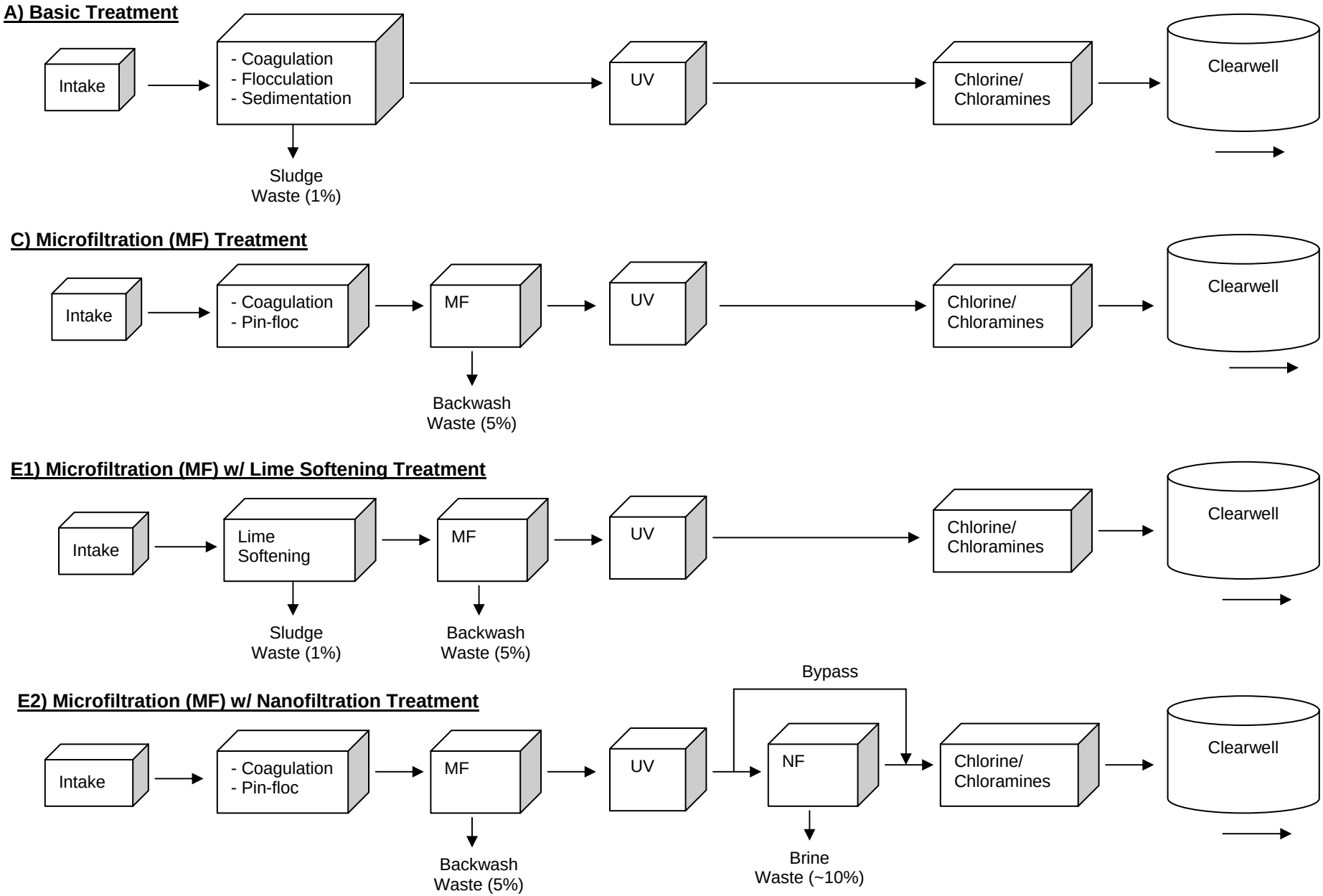


Figure 4.1: Process block diagram for selected treatment alternatives for which costs were developed.
(Note: % waste shown is the percentage of the feed to that process component. Use of chlorine or chloramines depends on the discharge location)

Sludge generated from this process is sent through a filter press to generate a solids concentration of 25% to 45%. This is trucked to the nearest landfill if a landfill is not established at the treatment site. Filter press effluent is sent back to the front of the treatment plant

4.2 Alternative B: Media

The Media alternative involves coagulation, flocculation, sedimentation, and media filtration (a.k.a. conventional media filtration) to meet Primary Standards. The media filter component typically uses a combination of sand and anthracite and sometimes has a layer of activated carbon. Conventional media filtration has been widely used in the US and has been the "conventional" treatment for many years. However, it is an older technology which has been surpassed by membranes in treatment performance, but not cost. Media filters provide good removal of particles, although less than membranes, and will eliminate the masking issue found in Alternative B. Media filters are affected by influent turbidity spikes which are connected to sedimentation basin performance. Media filters are backwashed using product water that is returned to the front of the treatment train. This water is subject to the Filter Backwash Recycling Rule that is in place to ensure a build up of microorganisms prior to the media filters does not occur.

Sludge generated from this process is sent through a filter press to generate a solids concentration of 25% to 45%. This is trucked to the nearest landfill if a landfill is not established at the treatment site. Filter press effluent is sent back to the front of the treatment plant.

4.3 Alternative C: Microfiltration

The Microfiltration alternative provides a near absolute barrier to particles with substantial log removal credit for *Giardia* and *Cryptosporidium*. Virus removal credit is low, typically 0.5 log credit or less. A microfilter uses tubular membranes with an approximately 0.1 μm pore size in a dead end filtration scheme. Depending on the type of membrane, they are operated under a pressurized or vacuum regime. Vacuum configurations use open tanks to house the membrane racks and can accommodate higher solids loading. An air scour is typically used to prevent solids buildup on the membrane surface. An option to add a coagulant is included to improve NOM removal. The coagulant is added with sufficient time to form pin-floc which is not large enough to settle, but can be easily removed by the membrane. The use of a coagulant has the down side of solids separation and disposal requirements. Backwash water at the McClusky Canal site is recycled with a solids separation step since the ability to discharge to the McClusky Canal is limited. The solids separation step is crucial to minimize biological contaminant build up in the feed stream. At the River location, solids separation is required because high suspended solids water (>30 mg/L consecutive 30-day average) can not be discharged into the river per North Dakota Department of Health NPDES guidelines. A centrifuge is used for solids separation producing a solids stream that can be fed to a filter press. The filter press generates a solids concentration of 25% to 45%. This is trucked to the nearest landfill if a landfill is not

established at the treatment site. Filter press and centrifuge effluent is sent back to the front of the treatment plant.

4.4 Alternative D: Ultrafiltration

The Ultrafiltration alternative provides similar treatment to MF, but the pore size of typically 0.01 μm provides increased log removal credit for viruses, usually 1.0 to 3.5 log credit. Organic matter removal is also improved, typically 10% and can be much higher if a coagulant is used. UF can be substituted for MF in any alternative, but often has a higher associated cost.

4.5 Alternative E1: Lime Softening

The Lime Softening alternative provides additional treatment for divalent cations to reduce hardness and overall TDS. This treatment alternative would be used where water is not discharged to a river and is not going to be further treated for hardness as would be the case with the GDU Water Supply Replacement Pipeline alternative. There is essentially no added benefit of lime softening for biota removal when compared to Alternative B and C. The process uses similar equipment to a coagulation and sedimentation process; instead of a coagulant, lime is added to raise the pH and precipitate calcium carbonate and calcium sulfate. Lime softening is often followed by media filtration. To produce a higher quality product MF is being used. MF filter backwash waste is recycled to the front of the treatment plant.

Sludge generated from this process is sent through a filter press to generate a solids concentration of 35% to 60%. This is trucked to the nearest landfill if a landfill is not established at the treatment site. Filter press effluent is sent back to the front of the treatment plant. A detailed design description of the lime softening process can be found in Section 6.

Lime softening will remove hardness from “hard” water conditions to “soft” water conditions. However, the Secondary standards for TDS are estimated to be met only 52% of the time at the McClusky Canal site. The majority of the exceedance is only expected to be 40 mg/L with a 100 mg/L maximum. This assumes that the water quality in Lake Audubon does not change after pumping begins. The water quality will start changing toward the source water quality, Lake Sakakawea. However, this may occur slowly and is flow dependent. The equilibrium point has not been determined. TDS in the Missouri River option is below the Secondary standard.

Sulfate in the McClusky Canal exceeds Secondary standards. Finished water concentrations are expected to exceed the Secondary standard of 250 mg/L 67% of the time. The majority of the exceedance is only expected to be 20 mg/L with a 50 mg/L maximum. Again, sulfate concentrations could decrease with the flushing of Lake Audubon.

4.6 Alternative E2: Nanofiltration

The Nanofiltration alternative provides a product which meets secondary TDS standards. The treatment process involves pin-floc coagulation, MF and nanofiltration (NF) with a bypass stream. The MF units provide a product that has a low NF membrane fouling potential. The MF product is sufficiently treated to allow for a portion of the flow to bypass the NF system. This water is blended with NF permeate to provide an exact product water TDS, even with changes in feed water TDS. This also allows for a smaller NF system. The NF membrane concentrate waste stream can not be substantially recycled due to the build up of membrane foulants (e.g. $CaCO_3$). Therefore, the concentrate flow, equal to about 10% of the feed flow, must be disposed. The most common method of disposal is river discharge which requires a NPDES permit. Other methods include evaporation ponds and deep well injection. Evaporation ponds, at the latitude and climate of Bismarck, ND and with the volume of waste, are not possible. The net evaporation rates are low and the ponds would freeze in the winter months. Deep well injection may be an option, but costs would be significant at the flow rates proposed.

Due to the large volume, the only realistic disposal method is discharge into a receiving stream that can transport the high TDS water. To avoid harmful environmental effects, this stream must be diluted substantially by the receiving stream. To meet North Dakota NPDES discharge permit limits, the dilution must occur immediately after entering the receiving stream. This is usually accomplished with a diffuser system. A mixing zone analysis would be needed in future design work. The Missouri River option is the only option that can accept the flow and high TDS water with sufficient dilution. Concentrate discharge at the McClusky Canal site would involve deep well injection or a concentrate pipeline back to the Missouri River. Cost estimates for these concentrate discharge options were not pursued for this report.

Preliminary discussions with Gary Bracht from the North Dakota Health Dept. do not show any definite barriers to the proposed concentrate discharge into the Missouri River (Bracht, 2005). This project alternative is unique in design with water being removed from the Missouri River, product water going out of the drainage basin and concentrate waste going back into the Missouri River. Unlike most treatment systems where there is a general mass balance of salt with almost all of the water taken out of the river going back into the river at the same salt concentration, this process increases the salt concentration in the river. This may affect users downstream of the discharge point.

In the NF alternative, sludge generated from the MF process is sent through centrifuge, followed by a filter press to generate a solids concentration of 25% to 45%. This is trucked to the nearest landfill or a landfill would be established at the treatment site. Centrifuge and filter press effluent is sent back to the front of the treatment process.

4.7 Disinfection for all Alternatives

Disinfection provides log inactivation credit for any remaining log reduction requirements and a disinfectant residual to reduce the chance of re-growth of organisms in the pipeline. The requirements for a river discharge biota treatment only scenario are undefined. Therefore, the general requirement for distribution system disinfection in a direct potable use scenario, a minimum 0.2 mg/L disinfectant residual leaving the treatment plant, and a detectable residual throughout the distribution system pipeline is used herein.

The first part of the disinfection process is the UV reactors that provide 3 log inactivation of *Giardia* and *Cryptosporidium*, but are not given credit for virus inactivation. Virus inactivation is possible, but only at the cost of significant increased energy usage (~3 times). UV disinfection has the benefits of no disinfection by-product formation. The remaining log reduction credit is achieved by chlorine and chloramines.

Chlorine and chloramines have a 1 hour maximum reaction time in the clearwell before entering the distribution system pipeline, which in this case is a supply system (pipeline). The clearwell could be baffled to reduce short circuiting and maximize the contact time if needed. The remaining contact time is achieved in the distribution system pipeline (**Table 4.3**).

Alternative	Approx. Distance (miles)	Travel Time (hr.)	Travel Time (min.)	Disinfectant	Concentration to achieve 3 log removal	CT Calculated	CT for 3 log removal	Discharge
GDU Import to Sheyenne River	120	29.3	1760	Free Chlorine	0.4	1408	277	Sheyenne River
Missouri River Import to Red River Valley	200	48.9	2933	Free Chlorine	0.4	2347	277	Distribution System & Reservoir
GDU Import Pipeline	220	53.8	3227	Chloramines	1.2	2581	3800	Distribution System
GDU Water Supply Replacement Pipeline	130	31.8	1907	Chloramines	2.0	1525	3800	Distribution System

Table 4.3: CT calculations and requirements

Product water is either transported to a potable water system, transported to another water treatment plant, or into a receiving stream. Discharge into a receiving stream requires the removal of the disinfectant to prevent negative impacts. Chloramines are very stable in the distribution system pipeline, but are significantly more difficult and expensive to remove

than chlorine. Therefore free chlorine is used in the alternatives that include river or reservoir discharge. If a disinfectant residual is required through the pipeline up to the point of discharge, a chlorine removal system using sodium bisulfite (H_2SO_3) would be added at the discharge point. The discharge chlorine concentration should not exceed 0.1 mg/L. The chlorine concentration in the receiving stream should not exceed 0.011 mg/L chronic standard (four day average) and 0.019 mg/L acute standard (one hour average) (NDDOH). If a disinfectant residual is not required through the entire pipeline, the chlorine dose could be metered to allow for the chlorine consumption through pipeline with no disinfectant residual present in the discharge. This option would reduce the system cost, but would require careful attention to chlorine dose and flow. The Missouri River Import to Red River Valley Alternative could utilize an ammonia addition point following the pipeline split between the reservoir and potable water distribution system pipeline. The advantage of chloramine formation at this point would be a stable residual and reduced DBP formation potential.

5.0 Intake Pumping Plant Design

5.1 Site Selection

Several locations for the Missouri River intake pumping plant were considered. Concerns in regard to locating an intake pumping plant on the Missouri River were expressed by the Dakota Area Office (DKAO) and considered by the Technical Service Center – Denver (TSC) in determining a site location and intake pumping plant type and configuration.

A major concern for the Missouri River sites is the large and frequent exposure to heavy sediment loads in the river. Experience with open channel or pipe intakes for existing pumping plants on the Missouri River has shown that these facilities are susceptible to significant flow restrictions or reductions in the channel or pipe intakes due to accumulation of sediment. Other concerns include the protection of the public for recreation and for fish screening. Based on these concerns, the DKAO recommended that the TSC evaluate and estimate the costs associated with constructing a radial collector well system for the Missouri River intake pumping plant.

The other site considered, evaluated, and estimated for an intake and water treatment plant was along the McClusky Canal. After site investigations and consultations between the TSC and the DKAO, a site was selected for the McClusky Canal intake pumping plant. This site is located at canal station 3060 + 00 and is approximately 1.5 miles north of State Highway 200. This site offered simple, direct access and the potential for least impact in regard to recreational, visual, and operational concerns for the surrounding community.

A) Missouri River Site

Location and Arrangement of Wells

The site designated as McLean Bottoms was selected as a preferred site on the Missouri River for the collector well type of intake system (**Figure 5.1**). This site provided a reasonable expectation for the presence of sufficient alluvial deposits that will be required for a collector well intake system. **Attachment D** provides additional collector well design information. This site also provides the necessary acreage for a collector well intake system, suitable access, and close proximity to a preferred location for the water treatment plant. The collector well site is located in the western edge of Burleigh County on Lake Oahe Corps of Engineers land, on the eastern river flood plain area. A 1.5 to 1.75 mile long pipeline will convey the water from the wells to the water treatment plant.

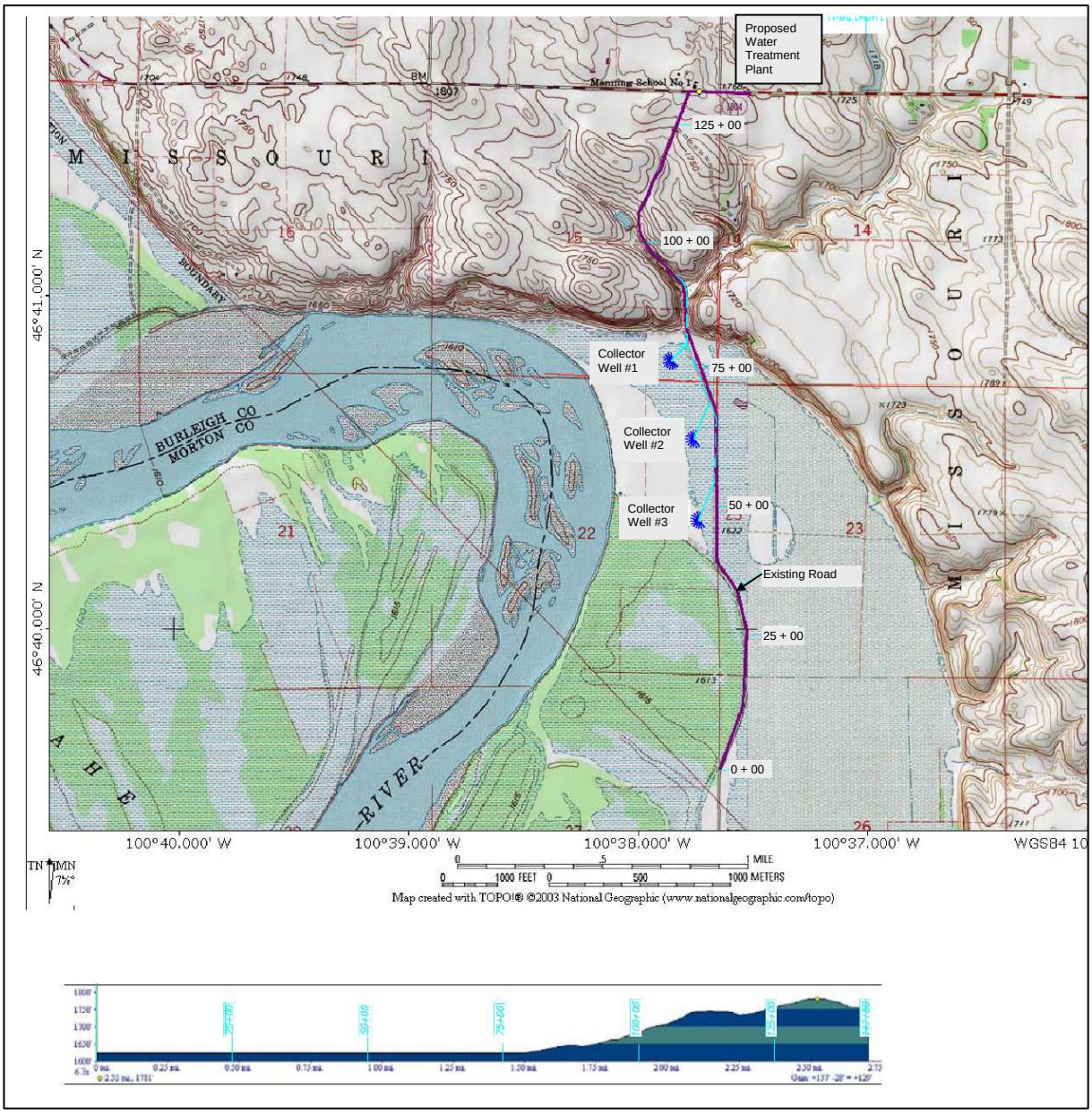


Figure 5.1: Proposed McLean Bottoms site on the Missouri River and alignment

The collector wells estimated for the Missouri River are sized and spaced based on conventional collector well systems currently installed (e.g. Ranney Collector Wells) or planned along the Missouri River. Spacing between collector wells is approximately 1500 ft. to eliminate well interference and offset approximately 1200 ft. from the river (**Attachment C – Figure 1.2**). These separations are based on the average or estimated aquifer properties as provided by the DKAO and others, and are derived from computations using a generic formula for estimating collector well parameters (International Water Consultants, Inc., 2004, "Horizontal Collector Well Feasibility Study – Report of Findings", page 16). Site specific

data will be needed to revise and more completely develop the collector well design parameters.

Each collector well is situated within its own service yard (**Attachment C – Figure 1.3**). Each service yard is sized and arranged to allow sufficient mobilization and positioning of equipment required for operation and maintenance of the pumping plant. The service yard elevation is approximately 3 ft. above the 100-year flood level for the Missouri River at this location. The service yard estimated for this evaluation has a 6-inch gravel surface with 7 ft. high chain link fence and a 20 ft. wide double swing gate for security and access.

The number and size of wells selected is based upon a reasonable expectation for inflow capacities at the selected site and the hydraulic requirements for the associated water treatment plant. Estimates were prepared to satisfy the required discharge capacities of 44 cfs and 63 cfs. Arrangement and layouts were prepared for 2 and 3 collector wells to accommodate the respective discharge capacities.

Access

Access to the three collector wells will be from North Dakota Highway 1804 to the existing 106th Street S.E. Each well service yard will be connected to this street by 16 foot wide gravel service roads. Other existing secondary roads and the road used for access to a boat ramp and a State Fish and Game pump station will not be altered by this design.

Other Considerations

Suitable alluvial soil from the well, flow meter vault, and discharge line excavations will be wasted on-site by constructing naturally shaped berms around each well service yard and around the air chamber service yard. These features will help reduce the visual impact of the well superstructures, air chamber, and chain link fencing around the service yards. The berms will have gradual outside slopes of 6:1.

B) McClusky Canal Pumping Plant Site

The pumping plant may be located along side and at the canal bank level (El 1844.33), while the water treatment plant will be located at the top of cut (El 1940) (**Figure 5.2** & **5.3**). The McClusky Canal intake pumping plant is a conventional wet-sump pumping plant. The pumping plant and service yard are located and sized to provide access into and around the structure to facilitate all the anticipated operation and maintenance requirements for this facility. A deck over the intake portion of the plant sump is provided to allow continuous access through the site required by the existing canal O&M road.

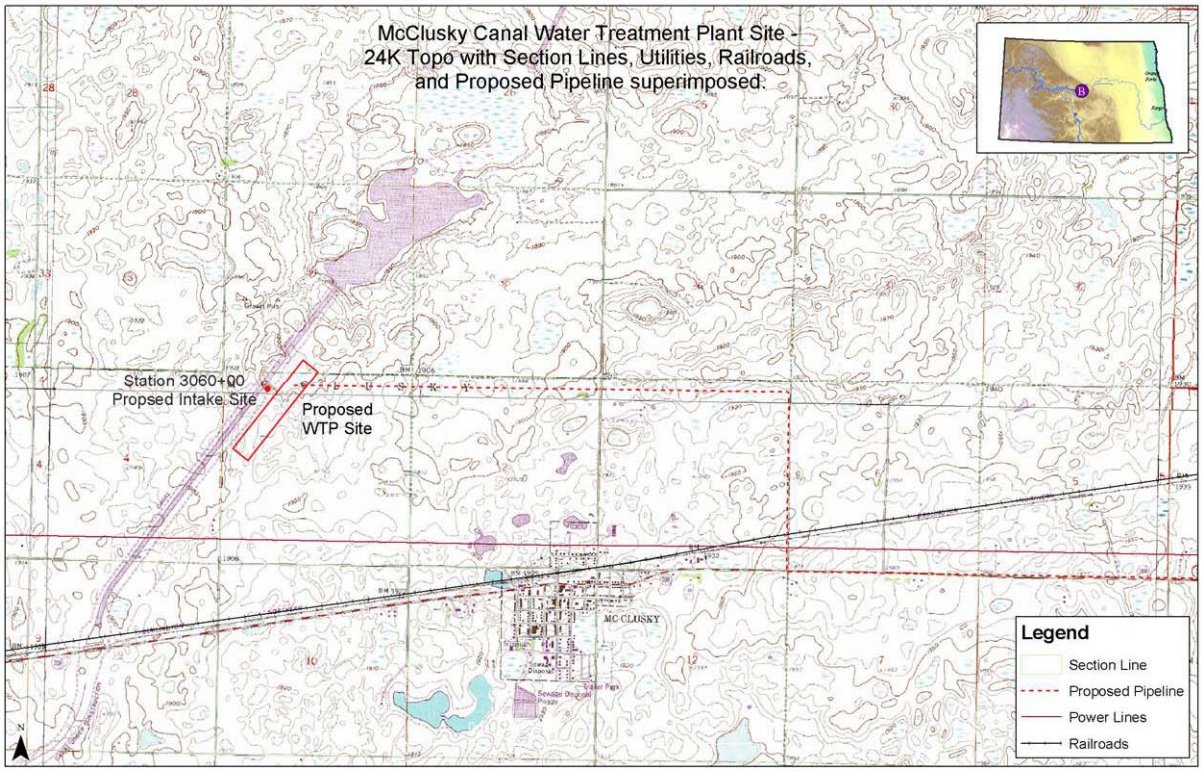


Figure 5.2: Proposed McClusky Canal site and alignment

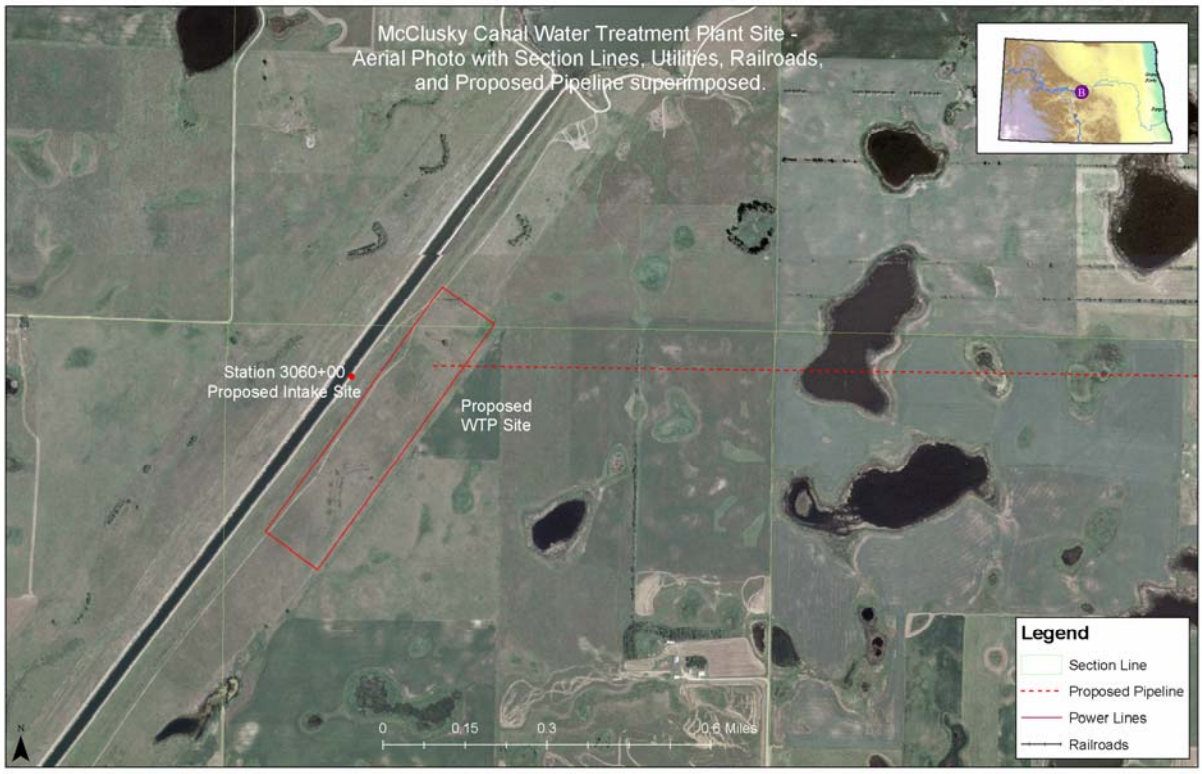


Figure 5.3: Proposed McClusky Canal site and alignment

Other features included within the service yard are areas for an electrical transformer and flow measurement vault. The service yard is secured with a 7 ft. high chain link fence and 24 ft. wide, double swing gates.

The McClusky Canal Water Treatment Plant may be located on the canal waste bank immediately to the east of the intake pumping plant service yard. An access road has been provided between the pumping plant service yard and the water treatment plant service yard (**Attachment C – Figure 1.6**).

Access

Access to the McClusky Canal intake pumping plant service yard is provided by the existing canal O&M road or from the McClusky Canal Water Treatment Plant access road. Larger vehicles such as tractor-trailers and mobile cranes will typically enter the Pumping Plant service yard from the Water Treatment Plant access road.

Other Considerations

Recreation According to information provided to the TSC from DKAO, this portion of McClusky Canal is used for fishing or other types of recreation. Boating is occasionally observed along this stretch of the canal. These factors will require further consideration in terms of providing for the public safety and security of the intake pumping plant facilities. The intake screens located within the McClusky Canal are large in diameter and submerged only several feet below the normal water surface level. This area of the canal will need to be restricted from use for recreational purposes.

Environmental The intake for the McClusky Canal intake pumping plant incorporates Johnson screens to facilitate year-round operation and comply with fish screening criteria required for this facility. Other means of fish screening may be considered for future study or design efforts; however, this type of intake provided the most direct and economical solution for the issues regarding public safety and fish screening.

5.2 Geology and Geotechnical Considerations

A) Missouri River Site

No site specific geologic investigations were performed for this evaluation and layout. Existing information that was provided to the TSC by DKAO included lithographic information from wells in the area of the proposed Missouri River intake pumping plant. Additional information from the vicinity of the proposed collector well system (International Water Consultants, Inc., 2004) for the City of Bismarck was provided and used for comparison purposes. A cursory geomorphic evaluation, based on topographic maps of the proposed sites, was completed. This information was used by the TSC to evaluate the potential suitability of the Missouri River site for a collector well system. (Refer to Appendix A - Evaluation of Collector Well Systems by Robert Talbot – D-8520).

B) McClusky Canal Site

Drill hole logs were available for the reach of canal considered for this pumping plant site. These geologic logs were part of the Garrison Diversion Unit Project, McClusky Canal Reach 3C specifications prepared in 1968. Specific drawings that were used to obtain this information include: 769-D-581, 791, and 792. Information from these drawings assisted the TSC in developing excavation and dewatering cost estimates for construction of the McClusky Canal intake pumping plant and Water Treatment Plant.

5.3 Pumping Plant Selection

A) Missouri River Site

Pumping Plant Hydraulic Criteria

The selection of number and size of pump units is based on meeting the flow requirements for the proposed water treatment plant (44 cfs and 63 cfs), satisfying the reliability criteria for the water treatment plant intake, and meeting realistic expectations for collector well inflow capacities. Based on the proposed location for the water treatment plant and the anticipated water surface levels within the collector well system at the Missouri River, the anticipated total dynamic head (TDH) for this intake pumping plant is approximately 200 ft.

There are two flow rate options (**Table 5.1**). Option 1 is a two well (caisson), 44 cfs (30 MGD) alternative and Option 2 is a three well (caisson), 63 cfs (40 MGD) alternative. Each collector well (caisson) has two 15 cfs pump units installed. As a matter of standard practice, one full size pump unit is provided as a spare unit for treated water systems.

Option	Nominal Flow Rate		Number of Caissons	Total # of pumps	# of spare pumps	Flow rate per pump (cfs)	Design flow (w/o spare) (cfs)	Water EL in Caisson
	cfs	mgd						
1	44	28.4	2	4	1	15.4	46.2	1950
2	63	40.6	3	6	1	13.23	66.15	1950

Table 5.1: Missouri River collector well pumping plant information summary

At this level of engineering design, rules-of-thumb are used to size the pipeline. An allowable pipe flow velocity of 5 feet per second produced the 36-inch diameter and 48-inch diameter pipelines for the 44 cfs and 63 cfs pumping alternatives, respectively.

A feasibility level hydraulic transient study was performed. Conservative assumptions were made during this study. All pumps, including the spare, were assumed operating at the time of the electrical power loss. This flow rate condition will cause the greatest hydraulic transients.

The system was analyzed to determine if surge protection would be required. In each option, the initial downsurge following loss of electrical power to the pump units fell below the ground elevation. This condition is not allowed during this level of design.

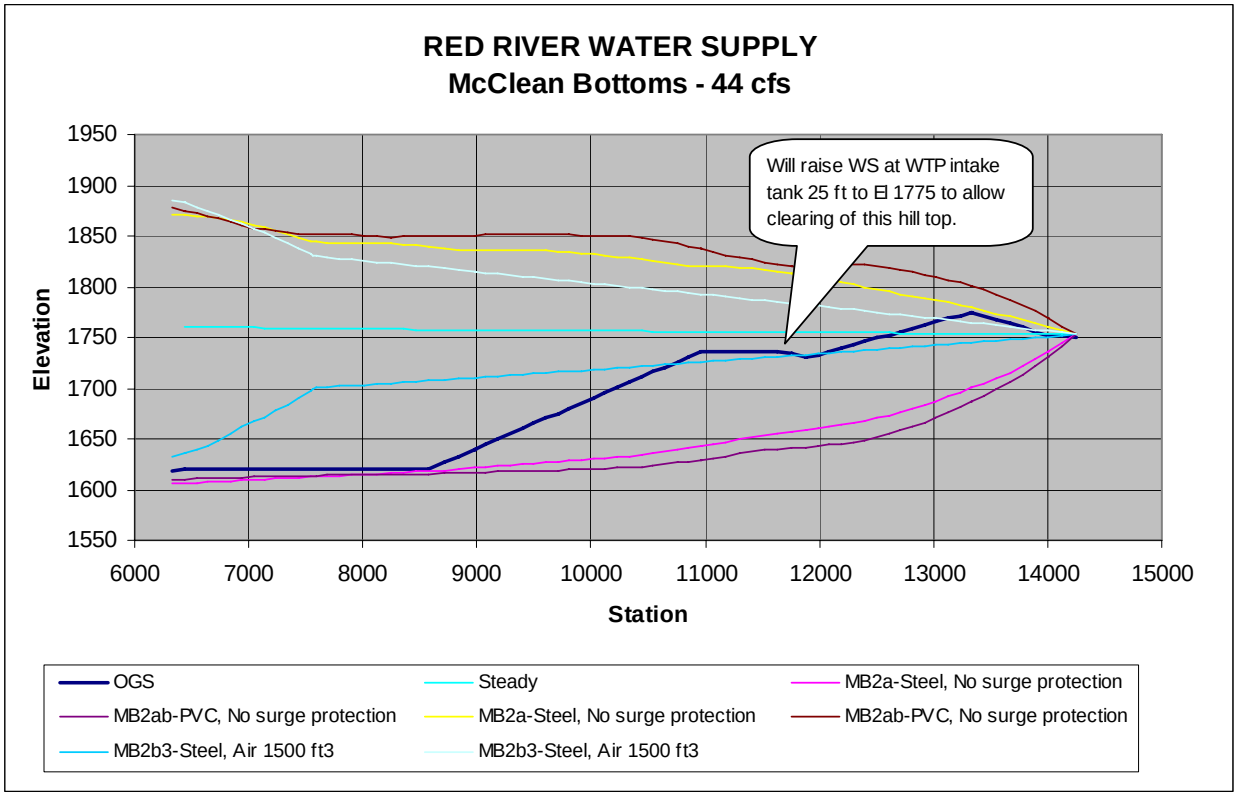
Common surge protection devices used to protect against downsurge are surge tanks and air chambers. One of the major system aspects considered when choosing the type of surge protection device is the static lift. Generally, surge tanks are used on low lift systems and air chambers are used on higher lift systems. The static lift in this system is about 150 feet (from about elev. 1625 to about elev. 1775) (**Table 5.2**). At an Appraisal level study, we may assume high hydraulic surge pressures to be about 30% greater than static pressure; this would require a stand pipe about 200 feet high for the transient protection. Generally, surge tanks should be limited to about 50 to 100 feet high; therefore, an air chamber near the pumping plant will be evaluated for this system.

Option	Parameter per Pump/Motor Unit						WR2		
	Q (cfs)	No. of units	TDH	Hp	Speed	No. of Stages	Motor	Pump	Total
1	12.5	3.0	225	400	1200	2	270	89	359
2	12.5	5.0	225	600	1200	2	471	89	560

Table 5.2: Missouri River summary of system parameters used for surge analysis

A plot showing the effects of a system with no surge protection device compared to a system with an air chamber is shown in **figure 5.4**. The downsurge of the system with the air chamber is held much higher between the air chamber location and the end of the pipe. It is recommended that the water treatment plant (WTP) equalization tank be placed near elevation 1775, if possible. Placing the tank at this elevation should allow the downsurge to remain above the ground level near Sta 109+60. If the downsurge still dips below the ground level near Sta 133+35, it may be necessary to re-route the alignment.

A surge tank located at the first high point in the ground level near Sta 109+60 may be an alternative to a surge protection device. The tank located at this point will likely be less than 30 feet tall. There is a drawback to locating a surge protection device a significant distance from the point of origin of the transient (pumps). This produces a condition where the reach for surge protection is so large that the pumps realize little to no surge relief. A comparison between the use of an air chamber versus a surge tank for the 63 cfs option is shown in **figure 5.4**. This analysis includes raising the WTP tank to elevation 1775. The downsurge between the surge tank and the treatment plant remains above the ground except at the high point near Sta 133+35. However, the downsurge near collector well (caisson) #3 does dip below the ground. Further analysis during feasibility or final design phases should investigate the use of a surge tank versus an air chamber.



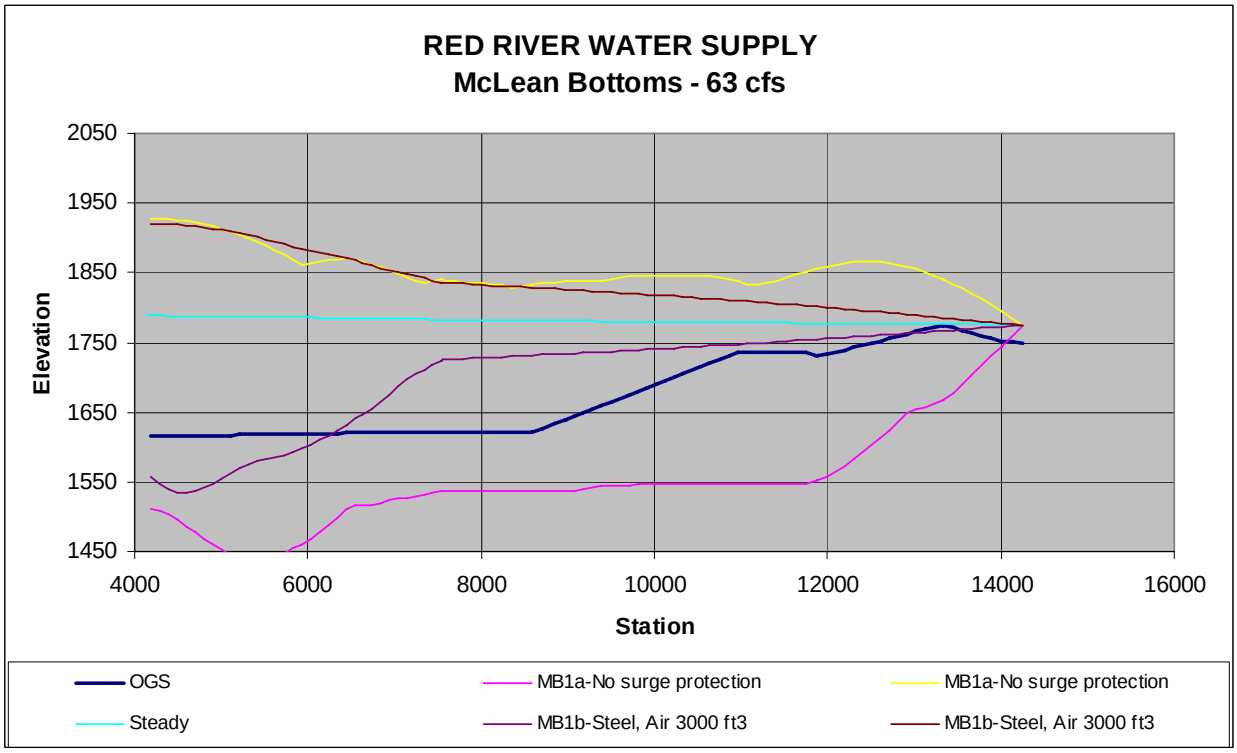


Figure 5.4: Missouri River hydraulic transient results (Air chamber on main line near Caisson #1)

For this study, the pipe material type alternatives assumed were steel or PVC. The pressures needed on this system for 36-inch and 48-inch pipelines are low for steel pipe and medium to high for PVC pipe. The effect of the different pipe material types is shown in **figure 5.4** for the 44 cfs system. The initial downsurge is essentially the same when no surge protection is provided and is essentially inconsequential on the system with an air chamber.

Table 5.3 outlines the basic system parameters for both options and the surge protection used for the cost estimate.

Option	Flow Rate		Pipeline Dia (inch)	Velocity fps	Pipe Type Options	Transient Surge Protection
	cfs	mgd				
1	44	28.4	36	6.22	Steel PVC	Air Chamber 14' dia x 24' long
2	63	40.6	48	5.01	Steel	Air Chamber 14' dia x 24' long

Table 5.3: Missouri River pipeline information summary

Figure 5.4 shows the hydraulic transient results with downsurge and upsurge pressure envelopes. A simplified ground surface and the normal operating pressure gradient are also plotted. The predicted upsurge pressures, based on the preliminary analysis, varied from about 225 to 275 feet or 50% to 85% greater than static lift depending on the size of air chamber used.

Additional analyses were performed using the potential drawdown of the water surface in the caisson of 60 ft to a water surface of 1550. The analysis indicated it will probably be necessary to replace the single air chamber surge protection from Sta 75+90 with air chambers located at each caisson.

More extensive analysis should be performed during the Feasibility or Final Design phase to balance cost of pipe (size, material type and pressure) against surge protection devices.

Plant Structure Selection

Horizontal radial collector wells are comprised of a large diameter reinforced concrete caisson that serves as a wet well pumping plant. The collector is equipped with a series of well screens that are projected horizontally into the aquifer from near the bottom of the caisson. The caisson is constructed to the required depth using the open-end caisson sinking method and a bottom-sealing plug is placed to make the caisson watertight. The radial collectors can be installed at one or more elevations and may be placed in a variety of patterns and lengths depending upon aquifer characteristics. A typical radial spacing for the collectors is 40 degrees. The caisson is extended above the known or anticipated flood elevations (in this case the 100-year flood) and the well is typically completed with a pump house and controls.

The caissons sized for the Missouri River Pumping Plant have an inside diameter of 20 ft. and extend approximately 100 ft. below grade. Each caisson will contain two, 15 cfs vertical turbine pumping units and associated discharge pipe manifold and valves. Pump house

facilities will be constructed on top of the caisson and will contain the pumps, motors, electrical switchgear and discharge piping. Other design criteria used to estimate the construction cost for this facility are:

- The top of the caisson is set 3 ft. above the 100-year flood level
- The caisson is reinforced to withstand the forces it will be subjected to from the aquifer material and water.
- Radial collectors are essentially horizontal
- The top of the caisson is covered with a watertight floor.
- All openings in the caisson floor are curbed to protect the sump/well from the entrance of foreign material.
- Radial collector pipes have provisions for isolating them from the caisson.
- Collector screens will be constructed of materials resistant to damage by chemical action of the groundwater or cleaning operations.
- Maximum screen entrance velocity should not exceed 0.03 ft/sec, assuming 50 percent of the screen openings are plugged.

Pump Design

The 63 cfs option utilizes six vertical turbine pumps (5 + 1 spare). The 44 cfs option utilizes four vertical turbine pumps (3 + 1 spare). Each pump is rated at 15 ft^3/s with a total head of 180 feet operating at 1170 rpm with a brake horsepower of 370 hp.

Electrical Equipment

Main Pumping Unit Motors The motors for driving the vertical turbine pumping units are vertical-shaft induction type with weather-protected type I enclosures. For each collection drainage well, two motors rated 400 hp, 1200 rpm, 480 volts are provided. Six motors (three wells) are provided for the 63 cfs option. Four motors (two wells) are provided for the 44 cfs option.

All motors have similar control and protective devices for alarm and shutdown of the units for problem conditions. Shutdown of the respective pumping unit occurs for low water level well condition.

Incoming Power and Unit Substation Incoming power from the local utility is from underground, 8-kV cable to a main unit substation located near well no. 2. This unit substation contains a high-voltage switchgear section consisting of one fused-interrupter switch, two disconnect switches, metering equipment, and surge arresters; a transformer section consisting of a 3-phase, 7.2-kV - 480V, 750-kVA liquid-filled power transformer; and a low-voltage section consisting of two circuit breakers. One breaker is a spare for any unforeseen future power needs at the site. Power for the other wells is fed from 8-kV underground cables from the main unit substation. These unit substations consist of high-voltage switchgear section consisting of one fused-interrupter switch and surge arresters; a transformer section consisting of a 3-phase, 7.2-kV - 480V, 750-kVA liquid-filled power transformer; and a low-voltage section consisting of one circuit breaker. A 600-V outdoor busway connects the unit substations and the respective motor control centers.

The 63 cfs design option consists of 3 unit substations and the 44 cfs design option has two unit substations. Incoming power from the local utility has been assumed to be at a voltage of 7.2-kV.

Power Distribution Equipment Incoming power to each well is 480 volts. A 480 volt distribution panel board is provided to service plant loads. A 120/208 volt panel board is provided to service lighting, receptacles and other low voltage plant loads.

600-Volt Motor Control Centers A 600 volt motor control center (MCC) is utilized for the starting the 400 hp motors. The motor control center contains the standard equipment, including draw out fuses, starters, control power transformers, selector switches, pushbuttons, and all unit protective and control devices.

The 600-volt motor control center operates all of the auxiliary systems at the well such as valves and HVAC equipment and will also provide water level and flow indication.

Mechanical Equipment

The auxiliary mechanical systems in the pumping plant consist of a gravity drainage system, fire suppression system, compressed air system and heating and ventilating system.

The gravity drainage system consists of floor drains around the perimeter of the plant interior and in floor areas where the leakage of water can be expected. Sloped, cast iron, hub and spigot soil pipe will collect wastewater from the floor drains and convey it by gravity to the plant sump.

The fire suppression system consists of portable, multi-purpose, wall-mounted, dry chemical fire extinguishers to extinguish fires in flammable materials and equipment on the interior of the pumping plant.

A compressed air system is provided in the interior of the pumping plant. The system consists of a 10 ft^3/min air compressor operating at 125 lb/in^2 with a 30 gallon receiver tank and distribution piping for use by plant personnel for operation of pneumatic tools for maintenance activities. The compressed air can also be used for any air-operated control valves in the plant.

The heating and ventilating system consists of fans, louvers, dampers, ductwork, unit heaters, instrumentation, controls and accessories. This system will provide ventilation for the interior of the pumping plant and circulate air for the air cooled pumping unit motors. Heaters will be provided to warm the interior of the pumping plant and prevent freezing during the winter months. Plant operation will occur with outdoor temperature extremes from less than 0 degrees to over 100 degrees Fahrenheit.

An electromagnetic flow meter, provided in the pumping plant discharge line, measures the flow of water from each pumping plant.

Steel Manifold

Discharge Piping Steel piping connects the individual pump discharge lines into a single manifold. The manifold extends from the pumping plant to the outlet structure. The individual steel pipe branches and the main manifold are sized to limit the flow velocity and minimize friction loss.

A hydraulic dampened check valve is installed on each pump discharge line to prevent reverse flow through the pump during normal operation or during power failure. The manually-operated butterfly valves installed on the pump discharge lines are used as guard valves for maintenance on the pumps and the check valves. A sleeve-type coupling is provided for each individual discharge pipe for installation and removal of the valves and pump as needed. A harness is provided for each sleeve-type coupling to resist thrust loads from the pumps. Pipe, valve, flange supports, and pipe anchors are provided where required. Air valve assemblies are provided on the pump discharge lines at all the pumping plants. The air valves are combination type which both release air and admit air. Throttling air valve assemblies are provided on the pump discharge lines immediately downstream from the pumps.

Design Codes The pipe is fabricated in compliance with AWWA Standard C200 and AWWA Design Manual M-11. The maximum allowable design stress of the steel is 15,000 pounds per square inch. The minimum plate thickness is one-fourth inch. Minimum plate thicknesses for handling are in accordance with AWWA recommendations. This minimum thickness is the lesser of d/288 and (d+20)/400 where d is diameter in inches. After fabrication, all manifolds and piping are hydrostatically tested to 1.5 times the design pressure.

Steel plate, used for the manifolds and discharge pipes, conforms to ASTM A36, ASTM A283, grade C or D. This results in good weldability and resistance to brittle fracture.

B) McClusky Canal Site

Pumping Plant Hydraulic Criteria

The canal is located in an area of about 60 feet cut from the natural ground level of elevation 1910, down to the canal bank level of elevation 1850. The cut slope used in this area of the canal is 2(h) to 1(v). The resulting pipeline length between the pumping plant at the canal level and the water treatment plant equalizing reservoir at the upper ground level is about 750 feet.

There are two flow rate options (**Table 5.4**). Option 1 is a 128 cfs plant (82 MGD) alternative and Option 2 is a 340 cfs plant (220 MGD). The 128 cfs plant has two bays with two pumps per bay; the 340 cfs plant has four bays with two pumps per bay. As a matter of standard practice, one full size pump unit is provided as a spare unit.

Option	Nominal Flow Rate		Number of Bays	Total # of pumps	# of spare pumps	Flow rate per pump (cfs)	Design flow (w/o spare) (cfs)
	cfs	mgd					
1	128	82.6	2	4	1	44.8	134.4
2	340	219.4	4	8	1	51.0	357

Table 5.4: McClusky Canal intake pumping plant information summary

The short length of pipeline at this site is considered when using a rule-of-thumb to size the pipeline. General practice would use a pipe velocity of 5 feet per second (fps); however, due to the relatively short length of discharge line of 750 ft., a pipe velocity of about 10 fps is allowed which decreases the pipeline costs. The discharge pipeline diameter for the 128 cfs option is 48-inch (4 ft). The discharge pipeline diameter for the 340 cfs option is 78-inch (6.5 ft).

A feasibility level hydraulic transient study was performed for the 128 cfs option (**Table 5.5, Figure 5.5**). Pipeline velocity is a factor that significantly affects the transient analysis results. The pipe velocity used for both options was essentially the same; therefore the results will be comparable. Conservative assumptions were made during this study. All pumps were assumed operating at the time of the electrical power loss. This flow rate condition will cause the greatest hydraulic transients.

Option	Parameter per Pump/Motor Unit						WR^2		
	Q (cfs)	No. of units	TDH	Hp	Speed	No. of Stages	Motor	Pump	Total
1	60	8	200	800	900	1	700	450	1150
2	60	4	200	800	900	1	700	450	1150

Table 5.5: McClusky Canal summary of system parameters used for surge analysis

An initial analysis assumed a system without any surge protection to determine if hydraulic transient surge protection was required. The initial downsurge following loss of electrical power to the pump units is not allowed to fall below the ground elevation for this level of design.

For this study, the pipe type material alternatives were assumed to be steel or concrete. The pressures needed on this system are low for steel pipe and medium for concrete cylinder pipe. The concrete pipe will have a steel cylinder as a water tight barrier because the upsurge pressures will exceed 125 feet. The level of downsurge for steel and concrete pipe are nearly the same for the analyses performed.

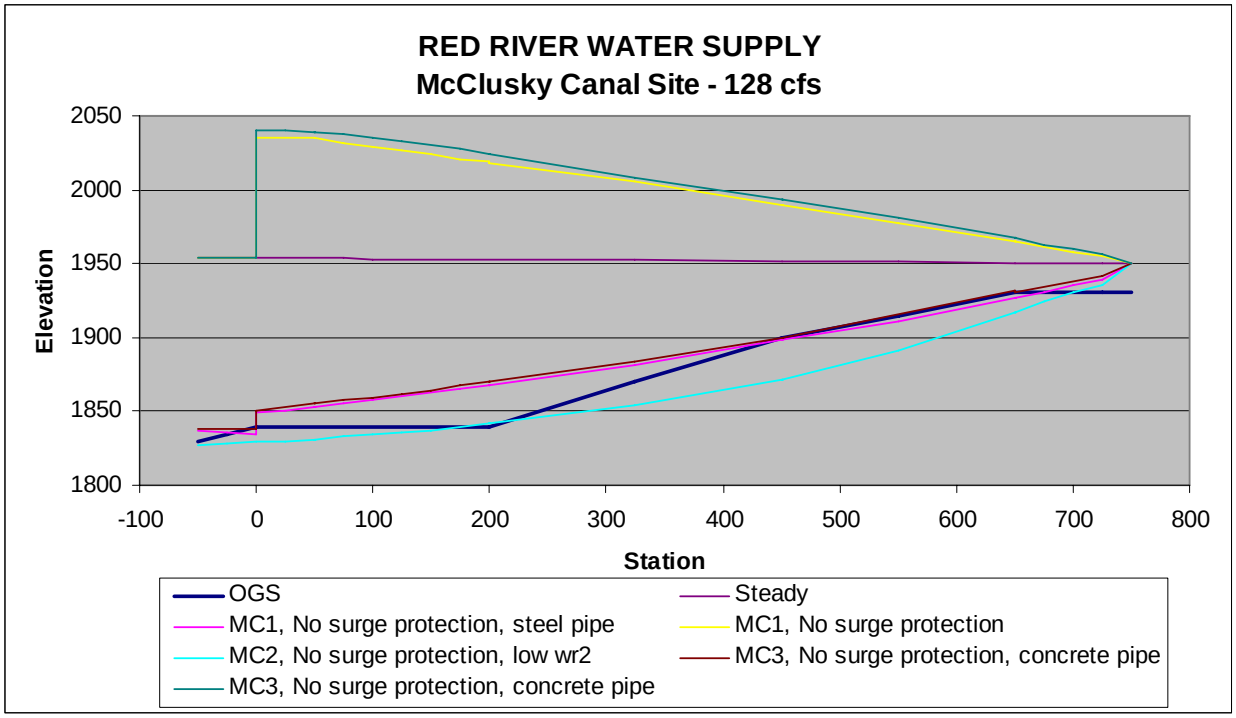


Figure 5.5: McClusky Canal hydraulic transient results

The system's sensitivity to the pump unit rotational momentum, WR^2, was also evaluated. Normal WR^2 for pump units is predicted based on the motor horsepower, motor speed, and typical pump characteristics. The effect of using both the predicted WR^2 and half WR^2 were evaluated. This evaluation is much more important for a system that will not be using a surge protection device. The results from this analysis indicated that transient downsurge with the full WR^2 is marginally acceptable and transient downsurge is unacceptable when using half WR^2 (**Table 5.6**).

Option	Flow Rate		Pipeline Dia (inch)	Velocity fps	Pipe Type Options	Transient Surge Protection
	cfs	mgd				
1	128	82.6	48	10.19	Steel Concrete	Not Required
2	340	219.4	78	10.25	Steel Concrete	Not Required

Table 5.6: McClusky Canal pipeline information summary

Intake Selection

Screened intakes are planned for this pumping plant. Submerged cylindrical screens were chosen because this plant is located in a cold climate and will be operated year-round.

Plant Structure Selection

The superstructure is a pre-engineered metal building that housed all of the pump units, associated electrical and mechanical equipment, unit discharge piping and valves, and space for a small control room. The roof of the superstructure contains hatches for access to the motors and pumps for a mobile crane. All other equipment access is provided through overhead doors at each end of the superstructure.

The space is ventilated and heated to allow year-round unit operation. It is assumed that this plant will be remotely operated.

The sump is sized and proportioned to accommodate the estimated size of the pump units and the anticipated loads for substructures of this type and configuration. Dewatering of the sump is provided by means of bulkheads that can be installed along the O&M access road deck. O&M vehicles using the canal O&M access road can travel directly over the intake of the pumping plant.

No unique foundation improvements are anticipated for this structure based on the data provided.

Pump Design

The 128 cfs option utilizes four vertical turbine pumps (3 + 1 spare). The 340 cfs option utilizes eight vertical turbine pumps (7 + 1 spare). Each pump is rated at 49 cfs with a total head of 115 feet operating at 880 rpm with a brake horsepower of 760 hp.

Electrical Equipment

Main Pumping Unit Motors The motors for driving the vertical turbine pumping units are vertical-shaft induction type with weather-protected type I enclosures. For the 128 cfs plant option, four motors rated 800 hp, 900 rpm, 4,160 volts are provided. For the 340 cfs plant option, eight motors rated 800 hp, 900 rpm, 4,160 volts are provided.

Since the motors are located indoors, special motor enclosures are recommended to limit the motor noise to a specified dB level within the plant.

All motors have similar control and protective devices for alarm and shutdown of the units for problem conditions. Shutdown of the respective pumping units also occurs for low sump conditions or for low water in the canal conditions.

Incoming Power and Unit Substation Incoming power from the local utility will be from underground, 8-kV cable to a unit substation. The unit substation contains a high-voltage switchgear section consisting of one fused-interrupter switch, metering equipment, and surge arresters; and a transformer section consisting of a 3-phase, 7.2-kV - 4.16-kV liquid-filled power transformer. A 5-kV non-segregated outdoor bus connects between the unit substation and the motor control center.

The 340 cfs design option consists of a 7,500-kVA transformer and the 128 cfs design option consists of a 5,000-kVA transformer. Incoming power from the local utility is assumed to be at a voltage of 7.2-kV.

Power Distribution Equipment Incoming power to the plant is 4,160 volts. The plant station service power supply will be obtained from a station service transformer which steps down the plant voltage from 4,160 to 480 volts. Various 480 volt distribution panel boards provided throughout the plant to service plant loads. A 120/208 volt panel board also provides service to lighting, receptacles and other low voltage plant loads.

Motor Control Equipment A 5 kV motor control equipment (MCE) will be utilized to start the 900 hp motors. The 5 kV MCE will contain the standard equipment including draw out fuses, starters, control power transformers, selector switches, pushbuttons, and all unit protective and control devices.

600-Volt Motor Control Centers The 600-volt motor control center will be provided at the plant for operating all of the auxiliary systems such as hydraulic pumps, valves, air compressors, and lighting and receptacle loads.

An auxiliary control section, provided as part of the motor control center, centralizes all plant alarms and provides water level and flow indication.

Mechanical Equipment

The auxiliary mechanical systems in the pumping plant consist of a gravity drainage system, fire suppression system, compressed air system and heating and ventilating system. In addition, fish screens with an air burst cleaning system and water level measuring system are provided in the intake for the pumping plant. Bulkheads are provided on the intake upstream side of the pumping plant for use in dewatering the plant sump during maintenance activities.

The gravity drainage system consists of floor drains around the perimeter of the plant interior and in floor areas where the leakage of water can be expected. Sloped cast iron hub and spigot soil pipe will collect wastewater from the floor drains and convey it by gravity to the plant sump.

The fire suppression system consists of portable, multi-purpose, wall-mounted, dry chemical fire extinguishers to extinguish fires in flammable materials and equipment in the pumping plant. An automatic clean agent gas, life sustaining, fire extinguishing system is being provided for the control and communications room.

A compressed air system is provided in the interior of the pumping plant. The system consists of a 10 ft^3/min air compressor operating at 125 lb/in^2 with a 30 gallon receiver tank and distribution piping for use by plant personnel for operation of pneumatic tools for maintenance activities. The compressed air can also be used for any air-operated control valves in the plant.

The heating and ventilating system consists of fans, louvers, dampers, ductwork, unit heaters, instrumentation, controls and accessories. This system will provide ventilation for the interior of the pumping plant and circulate air for the air cooled pumping unit motors. Heaters will be provided to warm the interior of the pumping plant and prevent freezing during the winter months. Plant operation will occur with outdoor temperature extremes from less than 0 degrees to over 100 degrees Fahrenheit. An air conditioning unit has been provided for the control and communications room for plant personnel and the sensitive electronic equipment.

An electromagnetic flow meter, provided in the pumping plant discharge line, measures the flow of water from each pumping plant.

One rectangular bulkhead of coated carbon steel construction is provided for the main pump intake bays for dewatering the plant sump during maintenance activities. The bulkhead can be inserted by use of a mobile crane into any of the intake bays requiring dewatering. Bulkhead guides of coated carbon steel construction for support and mounting of the bulkhead are permanently installed in each pump intake bay.

Cylindrical tee fish screens constructed of stainless steel materials are provided in the intake to the pumping plant. The cylindrical tee screens (Johnson or Hendricks screens) are equipped with an air burst backwash cleaning system. The screen configuration and sizes are based on the fish species to be encountered and the fish screening criteria (maximum screen approach velocities, slot openings and percent open area) and the maximum through screen slot velocity recommended by the screen manufacturers (0.5 ft/s). Design data indicates that no endangered or threatened species are to be encountered, but specific screening criteria have not been provided yet. Each screen was sized for a maximum flow of 25 cfs and assumed 48 to 50 percent open screen area. The screens have a minimum submergence of 3-feet (normally about 9 feet) to prevent icing issues during winter operation, and needs to be at least one half a screen diameter above the canal invert. The air burst system equipment is located in the pumping plant and consists of a rotary screw type air compressor and a horizontal air receiver tank. The air compressor operates at 150 psi and is equipped with a 75 horsepower motor that could pressurize the 1000 gallon air receiver in 5 to 6 minutes. Only one screen is anticipated to be cleaned at a time. It would take approximately 50 minutes to clean all eight 60-inch diameter by 199-inch long fish screens on the small plant, or approximately 100 minutes to clean all sixteen 60-inch diameter by 199-inch long fish screens on the large plant. A water level measuring system consisting of one upstream level sensor and two (four for large plant) downstream level sensors with a transmitter/receiver is provided to indicate the need for operation of the manually controlled air burst cleaning equipment.

Mechanical Equipment

Intake Piping Steel piping connects the individual fish intake screens into 4 individual pump intake manifolds. Each manifold feeds 2 pumps. The individual steel manifolds limit the flow velocity and minimize friction loss. Individual sections of steel piping extend from an air tank, located at the plant structure, to each fish screen. This steel pipe is needed for the air burst cleaning process for the fish screens.

Discharge Line Steel piping connects the individual pump discharge lines into a single manifold. The manifold extends from the pumping plant to the Red River WTP equalization tank. The individual steel pipe branches and the main manifold limit the flow velocity and minimize friction loss.

A hydraulic dampened check valve is installed on each pump discharge line to prevent reverse flow through the pump during normal operation or during a power failure. The manually-operated butterfly valves installed on the pump discharge lines are guard valves for maintenance on the pumps and the check valves. A sleeve-type coupling is provided for each individual discharge pipe for installation and removal of the valves and pump as needed. A harness is provided for each sleeve-type coupling to resist thrust loads from the pumps. Pipe, valve, flange supports, and pipe anchors are provided where required.

Air valve assemblies are provided on the pump discharge lines at all the pumping plants. The air valves are combination type which both release air and admit air. Throttling air valve assemblies are provided on the pump discharge lines immediately downstream from the pumps.

Design Codes The pipe is fabricated in compliance with AWWA Standard C200 and AWWA Design Manual M-11. The maximum allowable design stress of the steel is 15,000 pounds per square inch. The minimum plate thickness is one-fourth inch. Minimum plate thickness for handling is in accordance with AWWA recommendations. This minimum thickness is the lesser of d/288 and (d+20)/400 where d is diameter in inches. After fabrication, all manifolds and piping are hydrostatically tested to 1.5 times the design pressure.

Steel plates, used for the manifolds and discharge pipes, conform to ASTM A36, ASTM A283, grade C or D. This results in good weldability and resistance to brittle fracture.

6.0 Water Treatment Plant Design

The water treatment process chosen for the detailed Appraisal level design and cost estimation was lime softening. This cost estimate was used to calibrate a cost model. Lime softening was chosen because it represents the most expensive process that can be used at both Canal and River locations. This allows more confidence in the upper end costs and facilitates estimation of treatment system designs that use components of the lime softening process.

The lime softening-MF plant is designed for a final product water capacity of 77.6 MGD (120 cfs). Inflow to the water treatment plant is 82.5 MGD and the plant generates a 4.9 MGD waste stream. The waste stream consists of MF backwash water (4.1 MGD) which is approximately 5% of the MF influent, and lime softening sludge (0.8 MGD) which is approximately 1% of the lime softening influent. Flow from the McClusky Canal intake pumping plant is 127.6 cfs (82.5 MGD) if the plant waste stream is discharged offsite, or 120 cfs (77.6 MGD) if the waste stream is recycled to the front of the water treatment plant,

The origin of lime softening dates back to 1841 when lime was added to Thames River to reduce bicarbonate hardness by precipitation of calcium alkalinity as calcium carbonate and magnesium alkalinity as magnesium hydroxide, the added lime being also precipitated as calcium carbonate. Modern day lime softening, referred to as the cold lime process, operates under the same principle. Conventional media filters are traditionally used after lime softening to capture remaining suspended solids in the lime softening effluent. However, membrane technology is rapidly gaining popularity as an alternative to media filters due to their higher removal efficiencies of microorganisms. Microfiltration pore size is often as small as 0.1 μm compared to 2 μm and higher for media filters.

The water treatment plant consists of an equalization tank, solids contact upflow clarifiers, MF units, UV disinfection, chloramine injection and a clearwell (**Attachment C – Drawing 3** and **Drawing 4**). Supporting equipment for the lime softening process includes lime slaking and coagulant injection and sludge dewatering. The main treatment building houses the filtration and chloramine injection equipment. Two other buildings house the lime slaking and sludge dewatering equipment. A description of the unit processes is provided below.

6.1 Equalization Tank

A 575,000 gallon equalization tank dampens fluctuations in the feedwater flow from the McClusky Canal intake pumping plant. The retention time of the equalization tank is 10 minutes.

6.2 Clarifier

Cold lime softening is a chemical precipitation process which removes calcium alkalinity, to a minimum of 35 mg/l as $CaCO_3$, about 10% of the magnesium alkalinity, and most of the other solids in the feedwater. Six 150' diameter solids contact clarifiers are proposed for lime softening. Five upflow clarifiers would be required during the winter and four during the summer. At least one redundant clarifier will be available at all times. Solids contact clarifiers combine mixing, flocculation and sedimentation in a single basin and are commonly used for lime softening. Raw water and chemicals mix with previously formed lime slurry in a centrally located draft tube with impeller. The water then passes through distinct zones within the basin for reaction, flocculation and clarification. Clarified water is collected in radial effluent launders which direct the flow to an effluent discharge pipe. Solids in the clarification zone settle to the bottom of the basin and are moved to the center by a rotating sludge rake.

The upflow clarifiers were designed with an upflow rate of 0.67 gpm/ft^2 at 32 ^{o}F and a flow of 16.5 MGD per clarifier (5 active clarifiers). This equates to a retention time of 228 min. To prevent freezing of the feedwater, the concrete clarifier tanks will be partially buried and covered with aluminum domes. Burying the tanks will negate the need to insulate the clarifier walls and the aluminum domes should provide an insulating air pocket above the water surface.

Effluent pH from the lime softening process is around 10 to 11. A pH adjustment is required to reduce the pH to around 8. The pH adjustment is particularly important when using MF membranes since high pH water may induce scaling on membrane surfaces. The pH adjustment is performed by injecting sulfuric or hydrochloric acid into the effluent stream with a metering pump. Sulfuric acid is preferred over hydrochloric due to the lower dosages and costs required.

6.3 Microfiltration Membrane

Effluent from the upflow clarifiers flows to the main treatment plant building where it is further treated by MF units (**Attachment C – Drawing 1** and **Drawing 2**). The MF process will remove any remaining solid particles in the feedwater including meeting EPA Surface Water Treatment Rule standards for the removal of turbidity, *Giardia Lamblia* and *Cryptosporidium*. Virus removal through MF varies depending on the manufacturer and credit given by the state, typically 0 to 0.5 log removal credit. The MF units consist of 24 active and 2 redundant racks each with a capacity of 3.42 MGD. The membrane flux is 75 gal/ft^2/day. Outside-in flow MF modules are proposed where the membranes are placed parallel to the feed direction and clean liquid passes inwards through the membrane. Solids retained on the membrane are removed periodically by backwashing (reverse filtration) and air scrubbing. Approximately every 30 to 60 minutes, water is pumped from the clearwell for the reverse filtration. The MF modules will go through a reverse filtration cycle of about 15 to 30 seconds duration, and the spent reverse filtration water is diverted to a waste pipe for recycling to the front of the water treatment plant. The amount of reverse filtration water

used daily is about 5% of the MF influent flow. In addition to the reverse filtration cycle, every 40 to 120 minutes, an air scrubbing process involving the injection of air into the feed side of the module rack is required. Air scrubbing is maintained for one hundred and twenty (120) seconds, 30 seconds with air and 90 seconds with air and water (Pall, 2005).

Periodically, the MF system will require a more thorough cleaning than reverse filtration or air scrubbing can provide. Cleaning chemicals will be added to the system and recirculated as required to regenerate the modules. The clean in place (CIP) and Enhanced Flux Maintenance (EFM) operation happens infrequently, and is designed to be an automatic operation (Pall, 2005).

6.4 Ultraviolet Disinfection

Any microorganisms that pass through the MF process are inactivated by the 48-inch diameter ultraviolet (UV) flow-through reactors (3 active units, 1 redundant unit). Ultraviolet energy is found in the electromagnetic spectrum between visible light and x-rays and can best be described as invisible radiation. In order to inactivate microorganisms, the UV rays must actually strike the cell. UV energy penetrates the outer cell membrane, passes through the cell body, and disrupts its DNA, preventing reproduction (Edstrom Industries, 2003). However, with UV reactors, a disinfection residual is not provided in the effluent.

6.5 Chlorine / Chloramines

The final disinfection process includes injection with chlorine or chloramines to provide a disinfectant residual in the distribution system pipeline. Contact time with chemical disinfectant is required to meet EPA virus treatment requirements; *Giardia* and *Cryptosporidium* inactivation requirements are already met by the point of UV reactor discharge. The disinfectant may be chlorine or chloramines, depending on the discharge scenario. Chloramines, formed by the reaction of chlorine with ammonia, will produce one of three forms of chloramines (monochloramine, dichloramine or trichloramine) with monochloramine being the dominant form used in water treatment. The type of chloramine formed depends on pH of the water, the amount of ammonia available and the temperature. The chloramine dose uses a 3:1 chlorine to ammonia ratio with a resulting 2 mg/L free chlorine to 0.67 mg/L ammonia. This satisfies the worst case disinfection scenario that requires the highest chloramine dose.

The proposed flow rates dictate the use of chlorine gas instead of liquid chlorine or onsite generation. Chlorine gas is trucked into the site in 1 ton cylinders. The addition of a rail spur and shipment of chlorine by rail car could be less expensive in the long term, but was not evaluated for this report. Chlorine gas is dangerous and requires safety precautions. A separate chlorine gas scrubber system is required in the treatment building in case of a chlorine gas leak. Appropriate chlorine gas detection and warning systems are located throughout the treatment building. Anhydrous ammonia is stored in a separate room in two 3000 gal. tanks.

Chloramines have the advantage of reduced disinfection byproduct formation potential. Chloramines are effective against bacteria but are less effective compared to free chlorine for the inactivation of viruses and protozoal cysts. Chloramines are more stable than free chlorine which allows for a more consistent disinfectant residual in the distribution system pipeline. Chlorine requires significantly less contact time and dose to achieve the same log inactivation as chloramines. Chlorine is more easily removed for river and reservoir discharge scenarios. The 3.2 million gallon clearwell was sized to provide 1 hour of storage at the maximum flow, thus providing an equivalent maximum contact time of 1 hour.

6.6 Lime Softening Support Equipment

Two other buildings are required in support of the lime softening process; a lime slaking building and a sludge dewatering building. The lime slaking building is designed as a two-story structure consisting of lime slaking equipment on the top floor and mixing tanks on the bottom floor. The upflow clarifiers require coagulant and slurry made of calcium oxide (CaO or quicklime). The solid quick lime pebbles and coagulant would be contained in lime silos and coagulant bulk tanks located outside the lime slaking building. The lime slaking and mixing equipment convert the pebble lime to a 2-part water, 1-part lime slurry which is fed to the upflow clarifiers through two pneumatic double diaphragm pumps. The coagulant is gravity fed to the feedwater influent pipe where it is injected via a chemical metering pump and an induction mixer. Coagulants for lime softening can be iron based (ferric sulfate, ferrous sulfate) or aluminum based (aluminum sulfate or sodium aluminate). Sodium aluminate is recommended since coagulants containing sulfates will add to the already high levels (often >250 mg/l) of sulfate in the feedwater.

Solids precipitated from the upflow clarifiers are collected in sludge sumps next to the clarifiers. Each sump contains two submersible vortex impeller pumps which pump the lime sludge to a 500,000 gallon concrete storage tank (3.5 day storage capacity). The storage tank is adjacent to a 2-story sludge dewatering building which contains two sludge filter presses on the top floor. The sludge is pumped from the sludge storage tank to filter presses through a combination of 2 centrifugal pumps and 2 progressive cavity pumps. The filter presses compress the sludge within a series of filter elements producing a filtrate (residual water) and a sludge cake (dewatered sludge). Filtrate is either disposed offsite or recycled to the front of the water treatment plant. The sludge cake is dropped through a bomb-bay door into dump trailers on the first floor. The dump trailers are either immediately hauled away offsite by large tractor trucks or moved to a temporary parking area for later removal. It is estimated that, at the maximum flow, approximately 108 yd^3 of sludge cake will be generated per day filling about three 40 yd^3 dump trailers. Since winter storms may prevent the access of trucks to the water treatment plant, a parking area for several days worth of dump trailers is recommended.

6.7 Backwash and Sludge Filtrate Recycling

The MF, reverse filtration, air scrubbing, filter press filtrate, and CIP wastewaters are recycled to the equalization tank. Recycling, and not discharge, is most appropriate at the

canal location since this is a dead end system and would not be able to handle a significant discharge. Wastewater from these processes at the river location could be recycled or discharged back into the river. If discharged into the river, a mechanical liquid/solids separation step is recommended (e.g. centrifuge) to remove suspended solids. A pH adjustment may be required for CIP wastes using lime or CIP wastes could be collected and disposed of separately and hauled off site.

6.8 Treatment Building

The treatment building houses the filtration and disinfection systems including the acid addition system, MF, UV, chlorine / chloramine systems, and chemical storage. It also houses the control room, offices, laboratory, reception area, break room, restrooms, and equipment storage.

Plant Structure Selection

The foundation for the WTP consists of a cast in place concrete slab, trenches, walls, stem walls, and footings to accommodate the superstructure frame, required piping, and water containment areas. The floor slab has been sized to support a 500 lb/ft^2 live load.

The superstructure consists of a welded steel rigid frame that has been sized to provide a clear span of 135 ft. This design eliminates the need for interior columns. The eave height of the superstructure is approximately 20 ft. The roof pitch is 4:12 and the total height of the rigid frame at the peak is approximately 45 ft. The rigid frames are spaced at 20 ft. center to center. A 20 ft. wide platform is suspended from the center of the roof to provide area for HVAC equipment. Monorail hoist can be provided and suspended from the rigid frames. Wide flange purlins have been sized to provide the roof support system between rigid frames. These purlins are W10x26 over the main portion of the building and are open web bar joist over the lower roof portions of the building. The lower roof sections of the building consist of typical wide flange columns and beams for the superstructure framing system.

All exterior and interior walls have been designed using concrete masonry units (CMU). All of these walls are designed as reinforced. Walls that are 20 ft. or less in height use an 8-inch deep CMU and walls higher that 20 ft. use a 12-inch deep CMU.

The roof of the structure consists of a corrugated metal decking with built up roof system. 10 ft. wide overhead doors have been provided for equipment access into and out of the building. No roof access hatches have been included in this estimate but can be provided if required.

Mechanical Equipment

The auxiliary mechanical systems in the water treatment plant and associated structures consist of gravity drainage, fire suppression, heating and ventilation, and interior domestic water, and sanitary waste plumbing.

The gravity drainage system consists of floor drains around the perimeter of the water treatment plant interior, restrooms and in floor areas where the leakage of water can be expected. Sloped cast iron hub and spigot soil pipe will collect waste water from the floor drains and will convey the water by gravity to the sanitary waste system

The fire suppression system in the water treatment plant consists of portable, multi-purpose, wall-mounted, dry chemical fire extinguishers and a wet pipe sprinkler system to extinguish fires in flammable materials and equipment in the interior of the plant. An automatic clean agent gas, life sustaining, fire extinguishing system is being provided for the control room. In order to provide fire suppression water of adequate pressure and capacity a fire pump will be installed.

The heating and ventilating system consists of fans, louvers, dampers, ductwork, unit heaters, instrumentation, controls and accessories. This system provides ventilation in accordance with ASHRAE standards for the interior of the water treatment plant and various associated vaults and process buildings. These associated vaults and buildings consist of the lime slaking building, sludge dewatering building, coagulant injection vault, sludge sump vault dry wells, upflow clarifier valve vaults and recycle water pump vault. Heaters provide warmth to the interior of all structures and prevent freezing during the winter months. These could be gas or electric; the availability of gas was not investigated. Operation of the plant and associated structures occurs with outdoor temperature extremes from less than 0 degrees to over 100 degrees Fahrenheit. Air conditioning systems provide a suitable air environment for control/communication rooms and office/administration areas.

Domestic and sanitary waste plumbing systems are provided for the men's and women's restrooms in accordance with the International Plumbing Code and state and local regulations. The various laboratories are also provided with plumbing systems that consist of the required water supply fixtures and disposal waste product collection equipment.

A 1-ton monorail hoist is provided for maintenance of the MF train feedwater pumps. A 1-1/2-ton monorail hoist is provided for maintenance and replacement of the chorine tanks in the chlorine storage room.

The workshop is provided with a drill press, pedestal grinder, welder, hydraulic press, belt/disk sander, metal band saw in addition to work benches and storage cabinets.

An engine generator set is provided on the exterior of the building to provide auxiliary backup power for portions of the building heating, ventilating and lighting systems in addition to the fire suppression system in the event of primary power failure.

6.9 Product Water Pump Station

Plant Structure Selection

The product water pumping plant is located at the top end of the clearwell in a pre-engineered metal building. The system is similar in design to the intake pumping plant. See

section 5 – B for a detailed description. The product pumping plant flow and head possibilities are shown in **table 6.1**.

Alternative	Flow (cfs)	WTP Product Water Elevation (ft.)	TDH (ft)	Pump HP	Downstream Pressure (psi)
GDU Import to Sheyenne River	78	1900	351	3106	149
	120	1900	346	4711	147
GDU Import Pipeline	160	1900	320	5809	136
	202	1900	316	7253	134
GDU Water Supply Replacement Pipeline	341	1900	350	13553	149
	410	1900	351	16341	149

Table 6.1: McClusky Canal product water pumping plant flow and head possibilities

Alternative	Flow (cfs)	WTP Product Water Elevation (ft.)	TDH (ft)	Downstream Pressure (psi)
Missouri River Import to Red River Valley	44	1772	98	43
	63	1772	98	43

TDH was calculated using the difference between the River to Finished Point TDH of 275 ft. from the River to WTP TDH of 177 ft.

Table 6.2: Missouri River product water pumping plant flow and head possibilities

7.0 Cost Assumptions

The Appraisal level cost estimates prepared for this report were generated using industry-wide accepted cost estimate methodology, standards and practices. Appraisal level cost estimates, which are intended for planning and preliminary budgetary purposes, were developed from approximate quantities, design data, and preliminary general designs and drawings.

Pricing sources include manufacturer's quotes and catalog list prices, published cost estimating guides, such as RSMeans, and Reclamation's historical costs databases and cost curves. Where historical data were used, the prices are indexed to January 2005 using the Reclamation Construction Cost Trends as a basis. Labor rates used are, at a minimum, those published in the most recent Davis-Bacon decision for the area.

It is assumed that the contract will be issued under full and open bidding conditions and that it will be awarded to a civil construction firm (prime contractor) with subcontractors utilized for the electrical, mechanical and other specialty work. For these items, appropriate prime contractor overhead and profit mark-ups were added.

Appraisal cost estimates are also for the purpose of determining whether more detailed investigations of this project are justified. ***Appraisal cost estimates are not suitable for requesting authorization or construction fund appropriations from Congress.*** These estimates are normally used as an aid in selecting the most economical plan by comparing alternative features such as intake sight, pipeline route, treatment plant type, etc. General cost factors and assumption can be found in **attachment E**.

Operational and maintenance (O&M) unit costs were obtained from a local chemical supplier 30 miles from the McClusky Canal site and other sources (**Table 7.1**). Costs are assumed to be the same for the Missouri River site. O&M costs were generated using the WT Cost program incorporating local chemical costs. Dechlorination facilities are not included in the cost.

Item	Cost	Units	Source
Lime – quicklime	$110.00	Per ton	Hawkins
Acid – H_2SO_4	$0.1095	per lb	Hawkins
Coagulant – $FeCl_3$	$0.1095	per lb	Hawkins
Coagulant – $FeSO_4$	$0.087	per lb	Hawkins
Scale inhibitor	$11.82	per gal.	Recent quote
Chlorine gas	$613.00	per 1 ton cylinder	Hawkins
Ammonia – Anhydrous	$0.48	per lb.	Hawkins
Membrane cleaning solution	$0.02	per 1000 gal.	Recent quote
Sodium Aluminate	$0.25	per lb.	Hawkins
MF Membrane replacement costs (14% per year)	$700	per module	Recent quote
NF membrane replacement costs (20% per year)	$650	per membrane	Recent quote
Employee	$80,000	Per year	TSC D8230 / D8170
Electricity	$0.058	per KWhr	Capital Electric Coop

Ref: (Hawkins, 2005) – Delivered cost to Canal site
Ref: (Capital Electric, 2005) Additional costs include $23 monthly service fee + capacity charge of $8 per KVA capacity over 10 KVA.

Table 7.1: Cost assumptions

Costs presented are broken down into two categories (**Table 7.2**):

1) "TSC sub-total"
2) "TSC total"

	Intake	Water Treatment Plant
TSC Developed Costs	Vendor Costs	Vendor Costs
	Installation	Installation
	Mobilization (5%)	Mobilization (5%)
	Unlisted (5%)	Unlisted (10%)
	TSC Subtotal	TSC Subtotal
TSC & DKAO Developed Costs	Unlisted (5%)	Unlisted (5%)
	Contingencies (25%)	Contingencies (25%)
	Non-Contract Costs (25%)	Non-Contract Costs (25%)
	TSC Total	TSC Total

Table 7.2: Cost components for TSC Sub-Total and Total costs

The TSC subtotal costs are to be used in the larger set of costs developed by the DKAO in the overall RRVWSP. This cost includes some of the unlisted items not accounted for by the DKAO and mobilization. The TSC total cost or "Construction Cost" includes additional unlisted items, contingencies and non contract costs used by the TSC and DKAO.

8.0 Cost Curves

The multitude of treatment system sizes and types do not allow for individual designs and individual estimates due to time and monetary constraints at this point in the evaluation process. Therefore cost curves were developed and models were used to estimate the costs (**Attachment G**). The cost models were calibrated by comparing their result to detailed Appraisal designs for the intake pumping plants and a water treatment plant.

8.1 Intake Pumping Plant

McClusky Canal

Intake pumping plant models have been developed by Reclamation for open water intake pumping plants. These cost models are based on costs from previous design projects which have been plotted and an equation developed for the best fit curve. They are based only on flow and head. Due to their basic design, it was determined that two points would be needed to calibrate the cost models. The flows chosen were 128 cfs and 340 cfs which were near the lower and upper end flow rates in the flow matrix. The results of comparing the model result to two design points showed good correlation. The adjusted model was close enough to a linear relationship at the flow rates for this project.

O&M costs were generated using a basic internal Reclamation cost model that incorporated power costs, labor, and pump maintenance.

Missouri River

A cost model does not exist for horizontal collector wells. In addition, the Missouri River option only has two flow rates of 44.1 cfs and 63.0 cfs, so both were used in the design and cost analysis.

O&M costs were generated using a basic internal Reclamation cost model that incorporated power costs, labor, and pump maintenance.

8.2 Water Treatment Plant

The water treatment plant cost model called WT Cost, is based on 1978 EPA treatment system cost curves adjusted over the years with design improvements. These cost curves were developed by Reclamation and further developed into this commercial cost model by Irvine Moch and Assoc. Costs for treatment technologies that have evolved since 1978 have been added. Costs are update with ENR indices to January 2005 costs.

The cost model was calibrated by comparing the 77.4 MGD (119.8 cfs) Appraisal level design point for lime softening to the cost curve result. A mathematical relationship was developed between the two points adjusted to match the Appraisal level design point. The model showed a linear relationship between flow and capital cost and a non-linear relationship between flow and O&M costs. The O&M costs developed from the model were

not adjusted because of the limited number of input variables and current costs were obtained for these variables. O&M and capital cost equations were developed for each of the four treatment alternatives and were to estimate costs for the flow matrix

9.0 Cost Results

The results of the detailed Appraisal designs are shown in **table 9.1**.

	Flow (cfs)	TSC Subtotal Cost	TSC Total Cost
Missouri River Intake	44	$10,805,531	$17,500,000
	63	$15,769,161	$26,000,000
McClusky Canal Intake	128	$9,005,240	$15,000,000
	340	$14,991,703	$24,000,000
Lime Softening WTP	128	$75,238,640	$125,000,000

Table 9.1: Summary of costs from Appraisal designs

A detailed breakdown of costs are presented in **attachment F**. The cost curves are presented in **attachment G**. The results of the calibrated water treatment plant cost model generated capital costs are shown in **table 9.2**. **Table 9.3** shows the intake pumping plant capital cost curve results. The TSC Sub-Total costs will be used by the DKAO in the project master cost table. The cost model generated O&M costs are shown in **table 9.4** and **table 9.5**.

Capital Costs		Treatment Alternative							
		A – Sedimentation		C - MF		E1 – Lime Softening		E2 - NF	
	Project Alternative	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2
Peak Product Flow (cfs)	GDU Import to Sheyenne River	77.7	119.8	77.7	119.8	77.7	119.8 [1]		
	Missouri River Import to Red River Valley	44.1	63.0	44.1	63.0	44.1	63.0	44.1	63.0
	GDU Import Pipeline	159.8	201.1	159.8	201.1	159.8	201.1		
	GDU Water Supply Replacement Pipeline	340.2	410.5	340.2	410.5	340.2	410.5		
TSC Sub-Total Costs	GDU Import to Sheyenne River	$18,073,484	$27,620,796	$44,647,295	$58,001,878	$55,620,633	$74,920,872		
	Missouri River Import to Red River Valley	$10,453,777	$14,739,862	$33,989,005	$39,984,293	$40,217,116	$48,881,594	$28,485,857	$41,979,795
	GDU Import Pipeline	$36,691,876	$46,057,766	$70,690,318	$83,791,132	$93,258,392	$112,191,882		
	GDU Water Supply Replacement Pipeline	$77,602,446	$93,544,870	$127,915,182	$150,215,116	$175,960,608	$208,188,799		
TSC Total Costs	GDU Import to Sheyenne River	$30,000,000	$45,000,000	$74,000,000	$95,000,000	$91,000,000	$123,000,000		
	Missouri River Import to Red River Valley	$18,000,000	$24,000,000	$56,000,000	$65,000,000	$66,000,000	$80,000,000	$46,000,000	$69,000,000
	GDU Import Pipeline	$60,000,000	$75,000,000	$116,000,000	$138,000,000	$153,000,000	$184,000,000		
	GDU Water Supply Replacement Pipeline	$128,000,000	$154,000,000	$210,000,000	$246,000,000	$289,000,000	$341,000,000		

GDU = Garrison Diversion Unit (canal)
[1] Detailed Lime Softening Treatment System design used 77.4 MGD

Table 9.2: Water treatment plant flow and capital costs

Capital Costs		Treatment Alternative following the Intake Pumping Plant							
		A – Sedimentation		C - MF		E1 – Lime Softening		E2 - NF	
	Project Alternative	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2
Peak Product Flow (cfs)	GDU Import to Sheyenne River	77.7	119.8	77.7	119.8	77.7	119.8		
	Missouri River Import to Red River Valley	44.1	63.0	44.1	63.0	44.1	63.0	44.1	63.0
	GDU Import Pipeline	159.8	201.1	159.8	201.1	159.8	201.1		
	GDU Water Supply Replacement Pipeline	340.2	410.5	340.2	410.5	340.2	410.5		
Peak Intake Flow (cfs)	GDU Import to Sheyenne River	78.5	121.0	81.8	126.1	82.6	127.3		
	Missouri River Import to Red River Valley	44.5	63.6	46.4	66.3	46.9	67.0	51.3	73.4
	GDU Import Pipeline	161.4	203.2	168.2	211.7	169.9	213.9		
	GDU Water Supply Replacement Pipeline	343.7	414.6	358.1	432.1	361.8	436.4		
TSC Sub-Total Costs	GDU Import to Sheyenne River	$7,606,205	$8,806,599	$7,699,486	$8,950,423	$7,722,806	$8,986,379		
	Missouri River Import to Red River Valley	$10,947,007	$15,928,116	$11,436,952	$16,627,792	$11,559,438	$16,802,711	$12,706,155	$18,474,157
	GDU Import Pipeline	$9,949,621	$11,127,949	$10,141,572	$11,369,514	$10,189,560	$11,429,905		
	GDU Water Supply Replacement Pipeline	$15,095,427	$17,099,026	$15,504,044	$17,592,005	$15,606,198	$17,715,249		
TSC Total Costs	GDU Import to Sheyenne River	$13,000,000	$15,000,000	$13,000,000	$15,000,000	$13,000,000	$15,000,000		
	Missouri River Import to Red River Valley	$18,000,000	$26,000,000	$19,000,000	$28,000,000	$19,000,000	$28,000,000	$21,000,000	$30,000,000
	GDU Import Pipeline	$16,000,000	$19,000,000	$16,000,000	$19,000,000	$16,000,000	$19,000,000		
	GDU Water Supply Replacement Pipeline	$25,000,000	$28,000,000	$25,000,000	$29,000,000	$25,000,000	$29,000,000		

Table 9.3: Intake pumping plant flow and capital costs

O&M Costs		Treatment Alternative							
		A – Sedimentation		C - MF		E1 – Lime Softening		E2 - NF	
	Project Alternative	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2
Peak Product Flow (cfs)	GDU Import to Sheyenne River	77.7	119.8	77.7	119.8	77.7	119.8		
	Missouri River Import to Red River Valley	44.1	63.0	44.1	63.0	44.1	63.0	44.1	63.0
	GDU Import Pipeline	159.8	201.1	159.8	201.1	159.8	201.1		
	GDU Water Supply Replacement Pipeline	340.2	410.5	340.2	410.5	340.2	410.5		
Average Product Flow (cfs)	GDU Import to Sheyenne River	22.9	34.1	22.9	34.1	22.9	34.1		
	Missouri River Import to Red River Valley	28.4	33.0	28.4	33.0	28.4	33.0	28.4	33.0
	GDU Import Pipeline	29.4	33.1	29.4	33.1	29.4	33.1		
	GDU Water Supply Replacement Pipeline	125.1	160.7	125.1	160.7	125.1	160.7		
O&M Costs	GDU Import to Sheyenne River	$1,719,000	$2,434,000	$2,995,000	$3,975,000	$4,724,000	$6,541,000		
	Missouri River Import to Red River Valley	$2,072,000	$2,363,000	$3,479,000	$3,878,000	$5,621,000	$6,361,000	$9,189,000	$11,301,000
	GDU Import Pipeline	$2,134,000	$2,372,000	$3,564,000	$3,890,000	$5,778,000	$6,384,000		
	GDU Water Supply Replacement Pipeline	$8,255,000	$10,533,000	$11,940,000	$15,059,000	$21,321,000	$27,108,000		
O&M Cost (per 1000 gal.)	GDU Import to Sheyenne River	$0.32	$0.30	$0.55	$0.49	$0.87	$0.81		
	Missouri River Import to Red River Valley	$0.31	$0.30	$0.52	$0.50	$0.84	$0.82	$1.37	$1.45
	GDU Import Pipeline	$0.31	$0.30	$0.51	$0.50	$0.83	$0.82		
	GDU Water Supply Replacement Pipeline	$0.28	$0.28	$0.40	$0.40	$0.72	$0.71		

GDU = Garrison Diversion Unit (canal)

Table 9.4: Water treatment plant flow and O&M costs

O&M Costs		Treatment Alternative following the Intake Pumping Plant							
		A – Sedimentation		C - MF		E1 – Lime Softening		E2 - NF	
	Project Alternative	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2	Scenario 1	Scenario 2
Peak Product Flow (cfs)	GDU Import to Sheyenne River	77.7	119.8	77.7	119.8	77.7	119.8		
	Missouri River Import to Red River Valley	44.1	63.0	44.1	63.0	44.1	63.0	44.1	63.0
	GDU Import Pipeline	159.8	201.1	159.8	201.1	159.8	201.1		
	GDU Water Supply Replacement Pipeline	340.2	410.5	340.2	410.5	340.2	410.5		
Average Intake Flow (cfs)	GDU Import to Sheyenne River	23.1	34.4	24.1	35.9	24.4	36.3		
	Missouri River Import to Red River Valley	28.7	33.3	29.9	34.7	30.2	35.1	33.1	38.4
	GDU Import Pipeline	29.7	33.5	30.9	34.9	31.3	35.2		
	GDU Water Supply Replacement Pipeline	126.3	162.3	131.6	169.1	133.0	170.8		
Costs	GDU Import to Sheyenne River	$279,000	$365,000	$286,000	$376,000	$288,000	$379,000		
	Missouri River Import to Red River Valley	$428,000	$479,000	$441,000	$494,000	$444,000	$498,000	$476,000	$534,000
	GDU Import Pipeline	$331,000	$359,000	$340,000	$370,000	$342,000	$373,000		
	GDU Water Supply Replacement Pipeline	$1,027,000	$1,270,000	$1,065,000	$1,317,000	$1,074,000	$1,329,000		
O&M Costs (per 1000 gal.)	GDU Import to Sheyenne River	$0.05	$0.04	$0.05	$0.04	$0.05	$0.04		
	Missouri River Import to Red River Valley	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06
	GDU Import Pipeline	$0.05	$0.05	$0.05	$0.04	$0.05	$0.04		
	GDU Water Supply Replacement Pipeline	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03		

Table 9.5: Intake pumping plant flow and O&M costs

10.0 References

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11.0 Attachments

Attachment A

Water Quality Data

Attachment A:
Water Quality Data

Last Update: 05/16/05

Last Full Regulation Check: 06/01/03

		Sampling Date	1990 - 2003	1990 - 2003	1969 - 2005[11]	2000 - 2004					
		Sampling Location	Lake Sakakawea	Lake Audubon	Missouri River @ Bismarck	Bismarck WTP (Treated)	Used for WTP Design	Used for WTP O&M	Red River		
WQ Type		Parameter	Units	MCL	MCLG	Secondary Limit				Reason for Sampling	Definition - Notes
Unregulated Constituents	General	pH	-	-	-	6.5 - 8.5	8.1 (7.1- 8.8)	8.4 (7.8 - 8.7)	8.2 (7.4 - 8.9)	8.9 (7.0 - 10.0)	8.4	8.4	7.0 - 7.6 *	Affects coagulation, DBPs, etc.	-
		Temperature	°C	-	-	-	10.8 (0.1 - 23.0)	12.5 (0.1 - 26.0)	8.9 (0.1 - 22.0)		0.1	10	1 - 28 *	Affects coagulation, DBPs, disinfection credit, etc	-
		Conductivity	µmhos/cm	-	-	-	500 - 810 *	869 - 1001 *	695 (670 - 722)		1000	800	600 - 1100 *	Correlates to TDS	-
		TSS	mg/L	-	-	-			30 (2 - 239)		100	30	130 (46-625) ***	Affects filter fouling, possible pathogen sites	Total suspended solids
		TDS (dissolved = 0.45 um)	mg/L	-	-	500	470 (342 - 805)	577 (444 - 690)	359 (262 - 454) **	277 (228 - 384)	650	550		Affects coagulation	Total Dissolved Solids (Inorganic salts, mainly: Ca^{2+}, Mg^{2+}, Na^{+}, K+, Cl-, HCO2, CO32-, SO42-, NO3-, + some dissolved organic matter)
		Alkalinity (total) [as $CaCO_3$]	mg/L	-	-	-	183 (144 - 305)	203 (158 - 245)	156 (120 - 188) **	62 (32 - 126)	240	190		Affects coagulation	Sum of HCO_3^-, CO_3^{2-}, OH^-, H^-
		Carbonate (CO_3^{-2})	mg/L	-	-	-			0 (0 - 0.8)		0	0		Affects coagulation	-
		Bicarbonate (HCO_3^-)	mg/L	-	-	-			188 (162 - 220)		220	188		Affects coagulation	-
		Hardness (total) [as $CaCO_3$]	mg/L	-	-	-	170 - 260 *	257 - 321 *	205 (140 - 230)**	109 (70 - 178)	300	250	200 - 330 *	Affects coagulation, aesthetic property, scaling	Sum of all multivalent metallic cations. Mainly Ca^{2+} & Mg^{2+}. Also Fe^{2+}, Mn^{2+},Al^{3+}, etc. <75 = soft, 75 - 150 = moderately hard, 150 - 300 = hard, >300 = very hard
		DOC (dissolved = 0.45 um)	mg/L	-	-	-			4 (2.4 - 15.0)		15	4		Indicator of pathogen removal, DBP formation, filter efficiency, etc.	Dissolved organic carbon
		TOC	mg/L	-	-	-	9.0 *	5.3 *	4.6 (2.1 - 17.0)		8	6	7.5 *	Indicator of pathogen removal, DBP formation, filter efficiency, etc.	Total organic carbon
		UV_{254}	1/cm	-	-	-								Indicator of DOC type and DBP formation	UV absorbance at 254 nm
		Color	color units	-	-	15			16 (7-222) **		20	16		General indicator of Iron and/or organic content, aesthetic requirement	-
		Odor	TON	-	-	3								Aesthetic property	-
		Foaming Agents	mg/L	-	-	0.5									-
		Corrosivity	-	-	-	non corr.								Infrastructure effects distribution system deterioration)	-
		Chemical Oxygen Demand (COD)	mg/L	-	-	-									-
		Silica (SiO_2) (total)	mg/L	-	-	-								Causing permanent fouling of membranes	-
		Silica (SiO_2) (reactive)	mg/L	-	-	-								Causing permanent fouling of membranes	-
		Silica (SiO_2) (dissolved)	mg/L	-	-	-			7.3 (2.7 - 21)		21	7.3		Causing permanent fouling of membranes	-
		Silt Density Index (SDI)	-	-	-	-								Indicator of membrane fouling potential in ####### membranes	-
	Dissolved Gases	Oxygen (O_2)	mg/L	-	-	-			10.7 (7.8 - 13.4)						-
		Ammonia (NH_3)	mg/L	-	-	-	0.14 (0.02 - 0.33)	0.11 (0.02 - 0.24)	0.1 (0 - 0.6)		0.14	0.13			
		Carbon Dioxide (CO_2)	mg/L	-	-	-									-
		Hydrogen Sulfide (H_2S)	mg/L	-	-	-									
	Cations (dissolved - 0.45 um) total	Iron (Fe)	mg/L	-	-	0.3								Aesthetic property (taste, staining of fixtures)	-
		Manganese (Mn)	mg/L	-	-	0.05			0.04 (0.010 - 0.07)		0.07	0.04		Aesthetic property (taste, staining of clothes), possible health effects	
		Phosphorous (total) (P)	mg/L	-	-	-									Sum of orthophosphate, polyphosphate, organic phosphate
	Cations (dissolved - 0.45 um)	Ammonium (NH_4^+)	mg/L	-											
		Aluminum (Al^{+3})	mg/L	-	-	0.05 to 0.2			30 (10 - 220)			30			-
		Boron (B)	mg/L												
		Calcium (Ca^{+2})	mg/L	-	-	-	54 (44-84)	42 (31 - 47)	53 (30 - 61)		60	50	44 - 63 *	Affects coagulation, aesthetic property, scaling	-
		Magnesium (Mg^{+2})	mg/L	-	-	-	23 (18 - 35)	34 (25 - 40)	21 (13 - 26)		35	30	20 - 40 *	Affects coagulation, aesthetic property, scaling	-
		Iron (Fe^{+2})	mg/L	-	-	-								Aesthetic property (taste, staining of fixtures)	-
		Manganese (Mn^{+2})	mg/L	-	-	-			0.012 (0.01 - 0.03)		0.03	0.012		Aesthetic property (taste, staining of clothes), possible health effects	
		Nickel (Ni)	mg/L	-	-	-								Potential Health effects (nervous system, liver, hear, dermal), formerly regulated	-
		Phosphorous (total) (P)	mg/L	-	-	-			0.0 (0.0 - 0.2)		0	0			Sum of orthophosphate, polyphosphate, organic phosphate
		Potassium (K^+)	mg/L	-	-	-	4.4 (2.4 - 7.1)	5.6 (1.3 - 8.4)	4.1 (2.7 - 6.9)		7	5			-
		Silver (Ag)	mg/L	-	-	0.10									-
		Sodium (Na^+)	mg/L	-	-	-	69 (25 - 160)	104 (76 - 130)	58.5 (38 - 80)		130	100	16 - 30 *	Aesthetic property (taste)	-
		Strontium (Sr^{+2})	mg/L	-	-	-									-
		Zinc (Zn^{+2})	mg/L	-	-	5			25 (20 - 30)		30	25		Aesthetic property (taste)	-
	Anions (dissolved - 0.45 um)	Bromide (Br^-)	mg/L	-	-	-			0.1 (0 - 0.1)		0.1	0.1		Effects brominated DBP formation	-
		Chloride (Cl^-)	mg/L	-	-	250	11 (7 - 16)	15 (12 - 18)	9.5 (3.1 - 15)		18	12	8 - 30 *		-
		Orthophosphate (PO_4^{-3})	mg/L	-	-	-	0.03 (0.01 - 0.14)	0.03 (0.01 - 0.09)	0.0 (0.0 - 0.3)		0.1	0.3		Indicator of nutrients in lake	PO_4^{3-}, HPO_4^{2-}, $H_2PO_4^-$, H_3PO_4
		Sulfate (SO_4^{-2})	mg/L	-	-	250	199 (128 - 341)	255 (199 - 302)	170 (100 - 160)		300	200	50 - 200 *	Aesthetic property (taste), health effects (laxative)	-
		Sulfide	mg/L	-	-	-									-
ntaminants	Inorganic (dissolved - 0.45 um)	Antimony (Sb)	mg/L	0.006	0.006	-								Health effects (decreased longevity, blood)	
		Arsenic (As)	mg/L	0.01	0	-			0.002 (0.001 - 0.005)		0.005	0.002		Health effects (carcinogen, cardio, dermal)	-
		As^{+5} (arsenate)	mg/L	-	-	-								Health effects (carcinogen, cardio, dermal), more treatable form of arsenic	
		As^{+3} (arsenite)	mg/L	-	-	-								Health effects (carcinogen, cardio, dermal), greater carcinogen, more difficult to treat	
		Asbestos	MFL	7	7	-								Health effects (benign intestinal polyps)	-
		Barium (Ba)	mg/L	2	2	-								Health effects (circulatory, gastrointestinal)	-
		Beryllium (Be)	mg/L	0.004	0.004	-								Health effects (carcinogen, bone, lung)	-
		Cadmium (Cd)	mg/L	0.005	0.005	-								Health effects (liver, kidney, bone, circulatory)	-
		Chromium (total) (Cr)	mg/L	0.1	0.1	-								Health effects (liver, kidney, circulatory)	-
		Chromium VI	mg/L	-	-	-									
		Copper (Cu)	mg/L	1.3 [A,8]	1.3	1.0								Health effects (gastrointestinal, liver, kidney)	-
		Cyanide (free) (CN^-)	mg/L	0.2	0.2	-								Health effects (thyroid, nervous system)	-
		Fluoride (F^-)	mg/L	4.0	4.0	2.0			0.5 (0.2 - 0.7)		0.2	0.5		Health effects (skeletal), Beneficial for teeth (below a certain level)	-
		Lead (Pb)	mg/L	0.015 [A,8]	0	-								Health effects (carcinogen, kidney, nervous system)	
		Mercury (inorganic) (Hg)	mg/L	0.002	0.002	-			0.0002 (0.0001 - 0.0012)		0.0012	0.0002		Health effects (kidney)	-
		Nitrate (NO^{-3}) (as N)	mg/L	10	10	-	0.1 (0.1 - 0.3)	0.2 (0.1 - 0.3)	0.2 (0 - 0.8)		0.3	0.2		Health effects in infants (cynanosis)	-
		Nitrite (NO^{-2}) (as N)	mg/L	1	1	-	ND = 0.02 (ND - 0.02)	ND = 0.02 (ND - ND)	0.0 (0 - 0)		0	0		Health effects in infants (cynanosis), Indicator of nutrients in lake	-
		Selenium (Se)	mg/L	0.05	0.05	-			0.001 (0.001 - 0.003)		0.003	0.001		Health effects (nervous system, kidney, liver, circulatory)	-
		Se^{+4}	mg/L												
		Se^{+6}	mg/L												
		Thallium (Tl)	mg/L	0.002	0.0005	-								Health effects (kidney, liver, brain, gastrointestinal)	-

Regulated Primary Co	Radionuclides	Combined Radium (Ra-226 & Ra-228)	pCi/L	5 [7]	0	-			0.1 (226 only)		0.1	0.1		Health effects (carcinogen)	-
		Gross Alpha (excluding Ra & U)	pCi/L	15 [7]	0	-								Health effects (carcinogen)	-
		Beta Particle & Photon Emitters	mrem/year	4 [7,10]	0	-								Health effects (carcinogen)	-
		Uranium	g/L / pCi/L	30 / 20	0	-								Health effects (carcinogen, kidney)	-
	Disinfect - ants	Chloramines (as Cl_2)	mg/L	4	4	-								Health effects (eye/nose irriation, stomach discomfort, anemia)	-
		Chlorine (free CL_2) (as Cl_2)	mg/L	4	4	-				2.2 (1.5 - 3.2)				Health effects	-
		Chlorine dioxide (as ClO_2)	mg/L	0.8	0.8	-								Health effects	
	DBP	Bromate	mg/L	0.010	0	-								Health effects (carcinogen)	mainly a concern with ozone systems
		Chlorite	mg/L	1.0	0.8	-								Health effects (anemia, nervous system)	only for chlorine dioxide systems
		HAAs (5 species)	mg/L	0.060 [6]	-	-								Health effects (carcinogen)	usually not a concern with chlorine dioxide systems
		DCAA	mg/L	-	0	-								-	usually not a concern with chlorine dioxide systems
		TCAA	mg/L	-	0.3	-								-	usually not a concern with chlorine dioxide systems
		HAAs (9 species)	mg/L	-	-	-								Health effects (carcinogen)	usually not a concern with chlorine dioxide systems
		THMs (4 species)	mg/L	0.080 [6,7]	-	-								Health effects (carcinogen, nervous system, kidney)	usually not a concern with chlorine dioxide systems
		BDCM	mg/L	-	0	-								-	usually not a concern with chlorine dioxide systems
		Bromoform	mg/L	-	0	-								-	usually not a concern with chlorine dioxide systems
		DBCM	mg/L	-	0.06	-								-	usually not a concern with chlorine dioxide systems
	Biological & Fouling Potential	Turbidity	NTU	0.3 [3]	-	-	0.2 - 10 *	2 - 7 *	6.3 (1.3 - 111) **	0.11 (0.05 - 0.37)	80	7	100 (31 - 820) ***	Indicator of pathgen removal, filter efficiency	-
		Particle Counts		-	-	-								Indicator of pathgen removal, filter efficiency	-
		Cryptosporidium	% removal	99.99 [3]	100	-								Regulated Pathogen	
		Giardia	% removal	99.9	100	-								Regulated Pathogen	-
		Heterotrophic Plate Count	Colonies/L	500 [3]	-	-								Indicator of the variety of bacteria	-
		Legionella		[3]	0	-								Health effects (Legionnaire's Disease)	-
		Total Coliforms (incl fecal colif. & E.Coli)	positive	5% [4]	0	-			200 (10 - 4000)		3000	200		Indicator of the potentially harmful bacteria	-

A = action level
MFL = million fibers per liter
TON = threshold odor number
# (# - #) = average or median value (minimum value - maximum value)

Calculated Parameters

	LSI	mg/L	-		-								Indication of membrane CaCO3 scaling potential, more accurate than Stiff & Davis for fresh water	Finished water LSI should be ~ +0.2 to 0.3 so obtain a little scale on pipes in distribution system
	Stiff & Davis	mg/L	-		-								Indication of membrane particulate fouling potential, more accurate than LSI for seawater	

Footnote

#	Footnote
1	**Maximum Contaminant Level (MCL)**- The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
	Maximum Contaminant Level Goal (MCLG)- The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
	Maximum Residual Disinfectant Level (MRDL)- The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
	Maximum Residual Disinfectant Level Goal (MRDLG)- The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
	Treatment Technique- A required process intended to reduce the level of a contaminant in drinking water.
2	Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million.
3	EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:
	Cryptosporidium (as of1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99% removal.
	Giardia lamblia: 99.9% removal/inactivation
	Viruses: 99.99% removal/inactivation
	Legionella: No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated *Legionella* will also be controlled.
	Turbidity: As of January 1, 2002, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month. Previous rule: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month.
	HPC: No more than 500 bacterial colonies per milliliter.
	Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, Cryptosporidium removal requirements, updated watershed control requirements for unfiltered systems).
	Filter Backwash Recycling; The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.
4	more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli* if two consecutive TC-positive samples, and one is also positive for *E.coli* fecal coliforms, system has an acute MCL violation.
5	Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.
6	Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:
	Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L). Chloroform is regulated with this group but has no MCLG.
	Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L). Monochloroacetic acid, bromoacetic acid, and dibromoacetic acid are regulated with this group but have no MCLGs.
7	MCLGs were not established before the 1986 Amendments to the Safe Drinking Water Act. Therefore, there is no MCLG for this contaminant.
8	Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.
9	Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when acrylamide and epichlorohydrin are used in drinking water systems, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows:
	Acrylamide = 0.05% dosed at 1 mg/L (or equivalent)
	Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent)
10	4 mrem/year is limit (a dose) which is approximated by 50 piC/L (an activity)
11	USGS data sporadic over sampling period with some parameters sampled more than others
*	data obtained directly from report "Design Criteria, Red River Valley Water Supply Project, Needs and Options Study Element" by MWH Aprill 2004
**	2000 - 2004 USGS data
***	2001 - 2003 USGS data, sporadic sampling for Red River at Fargo

Attachment B

Log Reduction Credits Given by Treatment Type

Attachment B

Log Reduction Credits Given by Treatment Type

	Treatment Type	Mfg.	Giardia	Virus	Crypto [1]	Notes [2]
	Removal/Inactivation Credit Req'd		**3 log**	**4 log**	**2.0-4.5 log**	
Particle Removal	Watershed control program	-			0.5	C: Approved by the state with monitoring
	UF[4]	Zenon	4.0	2.0, 3.5	4.0	Credit is given by state following removal efficiency demonstration V: Example has 2.0 for 500 series membrane, 3.5 for 1000 series membrane
	MF[4]	US Filter	4.0	0.5	4.0	Credit is given by state following removal efficiency demonstration V: Example for PVDF membrane only
	NF [4]	Desal	3.0	2.0	5.0	Credit is given by state following removal efficiency demonstration
	RO	-				Credit is given by state following removal efficiency demonstration
	Cartridge Filter	-			2.0	Credit is given by state following removal efficiency demonstration of 3.0 log removal
	Bag Filter	-			1.0	Credit is given by state following removal efficiency demonstration of 2.0 log removal
	Coagulation & Sedimentation	-	See "Conventional Media Filtration"	See "Conventional Media Filtration"	See "Conventional Media Filtration"	
	Coagulation & Pre-Sedimentation	-	0.5 [6]	0.5 [6]	0.5	C: For new basins only
	Conventional Media Filtration (Coag., Sed, Media Filt.)	-	2.5	2.0	2.0	C: 3.0 log credit given if additional treatment is required for Cryptosporidium
	Media Filter	-	See "Conventional Media Filtration" or "Direct Filtration"	See "Conventional Media Filtration" or "Direct Filtration"	0.5, 1.0	C: 0.5 for combined filter effluent <0.15 NTU in 95%, 1.0 for individual filter <0.1 NTU in 95%
	Media Filter 2nd Stage	-			0.5	C: Rapid Sand, Dual Media, GAC. 1st stage must have coag. & filtration
	Direct Filtration	-	2.0	1.0	0.5, 1.0	C: 0.5 for combined filter effluent <0.15 NTU in 95%, 1.0 for individual filter <0.1 NTU in 95%
	Diatomaceous Earth	-	2.0	1.0	2.0	
	Lime Softening	-	2.5	2.0	0	C: additional credit over coagulation /sedimentation for two stage lime softening
	Lime Softening 2 Stage	-			0.5	
	River Bank Filter	-			0.5, 1.0	C: 0.5 log for 25 ft. setback, 1.0 log for 50 ft.
	Slow Sand Filter	-	2.0	2.0	3.0, 2.5	C: 3.0 log for primary fitler, 2.5 log as secondary filter
Disinfection [3]	Chlorine	-	0.5 – 3.0+	0.5 – 4.0+	0	Depends on CT (concentration & time)
	Chloramines	-	0.5 – 3.0+	0.5 – 4.0+	0	Depends on CT (concentration & time)
	Chlorine Dioxide	-	0.5 – 3.0+	0.5 – 4.0+	0.5, 1.0	Depends on CT (concentration & time)
	Ozone	-	0.5 – 3.0+	0.5 – 4.0+	0.5 - 2.0	Depends on CT (concentration & time)
	UV	-	0.5 – 3.0+	0.5 – 4.0+	0.5 - 3.0	Depends on CT (concentration & time)

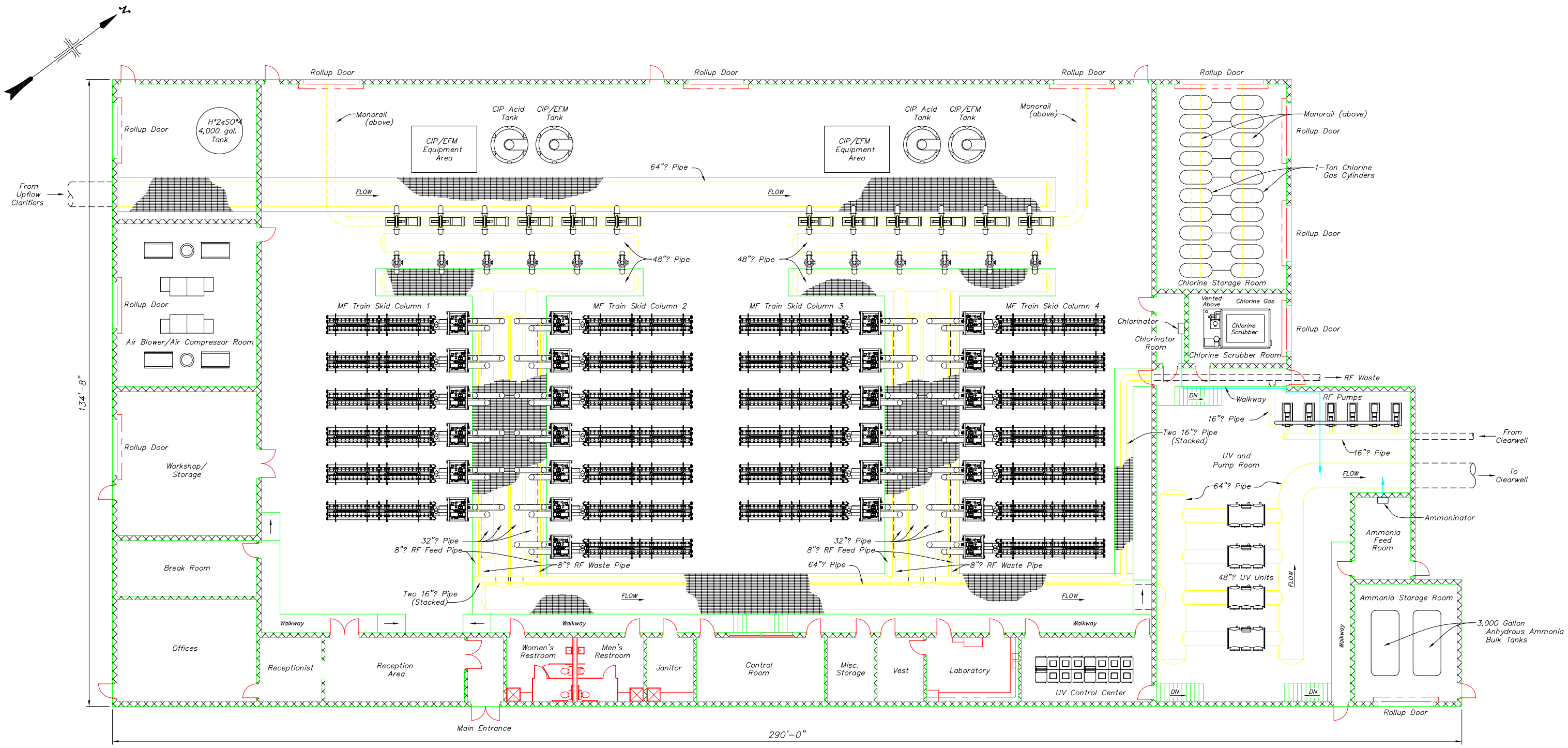
Note:
- Blank spaces indicate values that may exist, but have not been obtained to date.
- In many cases, there are nuances such as source water monitoring, demonstration of removal & inactivation, etc. that are not shown here, but are required for log reduction credit.

[1] Cryptosporidium credit required depends on amount of Cryptosporidium present in the source water and type of treatment. These values were obtained from the LT2ESWTR which has not been finalized, but is expected to be finalized in 2005.
[2] G = Giardia, V = Virus, C = Cryptosporidium
[3] Disinfection credit given for G & C depends on dose of disinfectant and contact time
[4] Example using California DHS approved log removal credit
[5] Under the proposed LT2ESWTR, unfiltered systems require two disinfectants with each disinfectant meeting the full inactivation requirements for at least one of the three biological contaminants regulated here.
[6] Not explicitly stated in any rule, but can be implied from similarities to Cryptosporidium (for Giardia) and in SWTR 1991 USEPA guidance document. This is a conservative approach.

Attachment C

Additional Figures and Drawings

DRAWING 1



FLOOR PLAN

1 0 5 10 15 20 25
SCALE OF FEET

LEGEND/ABBREVIATIONS

RF – Reverse Filtration
MF – Microfiltration
UV – Ultraviolet
H*2«SO*4« – Sulfuric Acid
CIP – Clean In Place
EFM – Enhanced Flux Maintenence
? – Pipe Diameter

– Indicates Ramp

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BUREAU OF RECLAMATION
RED RIVER VALLEY WATER SUPPLY PROJECT
NORTH DAKOTA

RED RIVER APPRAISAL DESIGN

WATER TREATMENT SYSTEM DESIGN

FLOOR PLAN

DESIGNED S. DUNDORF/K. YOKOYAMA CHECKED R.A. JURENKA
DRAWN R.D. RODRIGUEZ TECH. APPR.
APPROVED
WATER TREATMENT ENGINEERING AND RESEARCH

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CADD FILENAME DRAWING1.DWG
DENVER, COLORADO FEBRUARY 23, 2005
DRAWING 1

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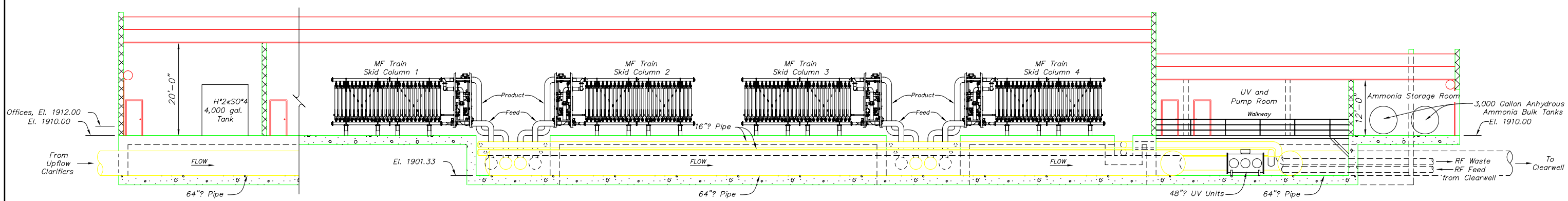
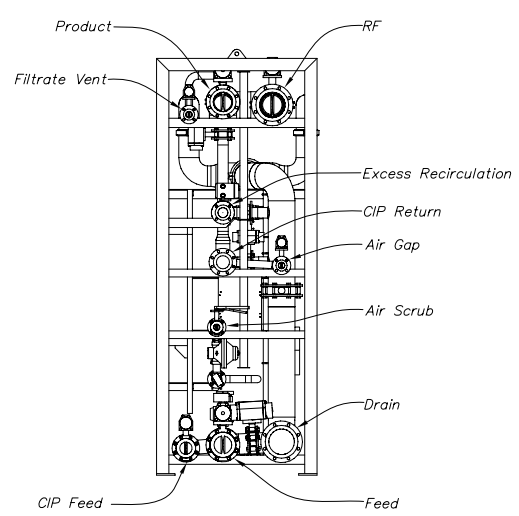
APRIL 5, 2005 07:32

DRAWING 2



TYPICAL LONGITUDINAL SECTION

10 5 10 15 20 25
SCALE OF FEET



TYPICAL SKID DETAIL
(NO SCALE)

LEGEND/ABBREVIATIONS

RF – Reverse Filtration
MF – Microfiltration
UV – Ultraviolet
H*2«SO*4« – Sulfuric Acid
CIP – Clean In Place
? – Pipe Diameter

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RED RIVER VALLEY WATER SUPPLY PROJECT
NORTH DAKOTA

RED RIVER APPRAISAL DESIGN
WATER TREATMENT SYSTEM DESIGN
TYPICAL LONGITUDINAL SECTION

DESIGNED S. DUNDORF/K. YOKOYAMA CHECKED R.A. JURENKA
DRAWN R.D. RODRIGUEZ TECH. APPR.
APPROVED
WATER TREATMENT ENGINEERING AND RESEARCH

CADD SYSTEM AutoCAD Rel. 16.0s
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DENVER, COLORADO FEBRUARY 23, 2005
DRAWING 2

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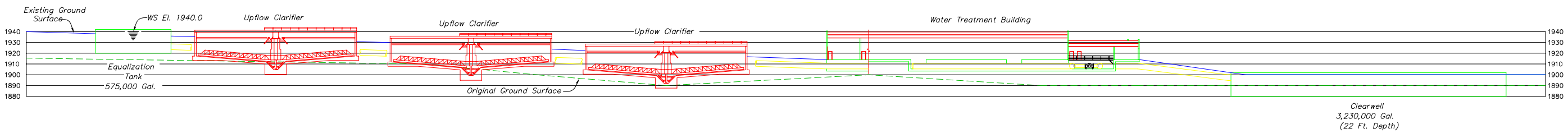
DRAWING 3



PROFILE

50 0 50 100 150
SCALE OF FEET

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RED RIVER VALLEY WATER SUPPLY PROJECT
NORTH DAKOTA

RED RIVER APPRAISAL DESIGN

WATER TREATMENT SYSTEM DESIGN

PROFILE

DESIGNED S. DUNDORF/K. YOKOYAMA CHECKED R.A. JURENKA
DRAWN R.D. RODRIGUEZ TECH. APPR.
APPROVED
WATER TREATMENT ENGINEERING AND RESEARCH

CADD SYSTEM AutoCAD Rel. 16.0s
DENVER, COLORADO FEBRUARY 23, 2005

CADD FILENAME DRAWING4.DWG
DRAWING 3

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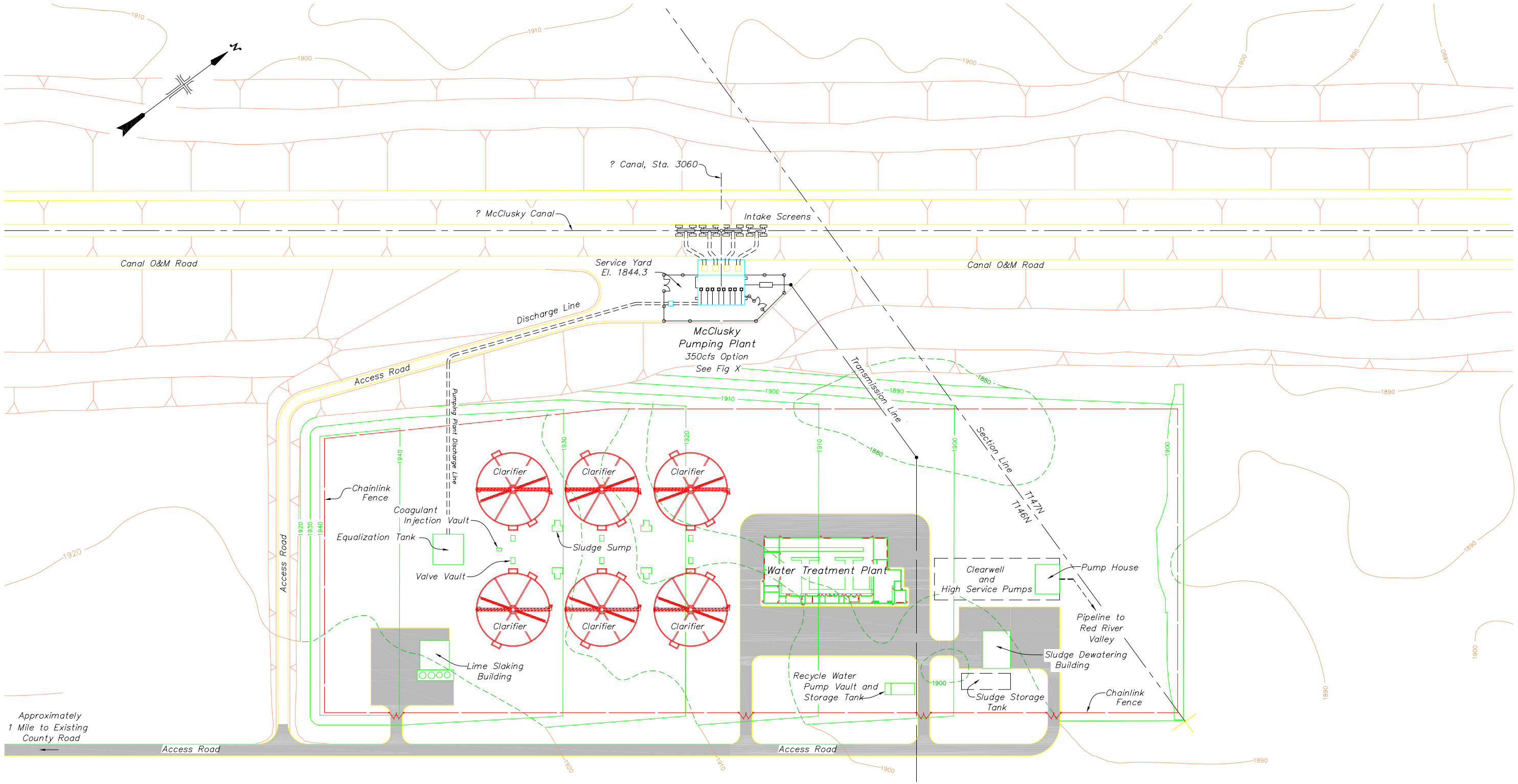
DRAWING 4



SITE PLAN

100 0 100 200 300
SCALE OF FEET

LEGEND

– Indicates Pavement

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RED RIVER VALLEY WATER SUPPLY PROJECT
NORTH DAKOTA

RED RIVER APPRAISAL DESIGN

WATER TREATMENT SYSTEM AND MC CLUSKY PUMPING PLANT
SITE PLAN

DESIGNED S. DUNDORF/K. YOKOYAMA CHECKED R.A. JURENKA
DRAWN R.D. RODRIGUEZ/J. PATTIE TECH. APPR.
APPROVED
WATER TREATMENT ENGINEERING AND RESEARCH

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DENVER, COLORADO MARCH 25, 2005
DRAWING 4

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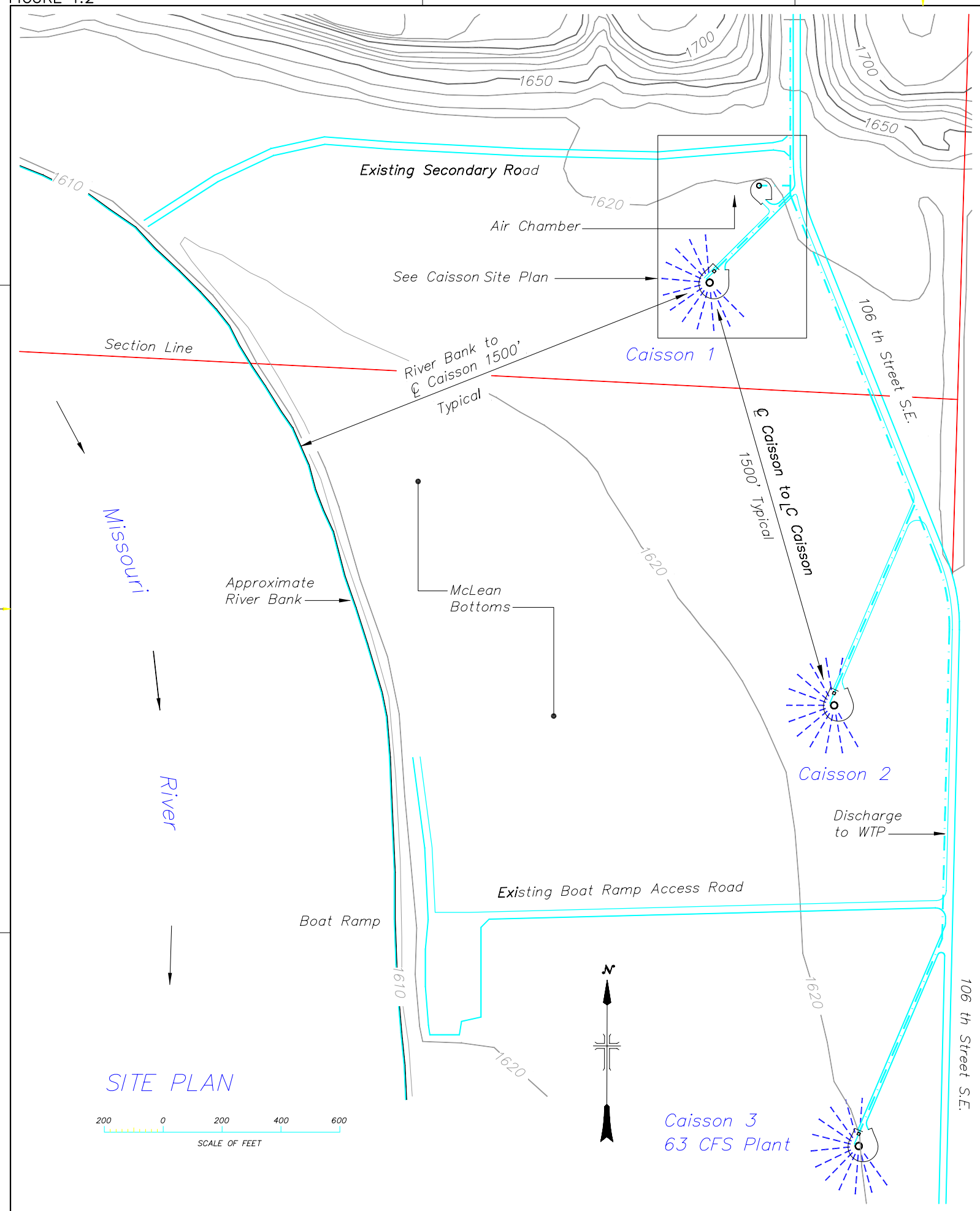
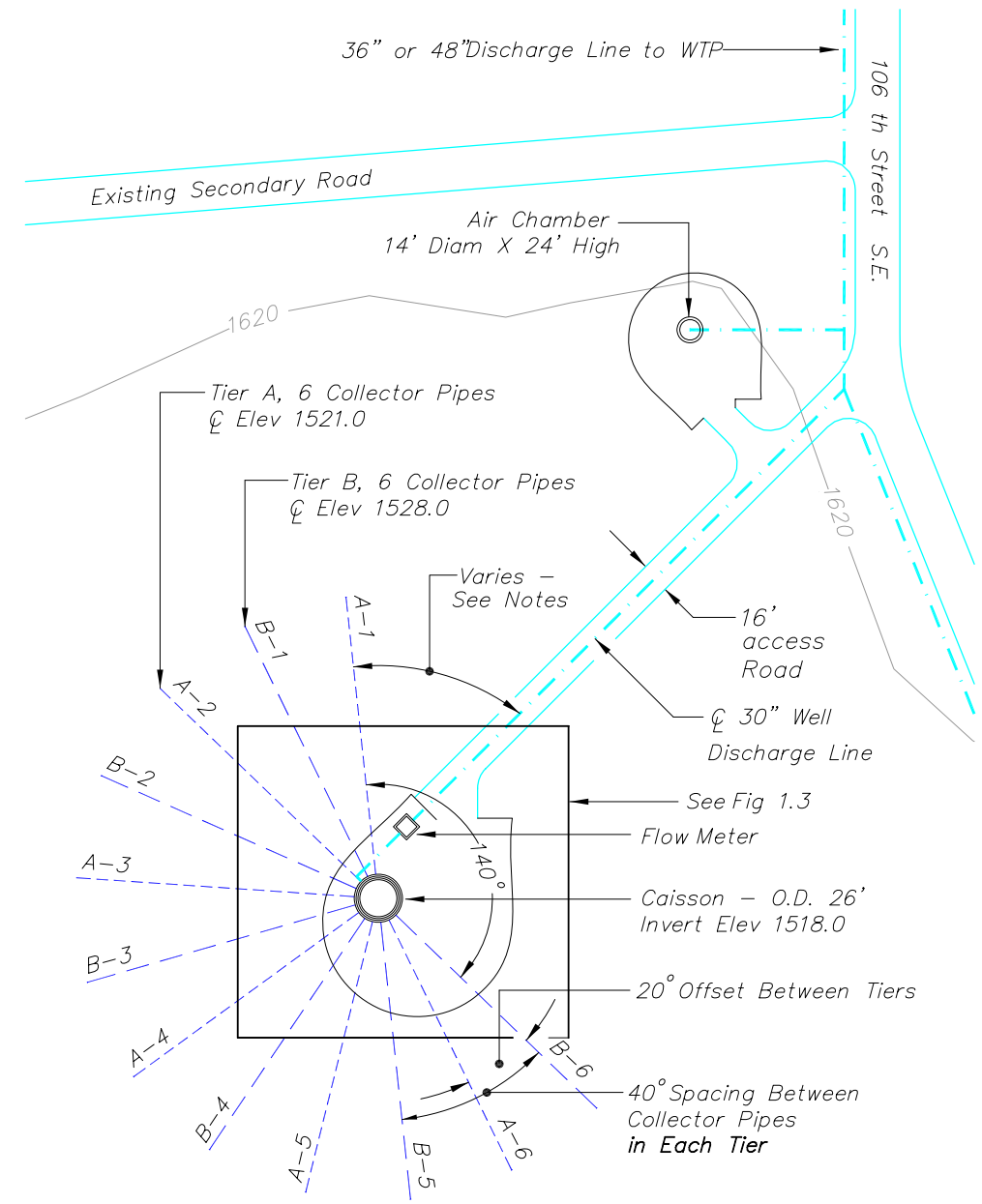
FIGURE 1.2



SITE PLAN



CAISSON PLAN – No Scale

Typical Caisson, Collector Pipes, and Discharge Line

NOTES

Angles between caisson discharge line and Collector Pipe A–1 varies as follows:

Caisson 1 = 50.00°
Caisson 2 = 13.00°
Caisson 3 = 19.00°

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RED RIVER APPRAISAL DESIGN

MC LEAN BOTTOMS INTAKE PUMPING PLANT
SITE PLAN AND CAISSON PLAN

Prepared by John Pattie, R.L.A.
Reviewed by M.R. O'Shea, P.E.

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
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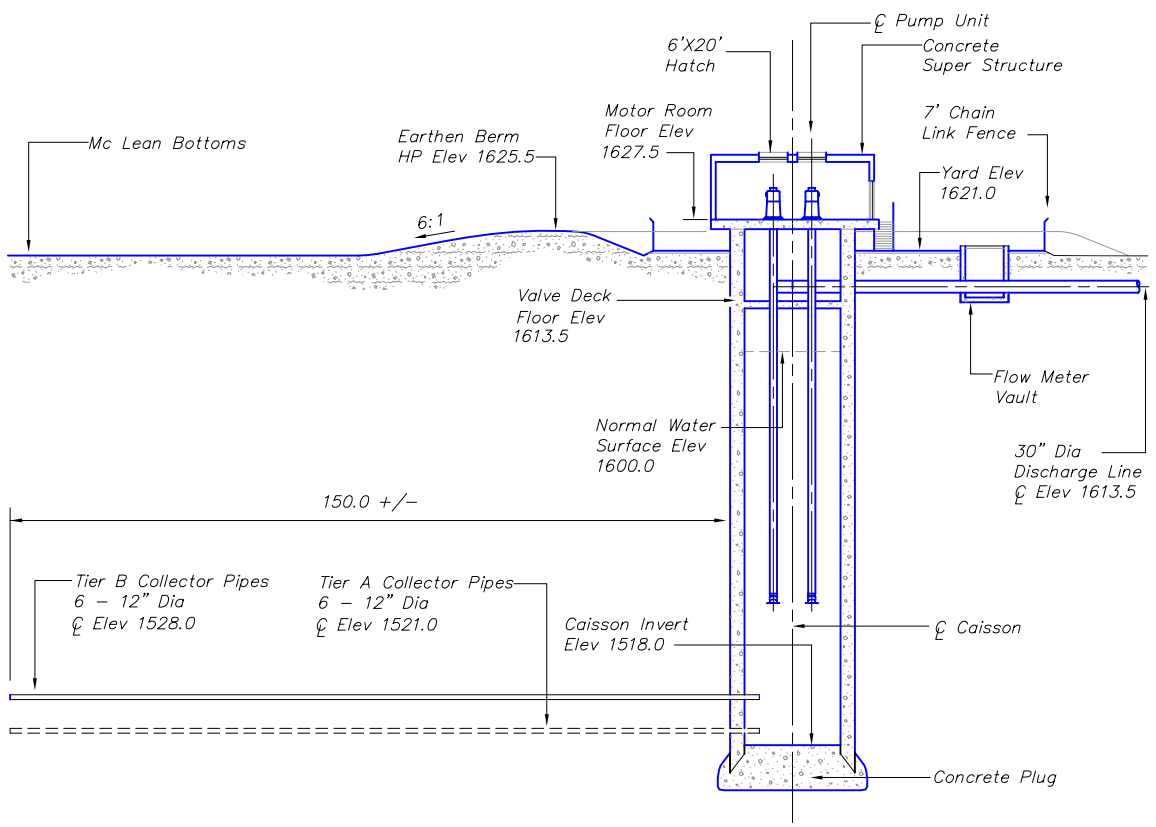
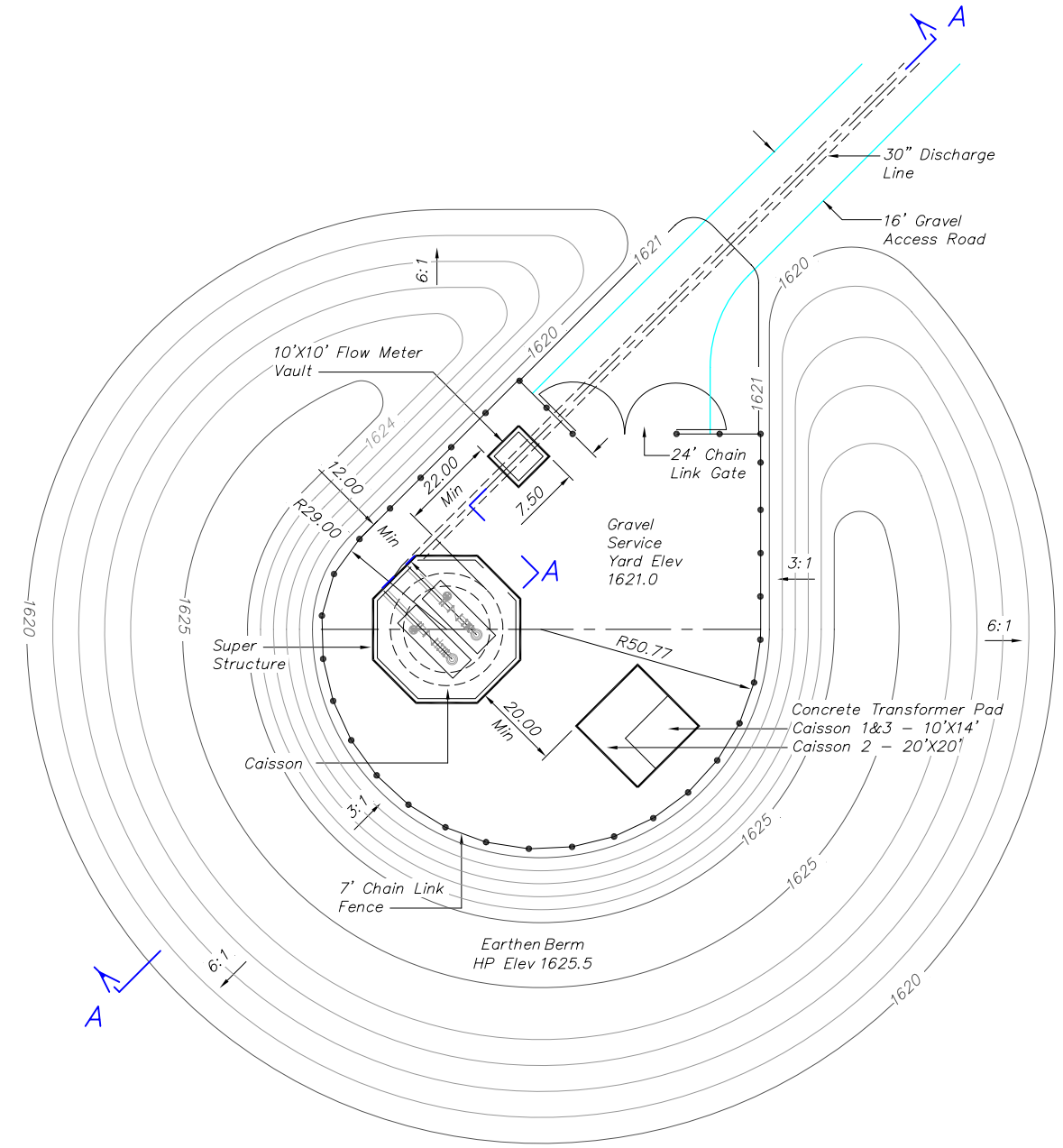
DENVER, COLORADO	APRIL 29, 2005	FIGURE 1.2

FIGURE 1.3



SECTION AA – SERVICE YARD AND TYPICAL CAISSON

20 0 20 40 60
SCALE OF FEET



SERVICE YARD SITE PLAN

TYPICAL FOR ALL CAISSONS

20 0 20 40 60
SCALE OF FEET

PUMP UNIT DATA

Pump Unit Number	Nominal Rated Capacity (ft^3/s)	Rated Head (ft)
1&2	15	225
Total	30	

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NORTH DAKOTA

RED RIVER APPRAISAL DESIGN

MC LEAN BOTTOMS INTAKE PUMPING PLANT
CAISSON SECTION AND YARD SITE PLAN

Prepared by John Pattie, R.L.A

Reviewed by M.R. O'Shea, P.E.

CADD SYSTEM	CADD FILENAME	DATE AND TIME PLOTTED
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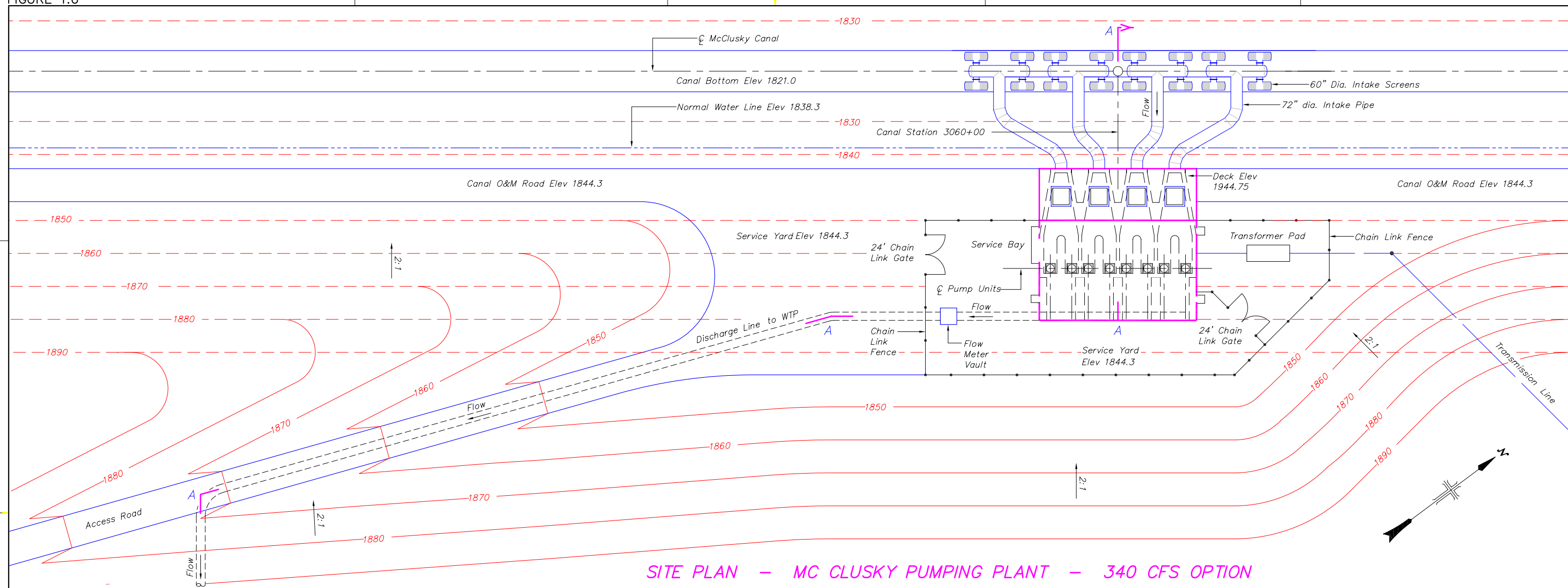
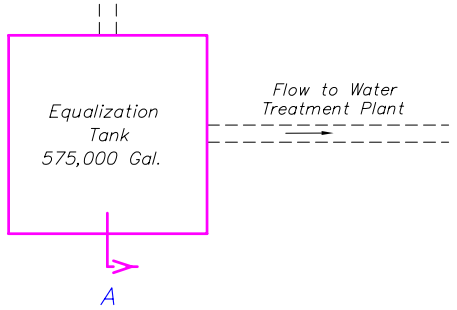
DENVER, COLORADO	APRIL 29, 2005	FIGURE 1.3

FIGURE 1.6



SITE PLAN – MC CLUSKY PUMPING PLANT – 340 CFS OPTION

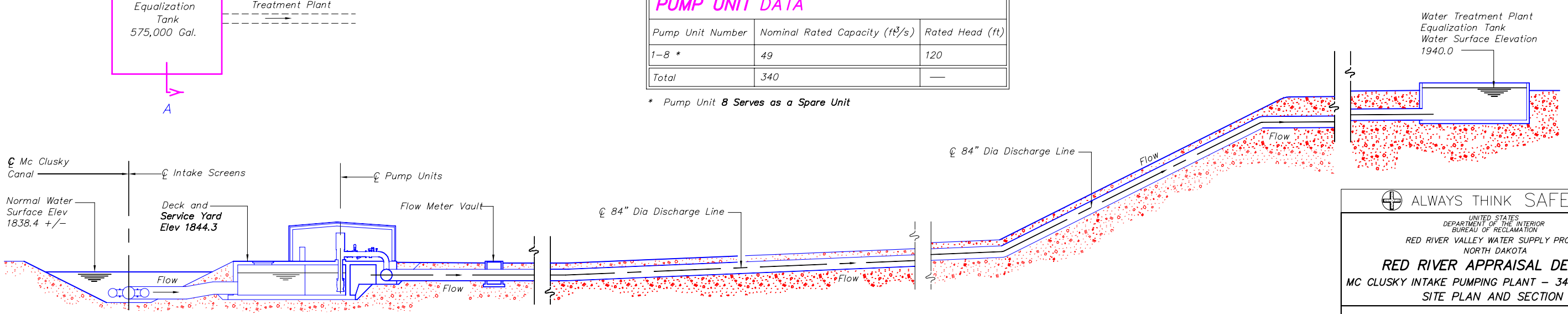
30 0 30 60 120
SCALE OF FEET



PUMP UNIT DATA

Pump Unit Number	Nominal Rated Capacity (ft^3/s)	Rated Head (ft)
1–8 *	49	120
Total	340	—

* Pump Unit **8 Serves as a Spare Unit**



SECTION AA – SECTION THROUGH WATERWAY

30 0 30 60 120
SCALE OF FEET

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RED RIVER VALLEY WATER SUPPLY PROJECT
NORTH DAKOTA

RED RIVER APPRAISAL DESIGN

MC CLUSKY INTAKE PUMPING PLANT – 340 CFS OPTION
SITE PLAN AND SECTION

Prepared by John Pattie, R.L.A
Reviewed by M.P. O'Shea, P.E.

CADD SYSTEM CADSYS	CADD FILENAME FILNAM	DATE AND TIME PLOTTED PLDATE
DENVER, COLORADO	APRIL 29, 2005	FIGURE 1.6

Attachment D

Collector Well Supplemental Design Information

Based on a decision by the project design team to evaluate representative design costs based on a production rate of 63 MGD from potential collector well systems at the Missouri River sites, the original evaluation (Red River Water Supply Project, north Dakota: Evaluation of Collector Systems, dated 01/18/2005) was revised to focus on the design specifics related to a collector system producing up to 63 MGD. For comparison purposes, the design specifics for a collector system producing up to 44 MGD are also included.

Table 1 shows the calculated amounts of screened piping that would be required for Bed-mounted Infiltration Gallery and On-land Infiltration Gallery systems at 44 MGD and 63 MGD production rates. The lengths of screened pipe are given for a variety of screen diameters (in terms of pipe radius) ranging in size from 6 inches to 4 feet.

Pipe Radius (feet)	**Calculated length of pipe @ 44 MGD (ft)**	**Calculated length of pipe @ 63 MGD (ft)**
Bed-Mounted Infiltration Galleries		
0.25	1060.57	1518.55
0.5	866.31	1240.39
0.75	752.67	1077.69
1	672.04	962.24
1.25	609.50	872.70
1.5	558.40	799.53
1.75	515.20	737.67
2	477.78	684.09
On-Land Infiltration Galleries		
0.25	45211.67	64734.89
0.5	32500.00	46534.09
0.75	30153.50	43174.34
1	30850.57	44172.41
1.25	12324.32	17646.19
1.5	7824.04	11202.61
1.75	5569.16	7974.02
2	2851.75	4083.18

Table 1: Calculated screen lengths as a function of pipe radius and system capacity.

Table 2 shows the number of laterals of a given length and size (as the radius of the pipe size) required for a Ranney Collector Well system with capacities of 44 MGD and 66 MGD.

System Capacity	Size of Laterals (Length of lateral in feet/radius of lateral in feet)					
	200/0.5	**150/0.5**	**100/0.5**	**200/1.0**	**150/1.0**	**100/1.0**
44 MGD	22	25	29	21	24	28
63 MGD	31	35	41	30	34	39

Table 2: Number of laterals required for a Ranney Collector Well system of 44 MGD and 66 MGD capacities as a function of the average length and diameter of the each lateral.

Recall that a typical Ranney Collector Well caisson is about 20 feet in diameter and can have up to 18 laterals extending outward from the caisson in a radial pattern. 12 to 14 laterals are also typical numbers of laterals per caisson depending upon the material properties and thickness of the alluvial materials in which the caisson is constructed. Dividing the above numbers by 12 would produce a conservative number of caissons needed; dividing by 18 would produce an optimistic number of caissons needed.

In the above tables, all the assumptions and criteria from the original evaluation were kept constant – only the design capacities were altered.

Attachment E

Cost Assumptions and Factors

Escalation

No escalation is needed since costs are from January 2005.

Installation

Installation cost is typically 25%, but may vary. All costs on the cost estimation sheets are installed costs.

Mobilization

Mobilization costs include mobilizing contractor personnel and equipment to the project site during initial project start-up. The assumed 5 percent of the subtotal cost is based on past experience of similar projects.

Unlisted

Per Reclamation Cost Estimating Handbook guidelines, the allowance for unlisted items in appraisal estimates should be at least 10%. and 20% was used for this report. It was determined that 5% be added to the estimate subtotals to be consistent with that developed by the client (chosen because pipeline costs, which have inherent fewer unlisted items, represent a majority of the alternate costs) (*Unlisted = 0.05 x (subtotal + installation + mobilization)*). However, it was recognized that for the estimates prepared for these pumping plants an additional unlisted item amount is warranted. It was determined that, based upon the completeness of the cost estimate listed items, this additional be set at 10 percent of the unlisted items for all the features cost estimated (*Unlisted = 0.1 x (subtotal + installation + mobilization)*). .

Contract Cost

The contract cost represents the expected value of the construction contract and is equal to: *subtotal + installation + mobilization + unlisted*

Contingencies

Per Reclamation Cost Estimating Handbook guidelines, contingencies are to be included in all appraisal estimates. The purpose for contingencies is to pay contractors for overruns on quantities, changed site conditions, change orders, etc. Contingencies are considered as funds to be used after construction starts and not for design changes in project planning. Per Reclamation Cost Estimating Handbook guidelines, appraisal estimates should have 25 percent added for contingencies. It was determined that based upon the completeness and reliability of the engineering design data provided, geological information, projected quantities and the general knowledge of the conditions at the site, that 25 percent be added for contingencies for all the features cost estimated (*Contingencies = 0.25 x (contract cost)*).

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Field Cost

The field cost is equal to: *subtotal + installation + mobilization + unlisted + contingencies*

Non-Contract Cost

Non-contract costs are included to cover work or services provided in support of the contract such as design and specifications development, procurement services, contract administration, construction supervision, etc. Reclamation historical data supports that these costs generally run at a minimum of 30% of the Field Costs. However, local data provided by the client for similar ongoing work on the Northwest Area Water Supply (NAWS) project (long pipeline runs and the use of state and federal oversight) suggests that a reduced value be employed. It was determined that 25% be added for non-contract costs, assuming this project is locally contracted and administered.

Attachment F

Detailed Cost Breakdown

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE:

128 CFS Water Treatment Plant
Estimate Summary Sheet

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Est Summary

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sheets 1 - 3 - (sitework and buildings) - Total =					$ 31,400,145.00
		Sheets 1 - 8 - (Yard Piping) - Total =					$ 3,818,425.30
		Sheets 1 - 6 - (Process Equipment) - Total =					$ 29,518,000.00
		Sheets 1 - 4 - (Mechanical Equipment) - Total =					$ 1,388,700.00
		Sheet 1 - (Pumps, Motors, Valves & Misc.) - Total =					$ 2,888,530.00
		All Sheets - Electrical - Total =					$ 1,843,495.00
		Subtotal					$ 70,857,295.30
		* Additonal Unlisted Item % (< 5%) broken out per client direction =					$ 3,500,000.00
		Subtotal					$ 74,357,295.30
		Mobilization (+/-5%)					$ 3,700,000.00
		Subtotal					$ 78,057,295.30
		* Unlisted items (+/- 5%)					$ 3,942,704.70
		CONTRACT COST					$ 82,000,000.00
		Contingencies (+/-25%)					$ 18,000,000.00
		FIELD COST					$100,000,000.00
		Noncontract					$ 30,000,000.00
		Construction Cost (+/-25%)					$130,000,000.00

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY JZ Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED April 20, 2005	PEER REVIEW	DATE PREPARED April 20, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE:

128 CFS Water Treatment Plant
Estimate Summary Sheet
with Generic Earthwork in lieu of
Sitework Items #1 and #2

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Est Summary

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sheets 1 - 3 - (Generic sitework and buildings) - Total =					$ 28,781,490.00
		Sheets 1 - 8 - (Yard Piping) - Total =					$ 3,818,425.30
		Sheets 1 - 6 - (Process Equipment) - Total =					$ 29,518,000.00
		Sheets 1 - 4 - (Mechanical Equipment) - Total =					$ 1,388,700.00
		Sheet 1 - (Pumps, Motors, Valves & Misc.) - Total =					$ 2,888,530.00
		All Sheets - Electrical - Total =					$ 1,843,495.00
		Subtotal					$ 68,238,640.30
		* Additonal Unlisted Item % (< 5%) broken out per client direction =					$ 3,400,000.00
		Subtotal					$ 71,638,640.30
		Mobilization (+/-5%)					$ 3,600,000.00
		Subtotal					$ 75,238,640.30
		* Unlisted items (+/- 5%)					$ 3,761,359.70
		CONTRACT COST					$ 79,000,000.00
		Contingencies (+/-25%)					$ 20,000,000.00
		FIELD COST					$ 99,000,000.00
		Noncontract					$ 26,000,000.00
		Construction Cost (+/-25%)					$125,000,000.00

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY JZ Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED April 20, 2005	PEER REVIEW	DATE PREPARED April 20, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Site work and Buildings
TSC Design Group: D-8120

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]1-3 Sitewk,Bldgs,Tanks

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Site Work					
	1	Removal of waste bank to original grade - Common Excavatio		950,000	CY	$ 2.75	$ 2,612,500.00
	2	Compacted Embankment for WTP Service Yard		720,000	CY	$ 3.60	$ 2,592,000.00
		Access Road to WTP Service Yard					
		Quantity provided with McClusky PP Qty Est Worksheet					
	3	6-in Gravel Surface for Service Yard		16,400	CY	$ 28.00	$ 459,200.00
		Chain Link Fencing					
	4	7' High with 3 strands of barb wire on top.		4,650	LF	$ 23.00	$ 106,950.00
	5	24' wide double swing vehicle		4	EA.	$ 2,600.00	$ 10,400.00
		access gates.					
		Main Water Treatment Building					
	6	Concrete for building foundation & substructure		3,580	CY	$ 590.00	$ 2,112,200.00
	7	Cement for fdn & substr concrete		1,010	TONS	$ 140.00	$ 141,400.00
	8	Steel reinforcement for concrete fdn & substr		447,500	LBS	$ 1.10	$ 492,250.00
	9	Misc Metalwork		75,000	LBS	$ 7.00	$ 525,000.00
	10	Structural steel framing for superstructure		638,000	LBS	$ 2.70	$ 1,722,600.00
	11	Open web bar joists for lower roof & HVAC Platform		23,100	LBS	$ 3.40	$ 78,540.00
	12	12-in reinforced CMU wall (22' high exterior walls)		8,800	SF	$ 24.00	$ 211,200.00
	13	8-in reinforced CMU wall (12' high interior walls)		25,000	SF	$ 20.00	$ 500,000.00
	14	Pre-Insulated Metal roof Panel (Metal-Span III)		40,300	SF	$ 19.00	$ 765,700.00
		2" high standing seam, foamed-in-place, blister-free,					
		non-CFC polyurethane, 6" thick with R-47 insulation value,					
		UL-90 uplift performance, FM I-90 windstorm resistance					
		42" wide panels					
		Lime Slaking Building					
	15	Concrete for substructure & first level		862	CY	$ 610.00	$ 525,820.00
	16	Cement for substructure & first level		243	TONS	$ 140.00	$ 34,020.00
	17	Steel reinforcement for concrete		107,750	LBS	$ 1.20	$ 129,300.00
	18	Pre-engineered metal building for second level		1	EA	$ 240,000.00	$ 240,000.00
		20' eave height					
		3:12 Roof Pitch, 60' wide x 60' long					
		Sheet 1 - (sitework and buildings) - subtotal =					**$ 13,259,080.00**

QUANTITIES		PRICES	
BY John Pattie, Brad Van Otterloo	CHECKED M. R. O'Shea	BY #3 Jerry Zander	CHECKED CJ
DATE PREPARED April 4, 2005	PEER REVIEW M. R. O'Shea	DATE PREPARED April 12, 2005	PEER REVIEW DCA

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Site work and Buildings
TSC Design Group: D-8120

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]1-3 Sitewk,Bldgs,Tanks

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sludge Handling Building					
	19	Concrete for substructure & first level		952	CY	$ 610.00	$ 580,720.00
	20	Cement for substructure & first level		270	TONS	$ 140.00	$ 37,800.00
	21	Steel reinforcement for concrete		119,000	LBS	$ 1.20	$ 142,800.00
	22	Pre-engineered metal Building - 20' eave height		1	EA.	$ 290,000.00	$ 290,000.00
		3:12 Roof Pitch, 58' wide x 75' long					
		Uplflow Clarifiers (6 Ea.)					
	23	Concrete		15,600	CY	$ 490.00	$ 7,644,000.00
	24	Cement		4,400	TONS	$ 130.00	$ 572,000.00
	25	Steel reinforcement for concrete		1,950,000	LBS	$ 1.00	$ 1,950,000.00
		Misc Metalwork (assumed qty covered in unlisted items)		-			
		Uplflow Clarifiers Valve Vaults (6 Ea.)					
	26	Concrete		540	CY	$640.00	$ 345,600.00
	27	Cement		152	TONS	$150.00	$ 22,800.00
	28	Steel reinforcement for concrete		67,500	LBS	$1.30	$ 87,750.00
		Misc Metalwork (assumed qty covered in unlisted items)		-			
		Clearwell (3,230,000 gals) - L=225', W=85', D=22'					
	29	Concrete		4,600	CY	$ 580.00	$ 2,668,000.00
	30	Cement		1,297	TONS	$ 140.00	$ 181,580.00
	31	Steel reinforcement for concrete		575,000	LBS	$ 1.10	$ 632,500.00
		Misc Metalwork (assumed qty covered in unlisted items)		-			
		Treated Water Pumping Plant					
	32	Pre-engineered metal Building - 18' eave height		1	EA.	$ 200,000.00	$ 200,000.00
		3:12 Roof Pitch, 60.5' wide x 50' long					
	33	Roof Access Hatches		4	EA.	$ 26,000.00	$ 104,000.00
		8' x 20' Type "D" Roof Scuttle as manufactured					
		by The Bilco Co.					
		Epoxy Coating for interior surface					
	34	IE-1A1 or IE-1C or IE-1D		31,500	SF	$ 2.60	$ 81,900.00
	35	Excavation (Common)		14,400	CY	$ 5.50	$ 79,200.00
	36	Compacted Backfill		3,700	CY	$ 8.70	$ 32,190.00
		Equalization Tank (575,000 gal) - L=62', W=62',H=22'					
	37	Concrete		950	CY	$ 610.00	$ 579,500.00
	38	Cement		268	TONS	$ 140.00	$ 37,520.00
	39	Steel reinforcement		118,750	LBS	$ 1.20	$ 142,500.00
		Misc Metalwork (assumed qty covered in unlisted items)					
		Sheet 2 - (sitework and building) - subtotal =					**$ 16,412,360.00**

QUANTITIES		PRICES	
BY Brad Van Otterloo	CHECKED M. R. O'Shea	BY Jerry Zander	CHECKED CJ
DATE PREPARED April 4, 2005	PEER REVIEW M. R. O'Shea	DATE PREPARED April 12, 2005	PEER REVIEW pcd

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Site work and Buildings
TSC Design Group: D-8120

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]1-3 Sitewk.Bldgs.Tanks

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Coagulant Injection Vault (1 Ea.)					
	40	Concrete		128	CY	$ 710.00	$ 90,880.00
	41	Cement		36	TONS	$ 160.00	$ 5,760.00
	42	Steel reinforcement		16,000	LBS	$ 1.60	$ 25,600.00
		Misc Metalwork (assumed qty covered in unlisted items)					
		Sludge Sump Vault (4 Ea.)					
	43	Concrete		580	CY	$640.00	$ 371,200.00
	44	Cement		164	TONS	$150.00	$ 24,600.00
	45	Steel reinforcement		72,500	LBS	$1.30	$ 94,250.00
		Misc Metalwork (assumed qty covered in unlisted items)					
		Lime Sludge Storage Tank (500,000 gal) - L=100', W=33', H=22'					
	46	Concrete		1,025	CY	$ 610.00	$ 625,250.00
	47	Cement		289	TONS	$ 140.00	$ 40,460.00
	48	Steel reinforcement		128,125	LBS	$ 1.20	$ 153,750.00
		Misc Metalwork (assumed qty covered in unlisted items)					
	49	Excavation (Common)		1,900	CY	$ 9.30	$ 17,670.00
	50	Compacted Backfill		650	CY	$ 12.00	$ 7,800.00
		Sludge Recycle Pump Vault & Storage Tank					
	51	Concrete		305	CY	$ 670.00	$ 204,350.00
	52	Cement		86	TONS	$ 160.00	$ 13,760.00
	53	Steel reinforcement		38,125	LBS	$ 1.40	$ 53,375.00
		Misc Metalwork (assumed qty covered in unlisted items)					
		Sheet 3 - (sitework and buildings) - subtotal =					**$ 1,728,705.00**
		Sheets 1 - 3 - (sitework and buildings) - Total					**$ 31,400,145.00**

QUANTITIES		PRICES	
BY Brad Van Otterloo	CHECKED M. R. O'Shea	BY Jerry Zander	CHECKED CJ
DATE PREPARED April 4, 2005	PEER REVIEW M. R. O'Shea	DATE PREPARED April 12, 2005	PEER REVIEW DEL

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Generic Water Treatment Plant Site Work
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Est Summary

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Site Preparation	D-8230				
		Buildings and Tank Site Preparation					
	1	Excavation		49,540	CY	$ 5.00	$ 247,700.00
	2	Compacted Gravel		3,850	CY	$ 30.00	$ 115,500.00
	3	Compacted Backfill		23,790	CY	$ 7.00	$ 166,530.00
		Upflow Clarifier Site Preparation					
	4	Excavation		141,140	CY	$ 4.00	$ 564,560.00
	5	Compacted Gravel		4,370	CY	$ 30.00	$ 131,100.00
	6	Compacted Backfill		86,850	CY	$ 7.00	$ 607,950.00
		Upflow Clarifier Berm					
	7	Compacted Backfill		79,960	CY	$ 7.00	$ 559,720.00
		Pipe Trenches					
	8	Excavation		11,730	CY	$ 7.00	$ 82,110.00
	9	Compacted Backfill		11,650	CY	$ 9.50	$ 110,675.00
		Subtotal (Generic WTP Site) - Sheet 1 =					**$ 2,585,845.00**

QUANTITIES		PRICES	
BY Ken Yokoyama D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED MH
DATE PREPARED April 10, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW RCN

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Yard Piping
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]1-8 Piping

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Yard Piping for Water Treatment Site	D-8230				
		Reach - 1					
		Equalization Tank to Beginning of Clarifier Effluent Manifold					
	1	Steel influent pipe, 72.0 inch pipe size, 0.375 wall thickness, 287 lbs/ft		68	LF	$ 860.00	$ 58,480.00
	2	Soil cement slurry for 72.0 inch pipe		86	CY	$ 150.00	$ 12,900.00
	3	Steel influent pipe, 64.0 inch pipe size, 0.375 wall thickness, 255 lbs/ft		90	LF	$ 770.00	$ 69,300.00
	4	Soil cement slurry for 64.0 inch pipe		103	CY	$ 125.00	$ 12,875.00
	5	IPS HDPE DR17 lime slurry pipe, 4.0 inch pipe size, 0.265 wall thickness, 1.54 lbs/ft (2 pipes @ 90.0 LF each)		180	LF	$ 12.00	$ 2,160.00
	6	Soil cement slurry for 4.0 inch pipe (2 pipes @ 90.0 LF each)		9	CY	$ 175.00	$ 1,575.00
	7	Detectable, metallic warning tape		338	LF	$ 0.10	$ 33.80
		Reach - 2					
		Beginning of Effluent Manifold to Third Column Clarifier					
	8	Steel influent pipe, 64.0 inch pipe size, 0.375 wall thickness, 255 lbs/ft		116	LF	$ 770.00	$ 89,320.00
	9	Soil cement slurry for 64.0 inch pipe		133	CY	$ 125.00	$ 16,625.00
	10	Steel influent pipe, 48.0 inch pipe size, 0.375 wall thickness, 191 lbs/ft		182	LF	$ 570.00	$ 103,740.00
	11	Soil cement slurry for 48.0 inch pipe		164	CY	$ 125.00	$ 20,500.00
	12	Steel effluent pipe, 32.0 inch pipe size, 0.375 wall thickness, 127 lbs/ft (2 pipes @ 116.0 LF each)		232	LF	$ 380.00	$ 88,160.00
	13	Soil cement slurry for 32.0 inch pipe (2 pipes @ 116.0 LF each)		56	CY	$ 150.00	$ 8,400.00
	14	Steel effluent pipe, 48.0 inch pipe size, 0.375 wall thickness, 191 lbs/ft (2 pipes @ 182.0 LF each)		364	LF	$ 570.00	$ 207,480.00
	15	Soil cement slurry for 48.0 inch pipe (2 pipes @ 182.0 LF each)		56	CY	$ 150.00	$ 8,400.00
	16	IPS HDPE DR17 lime slurry pipe, 4.0 inch pipe size, 0.265 wall thickness, 1.54 lbs/ft (2 pipes @ 298.0 LF each)		596	LF	$ 18.00	$ 10,728.00
	17	Soil cement slurry for 4.0 inch pipe (2 pipes @ 298.0 LF each)		31	CY	$ 150.00	$ 4,650.00
		Sheet 1 - (Yard Piping) - subtotal =					**$ 715,326.80**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY JZ Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 12, 2005	PEER REVIEW DCL

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Yard Piping
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]1-8 Piping

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8230				
	18	IPS HDPE DR17 lime sludge pipe, 4.0 inch pipe size,		466	LF	$ 18.00	$ 8,388.00
		0.265 wall thickness, 1.54 lbs/ft (2 pipes @ 233.0 LF each)					
	19	Soil cement slurry for 4.0 inch pipe (2 pipes @ 233.0 LF each)		24	CY	$ 175.00	$ 4,200.00
	20	Detectable, metallic warning tape		1,956	LF	$ 0.10	$ 195.60
		Reach - 3					
		Third Column Clarifier to End of Effluent Manifold					
	21	Steel effluent pipe, 64.0 inch pipe size,		198	LF	$ 770.00	$ 152,460.00
		0.375 wall thickness, 255 lbs/ft (2 pipes @ 99.0 LF each)					
	22	Soil cement slurry for 64.0 inch pipe (2 pipes @ 99.0 LF each)		36	CY	$ 150.00	$ 5,400.00
	23	IPS HDPE DR17 lime sludge pipe, 4.0 inch pipe size,		200	LF	$ 18.00	$ 3,600.00
		0.265 wall thickness, 1.54 lbs/ft (2 pipes @ 100.0 LF each)					
	24	Soil cement slurry for 4.0 inch pipe (2 pipes @ 100.0 LF each)		10	CY	$ 175.00	$ 1,750.00
	25	Detectable, metallic warning tape		398	LF	$ 0.10	$ 39.80
		Reach - 4					
		Upflow Clarifier Influent Branches					
	26	Steel influent pipe, 32.0 inch pipe size,		684	LF	$ 380.00	$ 259,920.00
		0.375 wall thickness, 127 lbs/ft (6 pipes @ 114.0 LF each)					
	27	Soil cement slurry for 32.0 inch pipe (6 pipes @ 114.0 LF each)		258	CY	$ 125.00	$ 32,250.00
	28	IPS HDPE DR17 lime slurry pipe, 4.0 inch pipe size,		684	LF	$ 18.00	$ 12,312.00
		0.265 wall thickness, 1.54 lbs/ft (6 pipes @ 114.0 LF each)					
	29	Soil Cement Slurry for 4.0 inch pipe (6 pipes @ 114 LF each)		35	CY	$ 150.00	$ 5,250.00
	30	Butterfly Valve, 32.0 inch		6	EA	$ 24,570.00	$ 147,420.00
	31	Butterfly Valve, 4.0 inch		6	EA	$ 650.00	$ 3,900.00
	32	Detectable, metallic warning tape		1,368	LF	$ 0.10	$ 136.80
		Sheet 2 - (Yard Piping) - subtotal =					**$ 637,222.20**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 12, 2005	PEER REVIEW

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Yard Piping
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]1-8 Piping

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8230				
		Reach - 5					
		Upflow Clarifier Effluent Branches					
	33	Steel effluent pipe, 32.0 inch pipe size,		336	LF	$ 380.00	$ 127,680.00
		0.375 wall thickness, 126.78 lbs/ft (6 pipes @ 56.0 LF each)					
	34	Soil Cement Slurry for 32.0 inch pipe (6 pipes @ 56 LF each)		127	CY	$ 125.00	$ 15,875.00
	35	Detectable, metallic warning tape		336	LF	$ 0.10	$ 33.60
		Reach - 6					
		Upflow Clarifier Sludge Branches					
	36	IPS HDPE DR17 sludge pipe, 4.0 inch pipe size,		624	LF	$ 18.00	$ 11,232.00
		0.265 wall thickness, 1.54 lbs/ft (6 pipes @ 104 LF each)					
	37	Soil Cement Slurry for 4.0 inch pipe (6 pipes @ 104 LF each)		32	CY	$ 150.00	$ 4,800.00
	38	Detectable, metallic warning tape		624	LF	$ 0.10	$ 62.40
		Reach - 7					
		Sludge Sump Branches					
	39	IPS HDPE DR17 sludge pipe, 4.0 inch pipe size,		92	LF	$ 18.00	$ 1,656.00
		0.265 wall thickness, 1.54 lbs/ft (4 pipes @ 23 LF each)					
	40	Soil Cement Slurry for 4.0 inch pipe (4 pipes @ 23 LF each)		5	CY	$ 175.00	$ 875.00
	41	Detectable, metallic warning tape		92	LF	$ 0.40	$ 36.80
		Reach - 8					
		Influent Pipe to Main Treatment Building					
	42	Steel effluent pipe, 64.0 inch pipe size,		60	LF	$ 770.00	$ 46,200.00
		0.375 wall thickness, 255 lbs/ft					
	43	Soil Cement Slurry for 64.0 inch pipe		63	CY	$ 150.00	$ 9,450.00
	44	Detectable, metallic warning tape		60	LF	$ 0.40	$ 24.00
		Sheet 3 - (Yard Piping) - subtotal =					**$ 217,924.80**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY #7 Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 12, 2005	PEER REVIEW DCL

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Yard Piping
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

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PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8230				
		Reach - 9					
		Lime Slaking Building to Main Line					
	45	IPS HDPE DR17 lime slurry pipe, 4.0 inch pipe size,		628	LF	$ 18.00	$ 11,304.00
		0.265 wall thickness, 1.54 lbs/ft (2 pipes @ 314.0 LF each)					
	46	Soil cement slurry for 4.0 inch pipe (2 pipes @ 314.0 LF each)		49	CY	$ 150.00	$ 7,350.00
	47	IPS HDPE DR11 coagulant pipe, 1.0 inch pipe size,		314	LF	$ 7.00	$ 2,198.00
		0.120 wall thickness, 0.19 lbs/ft					
	48	Compacted sand for 1.0 inch pipe		13	CY	$ 11.50	$ 149.50
	49	Detectable, metallic warning tape		942	LF	$ 0.10	$ 94.20
		Reach - 10					
		Lime Sludge Line to Sludge Storage Tank					
	50	IPS HDPE DR17 lime sludge pipe, 4.0 inch pipe size,		1,296	LF	$ 18.00	$ 23,328.00
		0.265 wall thickness, 1.54 lbs/ft (2 pipes @ 648 LF each)					
	51	Soil cement slurry for 4.0 inch pipe (2 pipes@ 648 LF each)		506	CY	$ 85.00	$ 43,010.00
	52	Detectable, metallic warning tape		1,296	LF	$ 0.10	$ 129.60
		Reach - 11					
		Main Treatment Building Effluent Pipe to Clearwell					
	53	Steel effluent pipe, 64.0 inch pipe size,		68	LF	$ 770.00	$ 52,360.00
		0.375 wall thickness, 255 lbs/ft					
	54	Soil Cement Slurry for 64.0 inch pipe		71	CY	$ 150.00	$ 10,650.00
	55	Detectable, metallic warning tape		68	LF	$ 0.40	$ 27.20
		Sheet 4 - (Yard Piping) - subtotal =					**$ 150,600.50**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY JZ Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 12, 2005	PEER REVIEW DCL

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Yard Piping
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

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PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8230				
		Reach - 12					
		Reverse Filtrate Influent from Clearwell					
	56	IPS HDPE DR17 RF influent pipe, 16.0 inch pipe size,		68	LF	$ 45.00	$ 3,060.00
		0.941 wall thickness, 19.47 lbs/ft					
	57	Compacted sand for 16.0 inch pipe		17	CY	$ 36.00	$ 612.00
	58	Detectable, metallic warning tape		68	LF	$ 0.40	$ 27.20
		Reach - 13					
		Reverse Filtrate Waste Line to Recycle Pump Vault					
	59	IPS HDPE DR17 RF waste pipe, 16.0 inch pipe size,		281	LF	$ 45.00	$ 12,645.00
		0.941 wall thickness, 19.47 lbs/ft					
	60	Compacted sand for 16.0 inch pipe		182	CY	$ 30.00	$ 5,460.00
	61	Detectable, metallic warning tape		281	LF	$ 0.10	$ 28.10
		Reach - 14					
		Sludge Press Filtrate to Recycle Water Storage Tank					
	62	IPS HDPE DR17 filter press filtrate pipe, 8.0 inch pipe size,		195	LF	$ 21.00	$ 4,095.00
		0.507 wall thickness, 5.66 lbs/ft					
	63	Compacted sand for 8.0 inch pipe		79	CY	$ 30.00	$ 2,370.00
	64	Detectable, metallic warning tape		195	LF	$ 0.10	$ 19.50
		Reach - 15					
		Recycle Line from Pump Vault to Head of Plant					
	65	IPS HDPE DR17 recycle line pipe, 18.0 inch pipe size,		1,130	LF	$ 54.00	$ 61,020.00
		1.059 wall thickness, 24.64 lbs/ft					
	66	Compacted sand for 18.0 inch pipe		816	CY	$ 30.00	$ 24,480.00
	67	Detectable, metallic warning tape		1,130	LF	$ 0.10	$ 113.00
		Sheet 5 - (Yard Piping) - subtotal =					**$ 113,929.80**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 12, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Yard Piping
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

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PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8230				
		Reach - 17					
		Overflow Pipe from Clarifiers					
	68	IPS HDPE DR 32.5 recycle line pipe, 32.0 inch pipe size,		2,412	LF	$ 76.00	$ 183,312.00
		0.985 wall thickness, 42.02 lbs/ft					
	69	Compacted sand for 32.0 inch pipe		3,288	CY	$ 30.00	$ 98,640.00
	70	Detectable, metallic warning tape		2,412	LF	$ 0.10	$ 241.20
		Main Treatment Plant Building Piping					
	71	Steel influent line pipe, 64.0 inch pipe size,		200	LF	$ 770.00	$ 154,000.00
		0.375 wall thickness, 255 lbs/ft					
	72	Steel influent line pipe, 48.0 inch pipe size,		216	LF	$ 570.00	$ 123,120.00
		0.375 wall thickness, 191 lbs/ft					
	73	Steel influent line pipe, 32.0 inch pipe size,		228	LF	$ 380.00	$ 86,640.00
		0.375 wall thickness, 127 lbs/ft					
	74	Steel influent line pipe, 14.0 inch pipe size,		260	LF	$ 160.00	$ 41,600.00
		0.375 wall thickness, 54.62 lbs/ft					
	75	Steel effluent line pipe, 14.0 inch pipe size,		260	LF	$ 160.00	$ 41,600.00
		0.375 wall thickness, 54.62 lbs/ft					
	76	Steel effluent line pipe, 32.0 inch pipe size,		232	LF	$ 380.00	$ 88,160.00
		0.375 wall thickness, 127 lbs/ft					
	77	Steel effluent line pipe, 64.0 inch pipe size,		246	LF	$ 770.00	$ 189,420.00
		0.375 wall thickness, 255 lbs/ft					
	78	Steel effluent line pipe, 48.0 inch pipe size,		48	LF	$ 570.00	$ 27,360.00
		0.375 wall thickness, 191 lbs/ft					
	79	IPS HDPE DR17 RF line pipe, 16.0 inch pipe size,		480	LF	$ 45.00	$ 21,600.00
		0.941 wall thickness, 19.47 lbs/ft					
	80	IPS HDPE DR17 RF line pipe, 8.0 inch pipe size,		448	LF	$ 21.00	$ 9,408.00
		0.941 wall thickness, 19.47 lbs/ft					
		Sheet 6 - (Yard Piping) - subtotal =					**$ 1,065,101.20**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY JZ Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 12, 2005	PEER REVIEW DCL

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Yard Piping
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]1-8 Piping

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8230				
	81	Butterfly Valves for UV disinfection units, 48.0 inch		4	EA	$ 43,000.00	$ 172,000.00
		Magnetic Flow Meters					
	82	Endress Hauser Electromagnetic Flowmeter		1	EA	$ 115,000.00	$ 115,000.00
		Promag 53W DN 1800/72 inch					
		Location of flow meter: Feedwater at Coagulant Injection Vault					
		(uninstalled cost $74,449.60 each)					
	83	Promag, Grounding Disk 72 inch, type 316SS		2	EA	$ 4,700.00	$ 9,400.00
		(uninstalled cost $3038.40 each)					
	84	Endress Hauser Electromagnetic Flowmeter		2	EA	$ 94,000.00	$ 188,000.00
		Promag 53W AWWA 66 inch					
		Location of flow meter: Influent to Main Treatment Plant Building					
		Effluent from Treatment Plant Building					
		(uninstalled cost $60,001.60 each)					
	85	Promag, Grounding Disk 66 inch, type 316SS		4	EA	$ 4,200.00	$ 16,800.00
		(uninstalled cost $2646.40 each)					
	86	Endress Hauser Electromagnetic Flowmeter		12	EA	$ 25,000.00	$ 300,000.00
		Promag 53W DN 800/32 inch					
		Location of flow meter: Influent to Upflow Clarifiers					
		Effluent from Upflow Clarifiers					
		(uninstalled cost $13,945.60 each)					
	87	Promag, Grounding Disk 32 inch, type 316SS		24	EA	$ 1,300.00	$ 31,200.00
		(uninstalled cost $639.20 each)					
	88	Endress Hauser Electromagnetic Flowmeter		6	EA	$ 5,400.00	$ 32,400.00
		Promag 35S PTFE DN 25/1 inch					
		Location of flow meter: Lime Slurry to Upflow Clarifiers					
		(uninstalled cost $3,614.00 each)					
	89	Promag, Grounding Disk 1 inch, type DN25/1", Alloy C-22		12	EA	$ 340.00	$ 4,080.00
		(uninstalled cost $220.00 each)					
		Sheet 7 - (Yard Piping) - subtotal =					**$ 868,880.00**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 12, 2005	PEER REVIEW Dal

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Yard Piping
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]1-8 Piping

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8230				
		Magnetic Flow Meters					
	90	Endress Hauser Electromagnetic Flowmeter		2	EA	$ 19,300.00	$ 38,600.00
		Promag 53W DN 400/16 inch					
		Location of flow meter: RF feedwater from clearwell					
		RF waste from main treatment building					
		(uninstalled cost $11,212.00 each)					
	91	Promag, Grounding Disk 16 inch, type 316SS		4	EA	$ 850.00	$ 3,400.00
		(uninstalled cost $429.00 each)					
	92	Endress Hauser Electromagnetic Flowmeter		1	EA	$ 6,800.00	$ 6,800.00
		Promag 53W DN 200/8 inch					
		Location of flow meter: Filter press filtrate from dewatering building					
		RF waste from main treatment building					
		(uninstalled cost $4,412.00 each)					
	93	Promag, Grounding Disk DN200 / 8"		2	EA	$ 320.00	$ 640.00
		(uninstalled cost $194.00 each)					
		Quote for magnetic flowmeters provided by Bob Bennett					
		Beabout Company 303-795-2274					
		Note: Pipe trenching quantities not provided for McClusky Canal					
		plant site. It is assumed that at this site, all waste material					
		will be excavated to the original site grade line. All structures					
		and pipes will be placed and the waste material used as compacted backfill.					
		Sheet 8 - (Yard Piping) - subtotal =					**$ 49,440.00**
		Sheets 1 through 8 - (Yard Piping) - Total =					**$ 3,818,425.30**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY JZ Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 12, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Process Equipment
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Lime Slaking Building					
	1	Enpro Technologies Pebble Lime Silos (14' diameter, 75' tall)	D-8230	1	LS	$ 400,000.00	$ 400,000.00
		complete with bulk fill controls, connectors, piping, hopper					
		bottom storage area with live bottom, electric rotary valve					
		for discharge to feeder, roof mounted bag house type dust					
		collector, top relief valve, level switches and controls,					
		interior lighting and heating, and FAA beacon.					
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
	2	Wallace and Tiernan 4000 lbs/hr Lime Slakers	D-8230	1	LS	$ 250,000.00	$ 250,000.00
		complete with slaker, screen type grit remover, volumetric					
		belt feeder, and NEMA 4X control panels.					
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
	3	Lime Slurry Tank Mixer (10 hp)	D-8230	1	LS	$ 40,000.00	$ 40,000.00
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
	4	Lime Slurry Mix/Feed Tanks, Carbon Steel 6500 gal	D-8230	1	LS	$ 60,000.00	$ 60,000.00
		10 ft diameter, 12 ft tall					
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
	5	Warren Rupp Air Operated Double Diaphram Lime Slurry	D-8230	2	EA	$ 7,000.00	$ 14,000.00
		Pump, Model MP04FEESDA1J0, 4.4 gpm max flow required					
		Quote provided by Tony Ciancio, McLemore Pump Inc.					
		303-227-1002					
		Sheet 1 - (Process Equipment) - subtotal =					**$ 764,000.00**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Process Equipment
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

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PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sodium Aluminate Coagulant System					
	6	FRP bulk storage tanks, 10,000 gal capacity, 12' diameter,	D-8230	1	LS	$ 73,000.00	$ 73,000.00
		12 ft tall with 24" side mounted manway, hold down lugs,					
		lifting lugs, and flanged nozzles as needed					
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
	7	Wallace and Tiernan diaphram metering pump with manual	D-8230	2	EA	$ 7,000.00	$ 14,000.00
		adj. of feedrate (for sodium aluminate 0.4 gpm max feedrate,					
		double simplex arrangement, 1 active, 1 redundant pump)					
		John Pass, Munincipal Treatment Equipment 303-231-9175					
	8	Wallace and Tienan metering pump adder for electric rate	D-8230	2	EA	$ 14,000.00	$ 28,000.00
		of control (SCR Panel, 1 active, 1 redundant pump)					
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
	9	*US Filter Stranco Water Champ In-Line Induction Mixer*	D-8230	2	EA	$ 77,000.00	$ 154,000.00
		15 hp mixer with control panel (need 1 active, 1 redundant)					
		Quote provided by Brian Stofko, US Filter/Stranco Pruducts					
		819-929-4180					
		Solids Contact Upflow Clarifiers					
	10a	WesTech 150 ft diameter solid contact clarifier equipment	D-8230	6	EA	$ 820,000.00	$ 4,920,000.00
		includes drive units, access bridges with walking surface					
		and handrails, center support column, torque cage, sludge					
		collection rakes (1.5 hp), recirculation impeller (15 hp) and					
		draft tube, reaction well, and effluent collection launders.					
		All steel will be shop cleaned and given one coat of shop					
		primer. Cost does not include tanks or finish painting.					
		Upflow rate = 0.67 gpm/sq ft @ 32 deg F and 16.5 mgd					
		Quote provide by Ryan Brady, WesTech Engineering Inc.					
		801-265-1007 ext 399					
		Sheet 2 - (Process Equipment) - subtotal =					**$ 5,189,000.00**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Process Equipment
TSC Design Group: D-8230

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PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Solids Contact Upflow Clarifiers (cont.)					
	10b	Adder for heaters for motors, reducers and torque control	D-8230	6	EA	$ 14,500.00	$ 87,000.00
	11	Conservatek Aluminum Domes for 150 ft dia clarifier tanks	D-8230	1	LS	$ 3,100,000.00	$ 3,100,000.00
		Quote provide by David Cornali, Conservatek.					
		800-880-3663					
	12	Epoxy paint clarifier metal components, area = 35,000 ft2		1	LS	$ 78,000.00	$ 78,000.00
		Sulfuric Acid Injection System					
	13	Sulfuric Acid Storage Tank, 6600 gal, carbon steel	D-8230	1	LS	$ 32,000.00	$ 32,000.00
		approx 10 ft diameter, 11.2 ft tall.					
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
	14	Dessicant Dryer for Acid Tank - Quote provided by	D-8230	1	LS	$ 5,200.00	$ 5,200.00
		John Pass, Municipal Treatment Equipment 303-231-9175					
	15	Wallace and Tiernan diaphram metering pump with manual	D-8230	2	EA	$ 6,400.00	$ 12,800.00
		adj. of feedrate (for sulfuric acid 0.11 gpm max feedrate,					
		simplex arrangement, 1 active, 1 redundant pump)					
		John Pass, Munincipal Treatment Equipment 303-231-9175					
	16	Wallace and Tienan metering pump adder for electric rate	D-8230	2	EA	$ 10,000.00	$ 20,000.00
		of control (SCR Panel, 1 active, 1 redundant pump)					
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
		Sheet 3 - (Process Equipment) - subtotal =					**$ 3,335,000.00**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Process Equipment
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Microfiltration System					
	17	Pall 82 MGD Capacity Rack Mounted MF System	D-8230	1	LS	$ 16,500,000.00	$ 16,500,000.00
		includes module rack assemblies consisting of Microza MF					
		modules, all pumps, tanks, piping, valves, instrumentation					
		and controls. Also included membrane clean in place					
		system, reverse filtration (RF) systems, air compressor and					
		related equipment, chemical feed system consisting of					
		small storage/mixing/feed tanks and metering pumps.					
		System redundancy includes 2 full module rack assemblies,					
		2 strainers, two feed pumps and two RF pumps.					
		Quote provided by Eric Geibel, Pall Water Processing					
		516-801-9060					
		UV Disinfection System					
	18	Calgon 82 mgd capacity 48 inch diameter UV units	D-8230	1	LS	$ 1,300,000.00	$ 1,300,000.00
		includes four 316 L SS reactors (3 active, 1 redundant)					
		(6) medium pressure 20 kW lamps per reactor, PLC					
		controller with touchscreen operator interface mounted in					
		control enclosure, electromagnetic power supply.					
		Quote provided by Ralph Franco, Calgon Carbon Corp.					
		412-787-6620					
	19	**Chlorine Injection System**					
		Two force flow two tank (1-ton) cylinder scales with digital	D-8230	1	LS	$ 120,000.00	$ 120,000.00
		ndicator and transmitter and 4-20 mA output.					
		Sets of cylinder manifold accessories, including header					
		valves, flex connectors, ton container auxiliary valves,					
		Cl2 ball valves, drip leg heaters, and two gas filters.					
		One pair of 3000 lb/day automatic switchover and vacuum					
		regulating valves.					
		Two Wallace and Tiernan V-2000 chlorine gas feed cabinets					
		sized for 2,000 lbs/day feed, complete with SCU proportional					
		electric control and 2 PVC injectors.					
		One lot system safety accessories to include (2) self					
		contained air masks w/ wall mount cabinets, (2) Cl2 gas					
		leak detectors, (8) pair cylinder trunnions for cylinder					
		storage, and (1) ton cylinder lifting bar					
		Sheet 4 - (Process Equipment) - subtotal =					**$ 17,920,000.00**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Process Equipment
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Chlorine Injection System (cont.)					
	19	Quote provided by John Pass, Municipal Treatment		See previous sheet			
		Equipment 303-231-9175					
	20	Powell one ton chlorine gas scrubber	D-8230	1	LS	$ 140,000.00	$ 140,000.00
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
	21	**Ammonia Injection System**					
		Anhydrous Ammonia Bulk Storage Tank 3000 gal capacity	D-8230	2	EA	$ 52,000.00	$ 104,000.00
		6 ft diameter, 14 ft long horizontal ASME pressure vessel,					
		complete with REGO ammonia valves, relief valves, isolation					
		valves, bulk fill connectors and valvesm flex connectors,					
		excess flow valves, two 15 kW electric vaporizers and					
		pressure switches for on/off control.					
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
	22	Wallace and Tiernan Direct Feed Ammoniator	D-8230	1	LS	$ 49,000.00	$ 49,000.00
		complete with inlet pressure reducing valve, electronic					
		federate control, and diffuser assembly.					
		Quote provided by John Pass, Municipal Treatment					
		Equipment 303-231-9175					
		Sheet 5 - (Process Equipment) - subtotal =					**$ 293,000.00**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Process Equipment
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Lime Sludge Dewatering System					
	23	Stancor Electric Submersible Vortex Impeller Lime Sludge	D-8230	8	EA	$ 4,000.00	$ 32,000.00
		Pump. Model SV 750 7.5 hp, 56 gpm max capacity required.					
		Quote provided by Rich Mellinger, Stancor Pumps					
		203-268-7513					
	24	US Filter J-Press Overhead Filter Press	D-8230	1	LS	$ 1,600,000.00	$ 1,600,000.00
		Model 1520N32-96-260SYLO Filter Press, 260 cu ft each					
		Quote provided by Michael Spring, US Filter					
		616-748-7609					
		Ancillary Equipment for Filter Press					
	25	Two Feed Pump Assemblies	D-8230	1	LS	$ 240,000.00	$ 240,000.00
	26	One air compressor (shared between two filter presses)	D-8230	1	LS	$ 105,000.00	$ 105,000.00
	27	One acid cloth wash system (shared between two filter presse	D-8230	1	LS	$ 40,000.00	$ 40,000.00
		Quote provided by Michael Spring, US Filter					
		616-748-7609					
		Sheet 6 - (Process Equipment) - subtotal =					**$ 2,017,000.00**
		Sheets 1 through 6 - (Process Equipment) - Total =					**$ 29,518,000.00**

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 23, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Mechanical Equipment

TSC Design Group: D-8410

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Gravity Drainage System: Consists of	D-8410	15,000	LBS	$ 5.00	$ 75,000.00
		40 - Cast iron floor drains					
		15,000 lbs. of cast iron soil pipe and fittings					
	2	Fire Suppression System: Consists of	D-8410	1	L.S.	$ 135,000.00	$ 135,000.00
		25 - Portable 20# multi-purpose extinguishers					
		1 - Clean agent gas fire extinguishing system for					
		2,000 ft^3 control room					
		1 - Wet Pipe Fire Extinguishing Sprinkler System					
		for 5000 ft^2 floor area					
		1 - Fire Pump, End-Suction, 500 gpm @ 231 ft head					
	3	Interior Domestic Water and Sanitary Waste	D-8410	1	L.S.	$ 76,000.00	$ 76,000.00
		Plumbing System: Consists of:					
		Fixtures: 3 - Water Closets, 1 - Urinal, 2 - Lavatories,					
		2 - Shower Compartments, 1 - Janitor's Floor Sink,					
		2 - Laboratory Sinks, 1 - 60 gallon Hot Water Heater					
		2,000 lbs. of cast iron soil pipe, 3,000 lbs copper tube					
	4	HVAC System: Consists of	D-8410	1	L.S.	$ 660,000.00	$ 660,000.00
		Heating, ventilating and air-conditioning system					
		for approx. 750,000 ft^3 water treatment building.					
		Outdoor temperature extremes during plant					
		operation can be less than 30 degrees F					
		to over 110 degrees F. HVAC equipment					
		will consist of fans, louvers, dampers, ductwork,					
		duct and unit heaters, instrumentation, controls and					
		accessories. Separate ventilation systems					
		to be provided for chemical storage areas.					
		Air conditioning systems to be provided for control/					
		communications rooms and office/administration areas					
	5	Monorail hoist; approx. 100 feet long monorail,	D-8410	2	L.S.	$ 26,000.00	$ 52,000.00
		1-ton capacity hoist; for MF train feedwater pumps					
	6	Monorail hoist; approx. 40 feet long monorail,	D-8410	2	L.S.	$ 16,000.00	$ 32,000.00
		1-1/2-ton capacity hoist; for chlorine storage room					
	7	Engine-generator set, 100 kw, propane fueled	D-8410	1	L.S.	$ 60,000.00	$ 60,000.00
		w/ automatic transfer switch					
	8	Workshop/Machine Shop Equipment:	D-8410	1	L.S.	$ 20,000.00	$ 20,000.00
		20-inch drill press, 8-inch pedestal grinder, 250 amp					
		AC/DC arc welder, 25-ton hydraulic press, 12-inch					
		belt/disk sander, 8-inch horizontal metal band saw,					
		3 work benches, 3 storage cabinets					
		Sheet 1 - (Mechanical Equipment) - subtotal =					**$ 1,110,000.00**

QUANTITIES		PRICES	
BY J.Grass, D-8410	CHECKED C. Lee	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 25, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Mechanical Equipment

TSC Design Group: D-8410

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Clearwell Pumping Plant					
	9	Gravity Drainage System: Consists of	D-8410	1,500	LBS	$ 8.00	$ 12,000.00
		8 - Cast iron floor drains					
		1,500 lbs. of cast iron soil pipe and fittings					
	10	Fire Suppression System: Consists of	D-8410	1	L.S.	$ 800.00	$ 800.00
		6 - Portable 20# multi-purpose extinguishers					
	11	Compressed Air System: Consists of	D-8410	1	L.S.	$ 3,900.00	$ 3,900.00
		1 - 10 cfm @ 125 psi compressor w/ 30 gallon					
		receiver tank and 100 feet of air hose					
	12	HVAC System: Consists of	D-8410	1	L.S.	$ 40,000.00	$ 40,000.00
		Ventilation and heating system for approx.					
		48,000 ft^3 pump motor room.					
		Outdoor temperature extremes during plant					
		operation can be less than 30 degrees F					
		to over 110 degrees F. HVAC equipment					
		will consist of fans, louvers, dampers, ductwork,					
		unit heaters, instrumentation, controls and					
		accessories.					
	13	Electromagnetic Flowmeter System: Consists of	D-8410	1	L.S.	$ 8,000.00	$ 8,000.00
		single sensor electromagnetic flowmeter sensors,					
		flowmeter console equipped with a alphanumeric					
		display, totalizer, 4-20 ma signal					
		output, Nema 4X rated enclosure, 120 Vac,					
		60 Hz, 200-ft length of signal cable, furnished					
		with all necessary equipment to mount sensors					
		and console, MarshMcBirney Model 282 or equal.					
		Sheet 2 - (Mechanical Equipment) - subtotal =					**$ 64,700.00**

QUANTITIES		PRICES	
BY J.Grass, D-8410	CHECKED C. Lee	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 25, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Mechanical Equipment

TSC Design Group: D-8410

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	14	HVAC System for Lime Slaking Building: Consists of	D-8410	1	L.S.	$ 50,000.00	$ 50,000.00
		Consist of: Heating and ventilating system for approx.					
		175,000 ft^3 building.. Outdoor temperature extremes					
		during plant operation can be less than 30 degrees F.					
		to over 110 degrees F. HVAC equipment					
		will consist of fans, louvers, dampers, ductwork,					
		duct and unit heaters, instrumentation, controls and					
		accessories.					
	15	HVAC System for Sludge Dewatering Building:	D-8410	1	L.S.	$ 60,000.00	$ 60,000.00
		Consists of: Heating and ventilating system for approx					
		190,000 ft^3 building. Outdoor temperature extremes					
		during plant operation can be less than 30 degrees F.					
		to over 110 degrees F. HVAC equipment will consist of					
		fans, louvers, dampers, ductwork, duct and unit heaters					
		instrumentation, controls and accessories.					
	16	HVAC System for Coagulant Injection Vault:	D-8410	1	L.S.	$ 6,000.00	$ 6,000.00
		Heating and Ventilation system for approx.					
		3,420 ft^3 vault. Outdoor temperature extremes can be					
		less than 30 degrees F to over 110 degrees F. HVAC					
		equipment will consist of fans, ductwork, unit heaters					
		instrumentation, controls and accessories					
	17	HVAC System for Sludge Sump Vault Dry Wells:	D-8410	2	L.S.	$ 2,000.00	$ 4,000.00
		Heating and ventilating system for approx. 1,000 CF					
		dry wells. Outdoor temperature extremes can be less					
		than 30 degrees F to over 110 degrees F. HVAC					
		equipment will consist of fans, ductwork, unit heaters					
		instrumentation, controls and accessories.					
	18	HVAC System for Upflow Clarifier Valve Vault:	D-8410	6	L.S.	$ 3,000.00	$ 18,000.00
		Heating and Ventilation system for approx.					
		1,725 ft^3 vault. Outdoor temperature extremes					
		can be less than 30 degrees F to over 110 degrees F.					
		HVAC equipment will consist of fans, ductwork,					
		unit heaters, instrumentation, controls and					
		accessories.					
		Sheet 3 - (Mechanical Equipment) - subtotal =					**$ 138,000.00**

QUANTITIES		PRICES	
BY J.Grass, D-8410	CHECKED C. Lee	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 25, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Mechanical Equipment
TSC Design Group: D-8410

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	19	HVAC System for Recycle Water Pump Vault:	D-8410	1	L.S.	$ 6,000.00	$ 6,000.00
		Heating and Ventilation system for approx.					
		3,456 ft^3 vault. Outdoor temperature extremes					
		can be less than 30 degrees F to over 110 degrees F.					
		HVAC equipment will consist of fans, ductwork,					
		unit heaters, instrumentation, controls and					
		accessories.					
	20	Recycle Water Vault Pumps:	D-8410	4	L.S.	$ 13,500.00	$ 54,000.00
		Horizontal, centrifigual, spilt-case type pumps,					
		1137 gal/min capacity @ 63 ft head,					
		cast iron construction, w/ stainless steel internal					
		components, flexible coupled, frame mounted,					
		w/ 25 hp, 460 Vac, 60 hz electric motor.					
		(Three primary and one backup pump)					
	21	Air Compressor for Air Diaphram Lime Slurry Pumps	D-8410	2	L.S.	$ 8,000.00	$ 16,000.00
		Rotary screw type compressor, single stage,					
		flood lubricated, air-cooled, 15 scfm @ 100 psi,					
		w/ 5 hp, 460 Vac, 60 hz electric motor,					
		w/ 120 gallon capacity ASME rated air receiver tank					
		(One primary and one backup compressor/receiver)					
		Sheet 4 - (Mechanical Equipment) - subtotal =					**$ 76,000.00**
		Sheets 1 through 4 - (Mechanical Equipment) - Total =					**$ 1,388,700.00**

QUANTITIES		PRICES	
BY J.Grass, D-8410	CHECKED C. Lee	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED March 25, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Biota WTP - Clearwell P. P.
(120 CFS Plant Capacity - 3 units, 1 spare unit

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Generic Site Earthwork

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	4 each Vertical turbine pumping pumps	8420	1	LS	$ 1,300,000.00	$ 1,300,000.00
		18,000 gpm (40 cfs), 346 ft TDH, 1180 rpm,					
		product lub., 24" column pipe assembly &					
		discharge head, 54" x 54" soleplate.					
		4 pumps - 13,300 lb each					
	2	4 each Vertical induction motors:	8420	1	LS	$ 1,200,000.00	$ 1,200,000.00
		2000 hp, 1200 rpm, solid shaft, TEAAC,					
		4160-volt					
		4 motors, 13,800 lb each					
	3	Motor-operated isolation butterfly valves:	8420	4	EA	$ 37,000.00	$ 148,000.00
		Class 250					
		4 - 24" Diameter valves, 1250 lb each					
		4 - motor operators, 350 lb each					
	4	Tilting-disc check valves:	8420	4	EA	$ 34,000.00	$ 136,000.00
		ANSI Class 250					
		4 - 24" Dia. valves, 3,814 lb per valve					
	5	Unit and manifold piping:					
		24" dia., 1/4" wall, 64 lb/ft, L=72 ft; 4608 lb	8420	72	LF	$ 190.00	$ 13,680.00
		42" dia., 1/2" wall, 222 lb/ft, L=75 ft; 16650 lb	8420	75	LF	$ 670.00	$ 50,250.00
	6	Air valves					
		4 - 4" combination air valves, 170 lb each	8420	4	EA	$ 3,400.00	$ 13,600.00
		4 - 6" air-vacuum valves, 150 lb each	8420	6	EA	$ 4,500.00	$ 27,000.00
		Sheet 1 - (Pumps, Motors, Valves & Misc.) - Total =					**$ 2,888,530.00**

QUANTITIES		PRICES	
BY R. Fehr/ R+A19. Frisz D-8420	CHECKED	BY Jerry Zander, D-8170	CHECKED
DATE PREPARED April 5, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

DE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1 #3

EATURE: 18-Mar-05

WATER TREATMENT PLANT

Electrical System Estimate Summary

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP | Appraisal Estimate

FILENAME: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls]Electrical Est Summary

LANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Electrical System	D8430				
		Sheets 1- 3 (WTP Conduit, Switchgear, MCC) - Total =					$ 1,113,130.00
		Sheets 1- 3 (Clearwell Pumping Plant) - Total =					$ 324,275.00
		Sheets 1- 2 (Vault Electrical Equipment) - Total =					$ 41,980.00
		Sheets 1- 2 (Lime Slaking Building) - Total =					$ 43,055.00
		Sheets 1- 2 (Sludge Dewatering Building) - Total =					$ 42,955.00
		Sheet 1 (WTP Substation, Transformer) - Total =					$ 278,100.00
		Electrical System - Total =					$ 1,843,495.00

QUANTITIES		PRICES	
Y M. Schuh D-8430	CHECKED	BY #3 J. Zander	CHECKED CJ / PEER REVIEW DLM 4/15/05
ATE PREPARED 3/18/2005	APPROVED	DATE 4/15/2005	PRICE LEVEL Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Mar-05

128 CFS Water Treatment Plant

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJEC

REGION: GP | Appraisal Estimate

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls]1-WTP

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Plant Grounding System (F&I)	D8430				
		Ground rods:					
	1	10 ft. 3/4" dia., copper-clad		14	EA	$220.00	$3,080.00
		Stranded bare-copper conductor:					
	2	4/0 AWG		1,200	FT	6.00	$7,200.00
	3	2/0 AWG		300	FT	4.50	$1,350.00
	4	4 AWG		300	FT	1.80	$540.00
	5	2 AWG		200	FT	2.20	$440.00
		Electrical Conduit (F&I)	D8430				
		Rigid steel:					
	6	3/4"		2,000	FT	17.00	$34,000.00
	7	1"		1,500	FT	23.00	$34,500.00
		Schedule 40 PVC:					
	8	1"		2,000	FT	$19.00	$38,000.00
	9	1 1/2"		800	FT	$24.00	$19,200.00
	10	2"		500	FT	$27.50	$13,750.00
	11	3"		300	FT	$37.00	$11,100.00
		600 Volt Insulated Conductors (F&I)	D8430				
		Single conductor, stranded copper:					
	12	12 AWG		2,600	FT	0.90	$2,340.00
	13	10 AWG		1,500	FT	1.00	$1,500.00
	14	8 AWG		800	FT	1.30	$1,040.00
	15	2 AWG (100 A feeders)		1,200	FT	2.70	$3,240.00
	16	1 AWG		500	FT	3.20	$1,600.00
	17	1/0 AWG		500	FT	3.50	$1,750.00
	17A	4/0 AWG		3,500	FT	6.00	$21,000.00
	18	500 kcmil (MCC feeders)		5,000	FT	10.70	$53,500.00
		Multi-conductor control cable					
	19	5-conductor 14 AWG		1,500	FT	$1.60	$2,400.00
	20	9-conductor 14 AWG		1,500	FT	$2.50	$3,750.00
	21	12-conductor 14 AWG		2,000	FT	$3.00	$6,000.00
		Sub Total sheet 1					$261,280.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED CJ PEER REVIEW G for DKD
DATE PREPARED 3/18/2005	APPROVED	DATE 4/12/2005	PRICE LEVEL Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 2 OF 3

FEATURE: 30-Mar-05

128 CFS Water Treatment Plant

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJEC

REGION: GP

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls]1-WTP

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Instrumentation Cable (F&I)	D8430				
	22	18 AWG 4 shielded pair		3,000	FT	$1.70	$5,100.00
		Ladder-Type Cable Tray (F&I)	D8430				
	23	Aluminum, 18-inch width		1,000	FT	$90.00	$90,000.00
		5 kV Medium-Voltage Cable (F&I)	D8430				
		Single-conductor, shielded, type MV-90					
		with 100 % insulation					
	24	4/0 AWG		600	FT	$9.50	$5,700.00
	25	**5 kV Metalclad Switchgear (F&I)**	D8430	2	EA	$23,000.00	$46,000.00
		Incoming section with two 1200 A, vacuum					
		power circuit breakers					
		2,000 ampere main bus rating					
	26	**Low-Voltage Power Ckt Bkr Swgr (F&I)**	D8430	1	LS	$63,500.00	$63,500.00
		4000 A bus, four 1600 A frame breakers,		1	EA	$22,300.00	
		four 800 A breakers		4	EA	$10,300.00	
		Motor Control Equipment (F&I)	D8430				
	27	600 volt motor control center:		4	EA	$56,407.50	$225,630.00
		1,600 amp bus; 42,000 amp short-circuit		5	EA	$1,500.00	
		Incoming lugs only					
		Five 20 inch wide sections		5	EA	$3,350	
		Four NEMA size 1 FVNR starter w/ ckt bkr		4	EA	$1,900	
		Four NEMA size 2 FVNR starters w/ ckt bkr		4	EA	$3,400	
		Six 100 A molded-case circuit breakers		6	EA	$600	
		(FVNR = full voltage non-reversing)					
		15% for misc. materials		1	LS	$7,357.50	
	27A	NEMA size 7 FVNR starter in one 30-inch		3	EA	$22,700.00	$68,100.00
		wide MCC sectrion (FVNR= full V non-reversing)					
		Sub Total sheet. 2					$504,030.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED CJ / PEER REVIEW for DCD
DATE PREPARED 3/18/2005	APPROVED	DATE 4/12/2005	PRICE LEVEL Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 30-Mar-05

128 CFS Water Treatment Plant

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJE

REGION: GP

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Bigs Est.xls]1-WTP

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Distribution Panelboard & Transformer (F&I)	D8430				
	28	75 kVA, 480-208Y/120 volt dry-type		2	EA	$5,000.00	$10,000.00
		transformer					
	29	225 ampere, 208Y/120 V panelboard		4	EA	$2,400.00	$9,600.00
		Non-Segregated Phase Bus (F&I)	D8430				
		5 kV, 1200 ampere, outdoor type		100	FT	$1,100.00	$110,000.00
		600 volt, 4000 ampere, outdoor type		200	FT	$660.00	$132,000.00
		Lighting (F&I)	D8430				
		Interior luminaires:					
	30	High bay, high-pressure sodium,		24	EA	$800.00	$19,200.00
		400 W, 208 volt					
	31	120 VAC, 4 ft fluorescent fixture w/ 2 tubes		30	EA	$150.00	$4,500.00
		Exterior luminaires:					
	32	High-pressure sodium, wall-mounted,		16	EA	$470.00	$7,520.00
		outdoor, 70 watt, 120 VAC					
	33	**Building Security System (F&I)**	D8430	1	LS	$10,000.00	$10,000.00
	34	**Power Transformer (F&I)**	D8430	1	EA	$45,000.00	$45,000.00
		4.16 kV-480Y/277 volt, 3-phase					
		3,750 kVA					
		Outdoor dry-type, VPI or VPE					
		Sub Total sheet 3					$347,820.00
		TOTAL, sheet 1-3, WPI					$1,113,130.00

QUANTITIES		PRICES	
M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED CJ PEER REVIEW for DCD
DATE PREPARED 3/18/2005	APPROVED	DATE 4/12/2005	PRICE LEVEL Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 3

FEATURE: 18-Mar-05

Clearwell Pumping Plant

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

Appraisal Estimate

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls]2-Clearwell PP

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Plant Grounding System (F&I)	D8430				
		Ground rods:					
	1	10 ft. 3/4" dia., copper-clad		8	EA	$220.00	$1,760.00
		Stranded bare-copper conductor:					
	2	4/0 AWG		400	FT	$6.00	$2,400.00
	3	2/0 AWG		150	FT	$4.50	$675.00
	4	4 AWG		150	FT	$1.80	$270.00
		Electrical Conduit (F&I)	D8430				
		Rigid steel:					
	5	3/4"		500	FT	$17.00	$8,500.00
	6	1"		800	FT	$23.00	$18,400.00
	7	1 1/2"		200	FT	$29.00	$5,800.00
	8	2"		200	FT	$36.00	$7,200.00
		600 Volt Insulated Conductors (F&I)	D8430				
		Single conductor, stranded copper:					
	9	12 AWG		2,000	FT	$0.90	$1,800.00
	10	10 AWG		1,200	FT	$1.00	$1,200.00
	11	8 AWG		600	FT	$1.30	$780.00
	12	2 AWG (100 A feeders)		400	FT	$2.70	$1,080.00
	13	1/0 AWG		300	FT	$3.50	$1,050.00
	14	4/0 AWG (MCC feeder)		300	FT	$6.00	$1,800.00
		Multi-conductor control cable:					
	15	9-conductor 14 AWG		1,000	FT	$2.50	$2,500.00
	16	12-conductor 14 AWG		1,000	FT	$3.00	$3,000.00
		Sub Total sheet 1					$58,215.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED CJ / PEER REVIEW g for DCD
DATE PREPARED 3/18/2005	APPROVED	DATE 4/12/2005	PRICE LEVEL Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 18-Mar-05

Clearwell Pumping Plant

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls]2-Clearwell PP

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		5 kV Medium-Voltage Cable (F&I)	D8430				
		Single-conductor, shielded, type MV-90					
		with 100 % insulation					
	17	4/0 AWG (motor leads & MCE feeder)		2,000	FT	$10.00	$20,000.00
	18	**5 kV Motor Control Equipment (F&I)**	D8430	1	LS	$112,600.00	$112,600.00
		Incoming section					
		4 full-voltage synchronous motor starters		4	EA	$25,600.00	
		with 400 amp vacuum contactors (2000 HP)					
		1-1,200 amp fused interrupter switch		1	EA	$10,200.00	
		Station-Service Transformer (F&I)	D8430				
	19	750 kVA, 4,160-480Y/277 volt, dry-type		1	EA	$47,700.00	$47,700.00
	20	**Motor Control Center (F&I)**	D8430	1	LS	$57,000.00	$57,000.00
		600 volt motor control center:					
		1,000 amp bus; 42,000 amp short-circuit		5	EA	$1,500	
		Incoming lugs only					
		Five 20 inch wide sections		5	EA	$3,350	
		6 NEMA size 1 FVNR starter w/ ckt bkr		6	EA	$1,900	
		3 NEMA size 2 FVNR starters w/ ckt bkr		3	EA	$3,400	
		Six 100 A molded-case circuit breakers		6	EA	$600	
		(FVNR = full voltage non-reversing)					
		15% for misc. materials		1	LS	$7,400	
		Sub Total sheet 2					$237,300.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED CJ / PEER REVIEW G for OCD
DATE PREPARED 3/18/2005	APPROVED	DATE 4/12/2005	PRICE LEVEL Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 18-Mar-05

Clearwell Pumping Plant

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls]2-Clearwell PP

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	Qty	UNIT	UNIT PRICE	AMOUNT
		Distribution Panelboard & Transformer (F&I)	D8430				
	21	75 kVA, 480-208Y/120 volt dry-type transformer		1	EA	$5,800.00	$5,800.00
	22	100 ampere, 208Y/120 V panelboard		2	EA	$2,300.00	$4,600.00
		Lighting (F&I)	D8430				
		Interior luminaires:					
	23	High bay, high-pressure sodium, 400 W, 208 volt		8	EA	$800.00	$6,400.00
	24	120 VAC, 4 ft fluorescent fixture w/ 2 tubes		8	EA	$150.00	$1,200.00
		Exterior luminaires:					
	25	High-pressure sodium, wall-mounted, outdoor, 70 watt, 120 VAC		8	EA	$470.00	$3,760.00
	26	**Building Security System (F&I)**	D8430	1	LS	$7,000.00	$7,000.00
		Sub Total sheet 3					$28,760.00
		TOTAL, sheet 1-3, WPI					$324,275.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED CJ J for DCD — PEER REVIEW
DATE PREPARED 3/18/2005	APPROVED	DATE 4/12/2005	PRICE LEVEL Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 2

FEATURE: 30-Mar-05

Vault Electrical Equipment

Estimate for Sludge Blowdown Sump, Coagulant Injection Vault, Upflow Clarifier Valve Vault, & Recycle Water Vault

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

Appraisal Estimate

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Vault Grounding Systems (F&I)	D8430				
		Ground rods:					
	1	10 ft. 3/4" dia., copper-clad		8	EA	$220.00	$1,760.00
		Stranded bare-copper conductor:					
	2	1/0 AWG		300	FT	3.00	$900.00
	3	4 AWG		150	FT	1.80	$270.00
		Electrical Conduit (F&I)	D8430				
		Rigid steel:					
	4	1"		250	FT	$23.00	$5,750.00
	5	1 1/2"		100	FT	$29.00	$2,900.00
		600 Volt Insulated Conductors (F&I)	D8430				
		Single conductor, stranded copper:					
	6	12 AWG		800	FT	$0.90	$720.00
	7	10 AWG		200	FT	$1.00	$200.00
		Combination Transformer Loadcenter (F&I)	D8430				
	8	10 kVA, 1-phase, 480-240/120 volt		2	EA	$2,100.00	$4,200.00
		Dry-type transformer					
		10 single-pole circuit breakers		2	EA	$1,400.00	$2,800.00
	9	15 kVA, 1-phase, 480-240/120 volt		2	EA	$2,800.00	$5,600.00
		Dry-type transformer					
		24 single-pole circuit breakers		2	EA	$2,300.00	$4,600.00
		Sub Total sheet 1					$29,700.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED CJ PEER REVIEW G for DCD
DATE PREPARED 3/18/2005	APPROVED	DATE 4/11/2005	PRICE LEVEL Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 2 OF 2

FEATURE: 30-Mar-05

Vault Electrical Equipment

'stimate for Sludge Blowdown Sump, Coagulant Injection vault, Upflow Clarifier Valve Vault, & Recycle Water Vault

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Distribution Panelboard (F&I)	D8430				
	10	100 amp, 480, 3-phase with 100 A main breaker		1	EA	$3,900.00	$3,900.00
	11	250 amp, 480, 3-phase with 250 A main breaker		1	EA	$5,500.00	$5,500.00
		Lighting (F&I)	D8430				
		Interior luminaires:					
	12	120 VAC, 4 ft fluorescent fixture w/ 2 tubes		8	EA	$150.00	$1,200.00
	13	120 VAC, 150 watt incandescent with gasketed fixture		12	EA	$140.00	$1,680.00
		Sub Total sheet 2					$12,280.00
		TOTAL, sheet 1-2, WPI					$41,980.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED CJ PEER REVIEW G for DLO
DATE PREPARED 3/18/2005	APPROVED	DATE 4/11/2005	PRICE LEVEL Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 2

FEATURE: 18-Mar-05

Lime Slaking Building

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

Appraisal Estimate

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls]3-Vaults

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Grounding System (F&I)	D8430				
		Ground rods:					
	1	10 ft. 3/4" dia., copper-clad		4	EA	$220.00	$880.00
		Stranded bare-copper conductor:					
	2	2/0 AWG		200	FT	4.50	$900.00
	3	4 AWG		100	FT	1.80	$180.00
		Electrical Conduit (F&I)	D8430				
		Schedule 40 PVC:					
	4	3/4"		300	FT	$18.00	$5,400.00
	5	1"		200	FT	$19.00	$3,800.00
	6	2"		50	50	$27.50	$1,375.00
		600 Volt Insulated Conductors (F&I)	D8430				
		Single conductor, stranded copper:					
	7	12 AWG		1,000	FT	0.90	$900.00
	8	10 AWG		500	FT	1.00	$500.00
		Combination Motor Starters (F&I)	D8430	1	EA	$14,500.00	$14,500.00
		480 volt, 3-phase with control transformer,					
		and thermal-magnetic circuit breaker:		1	EA	$2,850.00	
	9	with NEMA size 1 FVNR starter		4	EA	$1,800.00	
	10	with NEMA size 2 FVNR starter		2	EA	$2,130.00	
		(FVNR = full voltage non-reversing)					
		Bldg Service Panelboard (F&I)	D8430				
	11	250 amp, 480, 3-phase with 250 A		1	EA	$5,500.00	$5,500.00
		main breaker					
		Sub Total sheet 1					$33,935.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED MM / PEER REVIEW Y for DCD
DATE PREPARED 3/18/2005	APPROVED	DATE 12/4/2005	PRICE LEVEL Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 18-Mar-05

Lime Slaking Building

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts,

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Combination Transformer Loadcenter (F&I)	D8430				
	12	15 kVA, 1-phase, 480-240/120 volt		1	EA	$2,800.00	$2,800.00
		Dry-type transformer					
		24 single-pole circuit breakers		1	EA	$2,300.00	$2,300.00
		Lighting (F&I)	D8430				
		Interior luminaires:					
	13	120 VAC, 4 ft fluorescent fixture w/ 2 tubes		8	EA	$150.00	$1,200.00
		Exterior luminaires:					
	14	High-pressure sodium, wall-mounted,		6	EA	$470.00	$2,820.00
		outdoor, 70 watt, 120 VAC					
		Sub Total sheet 2					$9,120.00
		TOTAL, sheet 1-2, WPI					$43,055.00

QUANTITIES		PRICES	
M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED PEER REVIEW for DCD
DATE PREPARED 3/18/2005	APPROVED	DATE 12/4/2005	PRICE LEVEL Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 2

FEATURE: 18-Mar-05

Sludge Dewatering Building

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

Appraisal Estimate

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts, Blgs Est.xls]3-Vaults

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Grounding System (F&I)	D8430				
		Ground rods:					
	1	10 ft. 3/4" dia., copper-clad		4	EA	$220.00	$880.00
		Stranded bare-copper conductor:					
	2	2/0 AWG		200	FT	4.50	$900.00
	3	4 AWG		100	FT	1.80	$180.00
		Electrical Conduit (F&I)	D8430				
		Schedule 40 PVC:					
	4	3/4"		300	FT	$18.00	$5,400.00
	5	1"		200	FT	$19.00	$3,800.00
	6	2"		50	FT	$27.50	$1,375.00
		600 Volt Insulated Conductors (F&I)	D8430				
		Single conductor, stranded copper:					
	7	12 AWG		1,000	FT	0.90	$900.00
	8	10 AWG		500	FT	1.00	$500.00
		Combination Motor Starters (F&I)	D8430	1	EA	$15,000.00	$15,000.00
		480 volt, 3-phase with control transformer,					
		and thermal-magnetic circuit breaker:		1	EA	$2,850.00	
	9	with NEMA size 1 FVNR starter		4	EA	$1,800.00	
	10	with NEMA size 2 FVNR starter		2	EA	$2,130.00	
		(FVNR = full voltage non-reversing)					
		Bldg Service Panelboard (F&I)	D8430				
	11	250 amp, 480, 3-phase with 250 A		1	EA	$5,500.00	$5,500.00
		main breaker					
		Sub Total sheet 1					$34,435.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED MWI / PEER REVIEW G for DCD
DATE PREPARED 3/18/2005	APPROVED	DATE 12/4/2005	PRICE LEVEL Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 18-Mar-05

Sludge Dewatering Building

TSC Design Group: D-8430

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: J:\Red River ND- WTP\[Red River-WTP- Electric01- PP, Vauts,

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Combination Transformer Loadcenter (F&I)	D8430				
	12	15 kVA, 1-phase, 480-240/120 volt		1	EA	$2,700.00	$2,700.00
		Dry-type transformer					
		24 single-pole circuit breakers		1	EA	$1,800.00	$1,800.00
		Lighting (F&I)	D8430				
		Interior luminaires:					
	13	120 VAC, 4 ft fluorescent fixture w/ 2 tubes		8	EA	$150.00	$1,200.00
		Exterior luminaires:					
	14	High-pressure sodium, wall-mounted, outdoor, 70 watt, 120 VAC		6	EA	$470.00	$2,820.00
		Sub Total sheet 2					$8,520.00
		TOTAL, sheet 1-2, WPI					$42,955.00

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED	BY Ulrike Berg	CHECKED MU / PEER REVIEW Sy for DCD
DATE PREPARED 3/18/2005	APPROVED	DATE 12/4/2005	PRICE LEVEL Jan 05

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

SHEET__1__ OF __1__

FEATURE:

WATER TREATMENT PLANT
Electrical Power Equipment

PROJECT
RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP | **Appraisal Estimate**

FILE: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River-WTP- Electric02-Water Treatment Plant.xls]Sheet 1

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
D-8440	1	15-kV outdoor unit substation consisting of:	F&I	1	LS	$74,800	$74,800.00
	1.a	15-kV Incoming Primary Section (outdoor, NEMA 4) with:					
		1. 1-3-Phase, 15-kV,1200A, 63-kA Int. current, metal-clad circuit breaker.		1	ea	$37,600	
		2. 3-7.2-kV current transformers, 400:5.		3	ea	$3,300	
		3. 3-7.2kV - 120V potential transformers.		3	ea	$4,600	
		4. 3-9-kV metal-oxide surge arresters.		3	ea	$4,500	
		5. 1200 A rated main bus (copper). - included above					
	1.b	Transformer Section:					
		1-3-Phase, 7.2 - 4.16-kV, 10,000-kVA OA (soy-filled) power transformer with side-mounted bushings suitable for throat connections (oil containment by D-8120)		1	ea	$142,000	$142,000.00
D-8440	2	5-kV Non-segregated phase bus, outdoor, 2000A.	F&I	50	ln ft	$900	$45,000.00
		Aluminum or copper bus conductor.					
D-8440	3	8-kV, 3-1/C-1000kcmil, EPR-insulated power cable, buried in earth (30" min depth)	F&I	500	ln ft	$29	$14,500.00
D-8440	4	6-inch, plastic-coated rigid steel conduit	F&I	15	ln ft	$120	$1,800.00
		Total Water Treatment Plant (Power Equ.)					$278,100.00

QUANTITIES		PRICES	
BY: Doug Crawford	CHECKED: Terry Williams; 3/28/2005	BY: Ulrike Berg	CHECKED: CJ / PEER REVIEW: G for DCD
DATE PREPARED: March 28, 2005	PEER REVIEW:	DATE PREPARED: April 12, 2005	PRICE LEVEL: Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 18-Apr-05

McClusky Canal PP
340 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\McClusky Canal\[Red River - McClusky 340 CFS Summary.xls]Summary

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		SUMMARY SHEET					
		Subtotal D-8120 (Pattie)					$4,726,143.75
		Subtotal D-8410 (Grass)					$1,924,200.00
		Subtotal D-8420 (Fehr)					$1,760,000.00
		Subtotal D-8420 (Frisz)					$2,796,240.00
		Subtotal D-8430 (Schuh)					$1,281,745.00
		Subtotal D-8440 (Crawford)					$543,375.00
		Subtotal					$13,031,703.75
		***Additional Unlisted Item % (>5%) broken out per client direction**					$1,250,000.00
		Subtotal					$14,281,703.75
		Mobilization	+/-	5.00%			$710,000.00
		Subtotal					$14,991,703.75
		*Unlisted Items	+/-	5.00%			$508,296.25
		CONTRACT COST					$15,500,000.00
		Contingencies	+/-	25.00%			$4,000,000.00
		FIELD COSTS					$19,500,000.00
		Noncontract					$4,500,000.00
		Construction Cost	+/-	25.00%			$24,000,000.00

QUANTITIES		PRICES	
BY	CHECKED	BY G. Ruff K. Copeland	CHECKED DJR CJ
DATE PREPARED	APPROVED	DATE 4/18/2005	PRICE LEVEL Jan-2005 Appraisal

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

SHEET 1 OF

FEATURE:

McClusky Canal PP
340 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these estimate worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP **PRICE LEVEL** Jan 05 - Appraisal

FILE: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\McClusky Canal\[D8120 - 340 cfs.xls]Sheet 1

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8120				
		Earthwork					
	1	Excavation for plant substructure		8,720	CY	$10.00	$87,200.00
	2	Excavation for Service Yard & Access Road		207,000	CY	$3.00	$621,000.00
	3	Compacted Backfill for plant substructure		3,500	CY	$16.00	$56,000.00
	4	6" Gravel Surfacing for Yard & Access Road		3,600	CY	$25.00	$90,000.00
		(includes access road from county rd to WTP)					
	5	Excavation for discharge pipe trench		22,275	CY	$4.00	$89,100.00
	6	Compacted backfill of the trench including select material		22,055	CY	$12.00	$264,660.00
		Dewatering for Structure Excavation					
		2, earthen embankment cofferdams in canal		3,080	CY	$12.00	$36,960.00
		2-inch diameter pressure relief (dewatering) wells		20	EA	$15,000.00	$300,000.00
		approx. depth = 60 ft. (Bottom 10' screened					
		assume 50 ft3/day pump rate					
		Superstructure					
		Pre-engineered metal Building - 18' eave height					
		3:12 Roof Pitch, 60.5' wide x 95' long		1	EA	$650,000.00	$650,000.00
		Substructure					
		Concrete		2,920	CY	$580.00	$1,693,600.00
		Cement		823	TN	$140.00	$115,220.00
		Reinforcement		365,000	LB	$1.25	$456,250.00
		Misc. metalwork for pumping plant		Assume included in unlisted items			
		Chain Link Fencing					
		7' High with 3 strands of barb wire on top.		560	LF	$25.00	$14,000.00
		24' wide double swing vehicle		2	EA	$3,000.00	$6,000.00
		access gates.					
		Seeding of Disturbed Areas		8.7	AC	$2,500.00	$21,750.00
		Roof Access Hatches		8	EA	$26,000.00	$208,000.00
		8' x 20' Type "D" Roof Scuttle as manufactured					
		by The Bilco Co.					
		Switchyard					
		Concrete for foundations		15	CY	$900.00	$13,500.00
		Cement		4	TN	$140.00	$560.00
		Reinforcement		1,875	LB	$1.25	$2,343.75
		SUBTOTAL					$4,726,143.75

QUANTITIES		PRICES	
BY	CHECKED	BY K. Copeland	CHECKED CJ
DATE PREPARED	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW DLM 4/15/05

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Appraisal

McClusky Canal PP
340 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these estimate worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP | **PRICE LEVEL:** Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 340 CFS .xls]D-8410(Grass)

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Gravity Drainage System: Consists of	D-8410	1	L.S.	$32,000.00	$32,000.00
		16 - Cast iron floor drains					
		3,000 lbs. of cast iron soil pipe and fittings					
	2	Fire Suppression System: Consists of	D-8410	1	L.S.	$22,000.00	$22,000.00
		10 - Portable 20# multi-purpose extinguishers					
		1 - Clean agent gas fire extinguishing system for					
		2,000 ft^3 control and communications room					
	3	Compressed Air System: Consists of	D-8410	1	L.S.	$4,200.00	$4,200.00
		1 - 10 cfm @ 125 psi compressor w/ 30 gallon					
		receiver tank and 100 feet of air hose					
	4	HVAC System: Consists of	D-8410	1	L.S.	$73,000.00	$73,000.00
		Ventilation and heating system for approx.					
		95,000 ft^3 pump motor room.					
		Outdoor temperature extremes during plant					
		operation can be less than 30 degrees F					
		to over 110 degrees F. HVAC equipment					
		will consist of fans, louvers, dampers, ductwork,					
		unit heaters, instrumentation, controls and					
		accessories. Wall-type air conditioning					
		unit will be supplied for communications and					
		control room.					
	5	Electromagnetic Flowmeter System: Consists of	D-8410	1	L.S.	$64,000.00	$64,000.00
		single sensor electromagnetic flowmeter sensors,					
		flowmeter console equipped with a alphanumeric					
		display, totalizer, 4-20 ma signal					
		output, Nema 4X rated enclosure, 120 Vac,					
		60 Hz, 200-ft length of signal cable, furnished					
		with all necessary equipment to mount sensors					
		and console, MarshMcBirney Model 282 or equal.					
		Subtotal - Sheet 1					**$195,200.00**

QUANTITIES		PRICES	
BY J.Grass, D-8410	CHECKED C. Lee	BY G. Ruff	CHECKED PR DLM 4/15/05
DATE PREPARED March 18, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Appraisal

McClusky Canal PP
340 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these estimate worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP **PRICE LEVEL:** Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 340 CFS .xls]D-8410(Grass)

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	6	Cylinder tee intake fish screens, 60-inch diameter	D-8410	16	each	$100,000.00	$1,600,000.00
		stainless steel construction,					
		weight: 5,500 each					
	7	Screen air burst air compressor, rotary screw type	D-8410	1	L.S.	$70,000.00	$70,000.00
		rated at 150 psi @ 267 cfm, 75 hp motor,					
		weight: 4,000 lbs.					
	8	Screen air burst receiver tank, 1000 gallon	D-8410	1	L.S.	$23,000.00	$23,000.00
		capacity, 250 psi rated ASME tank w/ pressure					
		switch, pressure gauge and safety valve,					
		weight: 2,500 lbs.					
	9	Water level measuring system consisting of	D-8410	1	L.S.	$10,000.00	$10,000.00
		one upstream level sensor and four downstream					
		level sensors, with transmitter/receiver.					
	10	Bulkhead guides, coated carbon steel construction,	D-8410	1	L.S.	$14,000.00	$14,000.00
		4 sets of guide pairs,					
		Weight: 2,000 lbs. total for 4 sets					
	11	Bulkhead, coated carbon steel construction,	D-8410	1	L.S.	$12,000.00	$12,000.00
		9-ft x 9-ft rectangular shape,					
		Weight: 1,500 lbs. total					
		Subtotal - Sheet 2					**$1,729,000.00**
		Subtotal D-8410 (Grass)					**$1,924,200.00**

QUANTITIES		PRICES	
BY J.Grass, D-8410	CHECKED C. Lee	BY G. Ruff	CHECKED DLM PRV 4/15/05
DATE PREPARED March 18, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

CODE: D-8420

ESTIMATE WORKSHEET

FEATURE: 15-Apr-05

McClusky Pumping Plant
(340 cfs plant capacity)

Appraisal
Price Level - Jan. 2005

PROJECT: Missouri River Basin

LOCATION: Red River Valley Water Treatment Project

MEASUREMENT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Furnish and Install:					
	1	Vertical turbine pumps:	8420	8	ea	$220,000.00	$1,760,000.00
		22,000 gpm (49 cfs), 120 ft. TDH, 880 rpm;					
		with 36" column pipe assembly, discharge					
		head, and 60" x 60" soleplate.					
		8 pumps, 11,700 lb per unit					
		Pump based on Johnston 36DC					
		Subtotal D-8420 (Fehr)					**$1,760,000.00**

QUANTITIES		PRICES	
BY Rich Fehr x 2861		BY G Ruff	CHECKED DLM 4/15/05
DATE PREPARED 15-Apr-05	APPROVED	DATE 4-15-05	PRICE LEVEL DLM 4/15/05

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Appraisal

McClusky Canal PP
340 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these estimate worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP | **PRICE LEVEL** Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 340 CFS .xls]D-8420(Frisz)

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D8420				
		Furnish and Install the following:					
		Steel piping for manifold and air burst piping					
	1	36" Dia., t = .25", Wt. = 96 lb/ft		23,040	lb	$4.00	$92,160.00
	2	42" Dia., t = .25", Wt. = 112 lb/ft		3,360	lb	$4.00	$13,440.00
	3	78" Dia. t = ..375", Wt. = 314 lb/ft		370,520	lb	$3.00	$1,111,560.00
	4	84" Dia., t = ..375", Wt. = 326 lb/ft		221,680	lb	$3.00	$665,040.00
	5	6" Dia., Std. wall, Wt. = 19 lb/ft		39,330	lb	$4.00	$157,320.00
		Valves for manifold and air burst piping					
	6	AWWA Class 150, Motor operated butterfly valves:					
		8 - 36" Diameter valves, 3300 lb per valve		26,400	lb	$10.00	$264,000.00
	7	AWWA Class 150, Pneumatic operated butterfly valves:					
		16 - 6" Diameter valves, 90 lb per valve		1,440	lb	$9.00	$12,960.00
	8	AWWA Class 150, Manually operated butterfly valves:					
		16 - 6" Diameter valves, 90 lb per valve		1,440	lb	$8.00	$11,520.00
	9	ANSI Class 125, Tilting disk check valves:					
		8 - 36" Dia. valves, 7600 lb. per valve		60,800	lb	$7.00	$425,600.00
	10	Air valves:					
		16 - 6" Diameter valves, 205 lb per valve		3,280	lb	$13.00	$42,640.00
		Subtotal D-8420 (Frisz)					**$2,796,240.00**

QUANTITIES		PRICES	
BY Rick Frisz	CHECKED	BY G. Ruff Ruff	CHECKED CJ
DATE PREPARED 3/15/05	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW RICC 4/16/05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 18-Mar-05

McClusky Canal Pumping Plant

340 CFS Option

Includes Discharge Line to WTP

(WTP not included in these worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 340 CFS .xls]D-84

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Plant Grounding System (F&I)	D8430				
		Ground rods:					
	1	10 ft. 3/4" dia., copper-clad		10	EA	$230.00	$2,300.00
		Stranded bare-copper conductor:					
	2	4/0 AWG		800	FT	$6.00	$4,800.00
	3	2/0 AWG		800	FT	$4.50	$3,600.00
	4	4 AWG		500	FT	$1.80	$900.00
		Electrical Conduit (F&I)	D8430				
		Rigid steel:					
	5	3/4"		200	FT	$17.00	$3,400.00
	6	1"		300	FT	$23.00	$6,900.00
	7	1 1/2"		80	FT	$29.00	$2,320.00
	8	2"		100	FT	$36.00	$3,600.00
	9	3"		60	FT	$71.00	$4,260.00
		600 Volt Insulated Conductors (F&I)	D8430				
		Single conductor, stranded copper:					
	10	12 AWG		1,000	FT	$0.90	$900.00
	11	10 AWG		500	FT	$1.00	$500.00
	12	2 AWG (100 A feeders)		300	FT	$5.20	$1,560.00
	13	1/0 AWG		100	FT	$3.50	$350.00
	14	4/0 AWG (Lighting xfmr feeder)		150	FT	$6.10	$915.00
	15	350 kcmil (MCC feeder)		400	FT	$8.50	$3,400.00
		Subtotal - Sheet 1					**$39,705.00**

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi	BY G. Ruff	CHECKED MJ/ME
DATE PREPARED 3/18/2005	APPROVED	DATE 4/14/05	PRICE LEVEL Appraisal - Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 18-Mar-05

McClusky Canal Pumping Plant
340 CFS Option
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 34

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		5 kV Medium-Voltage Cable (F&I)	D8430				
		Single-conductor, shielded, type MV-90					
		with 100 % insulation					
	16	2 AWG		800	FT	$6.50	$5,200.00
	17	6 AWG		200	FT	$5.20	$1,040.00
	18	**5 kV Motor Control Equipment (F&I)**	D8430	1	LS	$270,000.00	$270,000.00
		Incoming section with two 1200 A, vacuum					
		power circuit breakers					
		8 full-voltage induction motor starters					
		with 400 amp vacuum contactors					
		Station-Service Transformer (F&I)	D8430				
	19	500 kVA, 4,160-480Y/277 volt, dry-type		1	EA	$36,000.00	$36,000.00
	20	**Motor Control Equipment (F&I)**	D8430	1	LS	$45,000.00	$45,000.00
		600 volt motor control center:					
		1,000 amp bus; 42,000 amp short-circuit					
		Incoming lugs only					
		Five 20 inch wide sections					
		One NEMA size 4 FVNR starter w/ ckt bkr					
		Four NEMA size 1 FVNR starters w/ ckt bkr					
		Six 100 A molded-case circuit breakers					
		Two 225 A molded-case circuit breakers					
		(FVNR = full voltage non-reversing)					
		Distribution Panelboard & Transformer (F&I)	D8430				
	21	150 kVA, 480-208Y/120 volt dry-type		1	EA	$8,500.00	$8,500.00
		transformer					
	22	250 ampere, 208Y/120 V panelboard		3	EA	$3,800.00	$11,400.00
		Subtotal - Sheet 2					**$377,140.00**

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi	BY G. Ruff Gmr	CHECKED DCR-PR MG/mc
DATE PREPARED 3/18/2005	APPROVED	DATE 4/14/05	PRICE LEVEL Appraisal - Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 3 OF 3

FEATURE: 18-Mar-05

McClusky Canal Pumping Plant
340 CFS Option
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 34

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Lighting (F&I)	D8430				
		Interior luminaires:					
	23	High bay, high-pressure sodium,		10	EA	$800.00	$8,000.00
		400 W, 208 volt					
	24	120 VAC, 4 ft fluorescent fixture w/ 2 tubes		6	EA	$150.00	$900.00
		Exterior luminaires:					
	25	High-pressure sodium, wall-mounted,		12	EA	$500.00	$6,000.00
		outdoor, 70 watt, 120 VAC					
	26	**Building Security System (F&I)**	D8430	1	LS	$10,000.00	$10,000.00
		Main Pump Motors (F&I)	D8430				
	27	800 HP, 4.16 kV, 3-phase, 900 rpm		8	EA	$105,000.00	$840,000.00
		vertical induction motor, WPI enclosure					
		Subtotal - Sheet 3					**$864,900.00**
		Subtotal D-8430 (Schuh)					**$1,281,745.00**

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi	BY G. Ruff	CHECKED
DATE PREPARED 3/18/2005	APPROVED	DATE 4/14/05	PRICE LEVEL Appraisal - Jan - 05

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: Appraisal

McClusky Canal PP
340 CFS Pumping Plant Option
Electrical Power Equipment

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP **PRICE LEVEL:** Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 340 CFS .xls]Summary

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
D-8440	1	Local utility to make a tap of existing 41.6-kV line and construct approx. 3/4 of a mile of transmission line and a substation at the site.	F&I	For the lump sum of:			$220,000.00
D-8440	2	15-kV outdoor unit substation USB consisting of:	F&I	1	ea	$220,000.00	$220,000.00
	2.a	15-kV Incoming Primary Section (outdoor, NEMA 4) with:					
		1. 1-3-Phase, 15-kV,1200A, 63-kA Int. current, metal-clad circuit breaker.					
		2. 3-7.2-kV current transformers, 400:5.					
		3. 3-7.2kV - 120V potential transformers.					
		4. 3-9-kV metal-oxide surge arresters.					
		5. 1200 A rated main bus (copper).					
	2.b	Transformer Section:					
		1-3-Phase, 7.2 - 4.16-kV, 7500-kVA OA (soy-filled) power transformer with side-mounted bushings suitable for throat connections (oil containment by D-8120)					
D-8440	3	5-kV Non-segregated phase bus, outdoor, 1200A.	F&I	50	ln ft	$1,200.00	$60,000.00
		Aluminum or copper bus conductor.					
D-8440	4	8-kV, 3-1/C-1000kcmil, EPR-insulated power cable, buried in earth (30" min depth)	F&I	500	ln ft	$80.00	$40,000.00
D-8440	5	6-inch, plastic-coated rigid steel conduit	F&I	15	ln ft	$225.00	$3,375.00
		Subtotal D-8440 (Crawford)					**$543,375.00**

QUANTITIES		PRICES	
BY Doug Crawford	CHECKED Terry Williams; 3-18-05	BY	CHECKED
DATE PREPARED March 18, 2005	PEER REVIEW	DATE PREPARED	PEER REVIEW

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 18-Apr-05

McClusky Canal PP
128 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\McClusky Canal\[Red River - McClusky 128 CFS Summary.xls]Summary

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		SUMMARY SHEET					
		Subtotal D-8120 (Pattie)					$3,218,705.00
		Subtotal D-8410 (Grass)					$1,030,200.00
		Subtotal D-8420 (Fehr)					$880,000.00
		Subtotal D-8420 (Frisz)					$1,499,520.00
		Subtotal D-8430 (Schuh)					$727,390.00
		Subtotal D-8440 (Crawford)					$479,425.00
		Subtotal					$7,835,240.00
		***Additional Unlisted Item % (>5%) broken out per client direction**					$740,000.00
		Subtotal					$8,575,240.00
		Mobilization	+/-	5.00%			$430,000.00
		Subtotal					$9,005,240.00
		*Unlisted Items	+/-	5.00%			$494,760.00
		CONTRACT COST					$9,500,000.00
		Contingencies	+/-	25.00%			$2,500,000.00
		FIELD COSTS					$12,000,000.00
		Noncontract					$3,000,000.00
		Construction Cost	+/-	25.00%			$15,000,000.00

QUANTITIES		PRICES	
BY	CHECKED	BY G. Ruff K. Copeland	CHECKED DCA CJ
DATE PREPARED	APPROVED	DATE 4/18/2005	PRICE LEVEL Jan-2005 Appraisal

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

SHEET 1 OF

FEATURE:

McClusky Canal PP
128 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these estimate worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP | **PRICE LEVEL** Jan 05 - Appraisal

FILE: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\McClusky Canal\[D8120 - 128 cfs.xls]Sheet 1

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8120				
		Earthwork					
	1	Excavation for plant substructure		5,400	CY	$10.00	$54,000.00
	2	Excavation for Service Yard		205,000	CY	$3.00	$615,000.00
	3	Compacted Backfill for plant substructure		2,610	CY	$16.00	$41,760.00
	4	6" Gravel Surfacing		3,500	CY	$25.00	$87,500.00
	5	Excavation for discharge pipe trench		22,275	CY	$4.00	$89,100.00
	6	Compacted backfill of the trench including select material		22,055	CY	$12.00	$264,660.00
		Dewatering for Structure Excavation					
		2, earthen embankment cofferdams in canal		3,080	CY	$12.00	$36,960.00
		2-inch diameter pressure relief (dewatering) wells		20	EA	$15,000.00	$300,000.00
		approx. depth = 60 ft. (Bottom 10' screened					
		assume 50 ft3/day pump rate					
		Superstructure					
		Pre-engineered metal Building - 18' eave height					
		3:12 Roof Pitch, 60.5' wide x 50' long		1	EA	$340,000.00	$340,000.00
		Substructure					
		Concrete		1,550	CY	$600.00	$930,000.00
		Cement		437	TN	$140.00	$61,180.00
		Reinforcement		193,750	LB	$1.25	$242,187.50
		Misc. metalwork for pumping plant		Assume included in unlisted items			
		Chain Link Fencing					
		7' High with 3 strands of barb wire on top.		555	LF	$25.00	$13,875.00
		24' wide double swing vehicle		2	EA	$3,000.00	$6,000.00
		access gates.					
		Seeding of Disturbed Areas		8.6	AC	$2,500.00	$21,500.00
		Roof Access Hatches		4	EA	$26,000.00	$104,000.00
		8' x 20' Type "D" Roof Scuttle as manufactured					
		by The Bilco Co.					
		Switchyard					
		Concrete for foundations		10	CY	$900.00	$9,000.00
		Cement		3	TN	$140.00	$420.00
		Reinforcement		1,250	LB	$1.25	$1,562.50
		SUBTOTAL					$3,218,705.00

QUANTITIES		PRICES	
BY John Pattie, Brad VanOtterloo	CHECKED Al Bernstein	BY K. Copeland	CHECKED CJ
DATE PREPARED March 17, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW DLM 4/15/05

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Appraisal

McClusky Canal PP
128 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these estimate worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP | **PRICE LEVEL:** Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 128 CFS .xls]D-8410(Grass)

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Gravity Drainage System: Consists of 8 - Cast iron floor drains 1,500 lbs. of cast iron soil pipe and fittings	D-8410	1	L.S.	$16,000.00	$16,000.00
	2	Fire Suppression System: Consists of 6 - Portable 20# multi-purpose extinguishers 1 - Clean agent gas fire extinguishing system for 2,000 ft^3 control and communications room	D-8410	1	L.S.	$21,000.00	$21,000.00
	3	Compressed Air System: Consists of 1 - 10 cfm @ 125 psi compressor w/ 30 gallon receiver tank and 100 feet of air hose	D-8410	1	L.S.	$4,200.00	$4,200.00
	4	HVAC System: Consists of Ventilation and heating system for approx. 48,000 ft^3 pump motor room. Outdoor temperature extremes during plant operation can be less than 30 degrees F to over 110 degrees F. HVAC equipment will consist of fans, louvers, dampers, ductwork, unit heaters, instrumentation, controls and accessories. Wall-type air conditioning unit will be supplied for communications and control room.	D-8410	1	L.S.	$41,000.00	$41,000.00
	5	Electromagnetic Flowmeter System: Consists of single sensor electromagnetic flowmeter sensors, flowmeter console equipped with a alphanumeric display, totalizer, 4-20 ma signal output, Nema 4X rated enclosure, 120 Vac, 60 Hz, 200-ft length of signal cable, furnished with all necessary equipment to mount sensors and console, MarshMcBirney Model 282 or equal.	D-8410	1	L.S.	$32,000.00	$32,000.00
		Subtotal - Sheet 1					**$114,200.00**

QUANTITIES		PRICES	
BY J.Grass, D-8410	CHECKED C. Lee	BY G. Ruff GLR	CHECKED DCM PRC 4/15/05 MM
DATE PREPARED March 18, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Appraisal

McClusky Canal PP
128 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these estimate worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP | **PRICE LEVEL:** Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 128 CFS .xls]D-8410(Grass)

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	6	Cylinder tee intake fish screens, 60-inch diameter	D-8410	8	each	$100,000.00	$800,000.00
		stainless steel construction,					
		weight: 5,500 each					
	7	Screen air burst air compressor, rotary screw type,	D-8410	1	L.S.	$70,000.00	$70,000.00
		rated for 150 psi @ 267 cfm, 75 hp motor,					
		weight: 4,000 lbs.					
	8	Screen air burst receiver tank, 1000 gallon	D-8410	1	L.S.	$23,000.00	$23,000.00
		capacity, 250 psi rated ASME tank w/ pressure					
		switch, pressure gauge and safety valve,					
		weight: 2,500 lbs.					
	9	Water level measuring system consisting of	D-8410	1	L.S.	$10,000.00	$10,000.00
		one upstream level sensor and two downstream					
		level sensors, with transmitter/receiver.					
	10	Bulkhead guides, coated carbon steel construction,	D-8410	1	L.S.	$7,000.00	$7,000.00
		2 sets of guide pairs,					
		Weight: 1,000 lbs. total for 2 sets					
	11	Bulkhead, coated carbon steel construction,	D-8410	1	L.S.	$6,000.00	$6,000.00
		9-ft x 9-ft rectangular shape,					
		Weight: 1,500 lbs. total					
		Subtotal - Sheet 2					**$916,000.00**
		Subtotal D-8410 (Grass)					**$1,030,200.00**

QUANTITIES		PRICES	
BY J.Grass, D-8410	CHECKED C. Lee	BY G. Ruff	CHECKED DCM PRV 4/15/05
DATE PREPARED March 18, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW

CODE: D-8420

ESTIMATE WORKSHEET

FEATURE: 15-Apr-05

McClusky Pumping Plant
(128 cfs plant capacity)

Appraisal
Price Level - Jan. 2005

PROJECT: Missouri River Basin

LOCATION: Red River Valley Water Treatment Project

MEASUREMENT:

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Furnish and Install:					
	1	Vertical turbine pumps:	8420	4	ea	$220,000.00	$880,000.00
		22,000 gpm (49 cfs), 120 ft. TDH, 880 rpm;					
		with 36" column pipe assembly & discharge					
		head, and 60" x 60" soleplate.					
		4 pumps, 11,700 lb per unit					
		Pump based on Johnston 36DC					
		Subtotal D-8420 (Fehr)					**$880,000.00**

QUANTITIES		PRICES	
BY Rich Fehr x2861		BY G. Ruff	CHECKED DLM 4/15/05
DATE PREPARED 15-Apr-05	APPROVED	DATE 4/15/2005	PEER REVIEW DLM 4/15/05

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Appraisal

McClusky Canal PP
128 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these estimate worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP | **PRICE LEVEL** Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 128 CFS .xls]D-8420(Frisz)

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D8420				
		Furnish and Install the following:					
		Steel piping for manifold and air burst piping					
	1	36" Dia., t = .25", Wt. = 96 lb/ft		11,520	lb	$4.00	$46,080.00
	2	42" Dia., t = .25", Wt. = 112 lb/ft		1,680	lb	$4.00	$6,720.00
	3	48" Dia. t = .375", Wt. = 193 lb/ft		277,740	lb	$3.00	$833,220.00
	4	84" Dia., t = ..375", Wt. = 326 lb/ft		52,160	lb	$3.00	$156,480.00
	5	6" Dia., Std. wall, Wt. = 19 lb/ft		19,665	lb	$4.00	$78,660.00
		Valves for manifold and air burst piping					
	6	AWWA Class 150, Motor operated butterfly valves:					
		4 - 36" Diameter valves, 3300 lb per valve		13,200	lb	$10.00	$132,000.00
	7	AWWA Class 150, Manually operated butterfly valves:					
		8 - 6" Diameter valves, 90 lb per valve		720	lb	$8.00	$5,760.00
	8	AWWA Class 150, Pneumatic operated butterfly valves:					
		8 - 6" Diameter valves, 90 lb per valve		720	lb	$9.00	$6,480.00
	9	ANSI Class 125, Tilting disk check valves:					
		4 - 36" Dia. valves, 7600 lb. per valve		30,400	lb	$7.00	$212,800.00
	10	Air valves:					
		8 - 6" Diameter valves, 205 lb per valve		1,640	lb	$13.00	$21,320.00
		Subtotal D-8420 (Frisz)					**$1,499,520.00**

QUANTITIES		PRICES	
BY Rick Frisz	CHECKED	BY G. Ruff	CHECKED CJ
DATE PREPARED 3/15/05	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW RKC 4/16/05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 18-Mar-05

McClusky Canal Pumping Plant
128 CFS Option
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 128 CFS .xls]D-84

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Plant Grounding System (F&I)	D8430				
		Ground rods:					
	1	10 ft. 3/4" dia., copper-clad		8	EA	$230.00	$1,840.00
		Stranded bare-copper conductor:					
	2	4/0 AWG		500	FT	$6.00	$3,000.00
	3	2/0 AWG		500	FT	$4.50	$2,250.00
	4	4 AWG		350	FT	$1.80	$630.00
		Electrical Conduit (F&I)	D8430				
		Rigid steel:					
	5	3/4"		120	FT	$17.00	$2,040.00
	6	1"		160	FT	$23.00	$3,680.00
	7	1 1/2"		80	FT	$29.00	$2,320.00
	8	3"		60	FT	$71.00	$4,260.00
		600 Volt Insulated Conductors (F&I)	D8430				
		Single conductor, stranded copper:					
	9	12 AWG		600	FT	$0.90	$540.00
	10	10 AWG		200	FT	$1.00	$200.00
	11	2 AWG (100 A feeders)		200	FT	$5.20	$1,040.00
	12	1/0 AWG		100	FT	$3.50	$350.00
	13	350 kcmil (MCC feeder)		400	FT	$8.50	$3,400.00
		Subtotal - Sheet 1					**$25,550.00**

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi	BY G. Ruff	CHECKED DCO PR MLme
DATE PREPARED 3/18/2005	APPROVED	DATE 4/14/05	PRICE LEVEL Appraisal - Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 18-Mar-05

McClusky Canal Pumping Plant
128 CFS Option
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 12

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		5 kV Medium-Voltage Cable (F&I)	D8430				
		Single-conductor, shielded, type MV-90					
		with 100 % insulation					
	14	2 AWG		400	FT	$6.50	$2,600.00
	15	6 AWG		200	FT	$5.20	$1,040.00
	16	**5 kV Motor Control Equipment (F&I)**	D8430	1	LS	$175,000.00	$175,000.00
		Incoming section with two 1200 A, vacuum					
		power circuit breakers					
		4 full-voltage induction motor starters					
		with 400 amp vacuum contactors					
		Station-Service Transformer (F&I)	D8430				
	17	500 kVA, 4,160-480Y/277 volt, dry-type		1	EA	$36,000.00	$36,000.00
	18	**Motor Control Equipment (F&I)**	D8430	1	LS	$35,000.00	$35,000.00
		600 volt motor control center:					
		1,000 amp bus; 42,000 amp short-circuit					
		Incoming lugs only					
		Four 20 inch wide sections					
		1 NEMA size 4 FVNR starter w/ ckt bkr					
		3 NEMA size 1 FVNR starters w/ ckt bkr					
		Four 100 A molded-case circuit breakers					
		(FVNR = full voltage non-reversing)					
		Distribution Panelboard & Transformer (F&I)	D8430				
	19	75 kVA, 480-208Y/120 volt dry-type		1	EA	$5,700.00	$5,700.00
		transformer					
	20	100 ampere, 208Y/120 V panelboard		2	EA	$2,600.00	$5,200.00
		Subtotal - Sheet 2					**$260,540.00**

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi	BY G. Ruff SinR	CHECKED Rcd-PR MM me
DATE PREPARED 3/18/2005	APPROVED	DATE 4/14/05	PRICE LEVEL Appraisal - Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 3 OF 3

FEATURE: 18-Mar-05

McClusky Canal Pumping Plant
128 CFS Option
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 12

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Lighting (F&I)	D8430				
		Interior luminaires:					
	21	High bay, high-pressure sodium,		8	EA	$800.00	$6,400.00
		400 W, 208 volt					
	22	120 VAC, 4 ft fluorescent fixture w/ 2 tubes		6	EA	$150.00	$900.00
		Exterior luminaires:					
	23	High-pressure sodium, wall-mounted,		8	EA	$500.00	$4,000.00
		outdoor, 70 watt, 120 VAC					
	24	**Building Security System (F&I)**	D8430	1	LS	$10,000.00	$10,000.00
		Main Pump Motors (F&I)	D8430				
	25	800 HP, 4.16 kV, 3-phase, 900 rpm		4	EA	$105,000.00	$420,000.00
		vertical induction motor, WPI enclosure					
		Subtotal - Sheet 3					**$441,300.00**
		Subtotal D-8430 (Schuh)					**$727,390.00**

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi	BY G. Ruff	CHECKED
DATE PREPARED 3/18/2005	APPROVED	DATE 4/14/2005	PRICE LEVEL Appraisal - Jan-05

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: Appraisal

McClusky Canal PP
128 CFS Pumping Plant Option
Electrical Power Equipment

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP **PRICE LEVEL:** Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McClusky 128 CFS .xls]D-8440(Crawford)

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
D-8440	1	Local utility to make a tap of existing 41.6-kV line and construct approx. 3/4 of a mile of transmission line and a substation at the site.	F&I	For the lump sum of:			$220,000.00
D-8440	2	15-kV outdoor unit substation USB consisting of:	F&I	1	ea	$190,000.00	$190,000.00
	2.a	15-kV Incoming Primary Section (outdoor, NEMA 4) with:					
		1. 1-3-Phase, 15-kV,1200A, 63-kA Int. current, metal-clad circuit breaker.					
		2. 3-7.2-kV current transformers, 400:5.					
		3. 3-7.2kV - 120V potential transformers.					
		4. 3-9-kV metal-oxide surge arresters.					
		5. 1200-A rated main bus (copper).					
	2.b	Transformer Section:					
		1-3-Phase, 7.2 - 4.16-kV, 5,000-kVA OA (soy-filled) power transformer with side-mounted bushings suitable for throat connections (oil containment by D-8120).					
D-8440	3	5-kV Non-segregated phase bus, outdoor, 600A.	F&I	50	ln ft	$900.00	$45,000.00
		Aluminum or copper bus conductor.					
D-8440	4	8-kV, 3-1/C-500 kcmil, EPR-insulated power cable, buried in earth (30" min depth)	F&I	500	ln ft	$46.00	$23,000.00
D-8440	5	4-inch, plastic-coated rigid steel conduit	F&I	15	ln ft	$95.00	$1,425.00
		Subtotal D-8440 (Crawford)					**$479,425.00**

QUANTITIES		PRICES	
BY Doug Crawford	CHECKED Terry Williams, 3-18-05	BY G. Ruff	CHECKED MM.
DATE PREPARED March 18, 2005	PEER REVIEW	DATE PREPARED 4/14/05	PEER REVIEW DCD

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 18-Apr-05

McLean Bottoms PP
44 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\Missouri River\[Red River - McLean 44 CFS Summary.xls]Summary

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		SUMMARY SHEET					
		Subtotal D-8120 (Pattie)					$4,981,645.00
		Subtotal D-8140 (Robertson)					$1,137,700.00
		Subtotal D-8410 (Grass)					$97,600.00
		Subtotal D-8420 (Fehr)					$620,000.00
		Subtotal D-8420 (Frisz)					$1,062,004.00
		Subtotal D-8430 (Schuh)					$566,507.00
		Subtotal D-8440 (Crawford)					$940,075.00
		Subtotal					$9,405,531.00
		***Additional Unlisted Item % (>5%) broken out per client direction**					$890,000.00
		Subtotal					$10,295,531.00
		Mobilization	+/-	5.00%			$510,000.00
		Subtotal					$10,805,531.00
		*Unlisted Items	+/-	5.00%			$694,469.00
		CONTRACT COST					$11,500,000.00
		Contingencies	+/-	25.00%			$2,500,000.00
		FIELD COSTS					$14,000,000.00
		Noncontract					$3,500,000.00
		Construction Cost	+/-	25.00%			$17,500,000.00

QUANTITIES		PRICES	
BY	CHECKED	BY G. Ruff K. Copeland	CHECKED GRR-PR CJ
DATE PREPARED	APPROVED	DATE 4/18/2005	PRICE LEVEL Jan-2005 Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

SHEET__1__ OF __1__

FEATURE: 15-Apr-05

McLean Bottoms Site - Missouri River
44 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\Missouri

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8120				
		Service Yard					
	1	6-in gravel surface		435	CY	$30.00	$13,050.00
	2	7 ft. chain link fence		939	LF	$25.00	$23,475.00
	3	7 ft. x 24 ft. access gate		3	Ea.	$3,000.00	$9,000.00
	4	Concrete transformer & Air chamber pads		25	CY	$700.00	$17,500.00
	4a	Clearing & minor grading		117,650	CY	$3.00	$352,950.00
	4b	6 in. gravel surface for 16' access road		339	CY	$30.00	$10,170.00
	4c	Construct earthen berms from excavated material		12,000	CY	$5.00	$60,000.00
	5	Construct 20 ft. I.D. Ranney Collector Well					
		Each well = 115 ft. deep, 26 ft. O.D.		2	Ea.	$2,100,000.00	$4,200,000.00
	5a	Excavation req'd to sink 26 ft. O.D. caisson		4,620	CY	included	
	5b	Concrete for caisson		1,848	CY	included	
	5c	Cement (0.282 tons / CY)		522	Tons	included	
	5d	Reinforcement (115 lbs / CY of concrete)		212,520	Lbs	included	
	5e	Concrete req'd for superstructure		248	CY	$650.00	$161,200.00
	5d	Cement (0.282 tons / CY)		140	Tons	$140.00	$19,600.00
	5f	Reinforcement (130 lbs / CY of concrete)		64,480	Lbs	$1.25	$80,600.00
	5g	Unwatering req'd for construction of wells &					
		jacking of pipe laterals					
	5h	Pipe Jacking from within caisson					
		12 in. dia. pipe laterals					
		12 laterals * 150 lf ea. * 2 caissons		3,600	LF	included	
	5h	Pipe Jacking from within caisson					
		12 in. dia. pipe laterals					
		*12 laterals * 150 lf ea. * 2 caissons*		3,600	LF	included	
	6	Seeding		5.4	AC	$2,500.00	$13,500.00
	7	Excavation for manifold pipe trench		800	CY	$6.00	$4,800.00
		(Common excavation)					
	8	Compacted backfill for manifold pipe trench		790	CY	$20.00	$15,800.00
		SUBTOTAL					**$4,981,645.00**

QUANTITIES		PRICES	
BY: JF Pattie	CHECKED: M. R. O'Shea	BY: K. Copeland	CHECKED: CJ DLM PRV 4/15/05
DATE PREPARED: 6-Mar-05	APPROVED:	DATE: 4/15/05	PRICE LEVEL: Jan-2005 Appraisal

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

SHEET 1 OF

FEATURE:

McLean Bottoms Site
44 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: Missouri River

REGION

PRICE LEVEL Jan 05 - Appraisal

FILE: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\Missouri River\[D8140 44 & 63 CFS.xls]44 Cfs

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Symbol Pipe 7,810					
		(Need cathodic monitoring and protertion)					
		fs allow = 15,000 psi					
		t (steel) AWWA M-11					
		30B300 0.1345 (D8420 covers first 1250 ft)		1100	lnft	$110.00	$121,000.00
		36B250 0.1345		6710	lnft	$120.00	$805,200.00
		Excavation (5 ft cover) (Vertical trench)		18,500	yd3	$4.00	$74,000.00
		Pipe embedment material		3,000	yd3	$20.00	$60,000.00
		Pipe trench backfill above embedment		15,500	yd3	$5.00	$77,500.00
		SUBTOTAL					**$1,137,700.00**

QUANTITIES		PRICES	
BY Steve Robertson	CHECKED Richard Fuerst	BY K. Copeland	CHECKED CJ
DATE PREPARED March 7, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW DCM 4/15/05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 15-Apr-05

McLean Bottoms Site - Missouri River
44 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 44 CFS .xls]D-8410(Grass)

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Gravity Drainage System: Consists of	D-8410	2	L.S.	$16,000.00	$32,000.00
		8 - Cast iron floor drains					
		1,500 lbs. of cast iron soil pipe and fittings					
	2	Fire Suppression System: Consists of	D-8410	2	L.S.	$400.00	$800.00
		3 - Portable 20# multi-purpose extinguishers					
	3	Compressed Air System: Consists of	D-8410	2	L.S.	$3,400.00	$6,800.00
		1 - 5 cfm @ 125 psi compressor w/ 30 gallon					
		receiver tank and 50 feet of air hose					
	4	HVAC System: Consists of	D-8410	2	L.S.	$13,000.00	$26,000.00
		Ventilation and heating system for approx.					
		10,000 ft^3 pump motor room and approx.					
		4,800 ft^3 pump discharge and valve room.					
		Outdoor temperature extremes during plant					
		operation can be from less than 30 degrees F					
		to over 110 degrees F. HVAC equipment					
		will consist of fans, louvers, dampers, ductwork,					
		unit heaters, instrumentation, controls and					
		accessories.					
	5	Electromagnetic Flowmeter System: Consists of	D-8410	2	L.S.	$16,000.00	$32,000.00
		single sensor electromagnetic flowmeter sensors,					
		flowmeter consule each equipped with a					
		alphanumeric display, totalizer, 4-20 ma signal					
		output, Nema 4X rated enclosure, 120 Vac,					
		60 Hz, 50-ft length of signal cable, furnished					
		with all necessary equipment to mount sensors					
		and console, MarshMcBirney Model 282 or equal					
		Subtotal D-8410 (Grass)					**$97,600.00**

QUANTITIES		PRICES	
BY J. Grass, D-8410	CHECKED C. Lee	BY G. Ruff GMR	CHECKED DLH PR 4/15/05 MM
DATE PREPARED 4-Mar-05	APPROVED	DATE 4/15/2005	PRICE LEVEL Jan-05 Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 15-Apr-05

McLean Bottoms Site - Missouri River
44 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 44 CFS .xls]D-8410(Grass)

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Pumps - Vertical turbine rated 7000 gpm @ 177 ft	D-8420	4	ea.	$155,000.00 ✓	$620,000.00
		TDH. Underground discharge head, 14 ft					
		between pump base and motor base. With					
		oversized sole plate and base plate. Minimum 36"					
		Column 18" diameter flanged, 85 ft.length					
		Pump based on Johnston 24CC two-stage.					
		Calculated pump weight, 13,500 lb / pump					
		Subtotal D-8420 (Fehr)					**$620,000.00**

QUANTITIES		PRICES	
BY Richard Fehr	CHECKED	BY G. Ruff GMR	CHECKED PK ✓ DCM 4/15/05 DCM
DATE PREPARED 7-Mar-05	APPROVED	DATE 4/15/2005	PRICE LEVEL Jan-05 Appraisal

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:
McLean Bottoms Site - Missouri River
44 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)
WOID: 6B657 Appraisal Estimate

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP | PRICE LEVEL: Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 44 CFS .xls]D-8420(Frisz)

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Hydraulic Equipment					
		Steel Manifold (furnish and install)	D8420				
	1	18-inch Dia., t= 0.25", Wt= 48 lb/ft					
		75 linear feet		3,600	LBS	$4.00	$14,400.00
	2	30-inch Dia., t= 0.25", Wt= 80 lb/ft					
		1140 linear feet		152,000	LBS	$4.00	$608,000.00
		Valves (fuurnish and install)					
	3	ANSI Class 125, Tilting disk, dampened, check valves:					
		4 -18" Diameter valves for pumps					
		with bottom mounted dampener, 1535 lb. per valve		6,140	LBS	$7.00	$42,980.00
	4	AWWA Class 150, Manually operated butterfly valves:					
		4 -18" Diameter valves for pumps					
		640 lb. per valve		2,560	LBS	$8.00	$20,480.00
	5	Air Valve Assemblies					
		8 - 3" Combination type valves, 120 lb. per valve		960	LBS	$13.00	$12,480.00
	6	Ball valves					
		8 - 3" diameter, 16 lb. per valve		128	LBS	$13.00	$1,664.00
		Air Chamber					
	7	Air Chamber	D8420				
		14-ft diameter cylinder with elliptical dished end heads					
		designed for 152 psig, Tank wall thickness = 1"					
		volume = 4414 cubic feet					
		Vertical orientation monted on cylinder skirt		68,000	LBS	$4.00	$272,000.00
	8	Air Compressor					
		100 horsepower motor					
		175 psig pressure @ 300 cfm free air displacement					
		Piston-reciprocal type compressor, air cooled	D8420	1	EA	$90,000.00	$90,000.00
		3750 Lbs.					
		Subtotal D-8420 (Frisz)					**$1,062,004.00**

QUANTITIES		PRICES	
BY Rick Frisz, D8420	CHECKED	BY G. Ruff GWR	CHECKED CJ
DATE PREPARED 3/1/05	PEER REVIEW	DATE PREPARED 04/15/05	PEER REVIEW RKC 4/16/05

CODE:D-8.70

ESTIMATE WORKSHEET

SHEET 1 OF 2

FEATURE: 14-Apr-05

McLean Bottoms Site - Missouri River
44 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 44 CFS .xls]Summary

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Plant Grounding System (F&I)	D8430				
		Ground rods:					
	1	10 ft. 3/4" dia., copper-clad		12	EA	$230.00	$2,760.00
		Stranded bare-copper conductor:					
	2	4/0 AWG		400	FT	$6.00	$2,400.00
	3	3/0 AWG		200	FT	$5.00	$1,000.00
	4	4 AWG		270	FT	$1.80	$486.00
		Electrical Conduit (F&I)	D8430				
		Rigid steel:					
	5	3/4"		470	FT	$17.00	$7,990.00
	6	1"		400	FT	$23.00	$9,200.00
	7	2"		400	FT	$36.00	$14,400.00
	8	3 1/2"		470	FT	$84.00	$39,480.00
		Schedule 80 PVC:					
	9	3 1/2"		670	FT	$30.00	$20,100.00
		600 Volt Insulated Conductors (F&I)	D8430				
		Single conductor, stranded copper:					
	10	12 AWG		1,670	FT	$0.90	$1,503.00
	11	2 AWG		340	FT	$2.70	$918.00
	12	3/0 AWG		2,400	FT	$5.20	$12,480.00
	13	350 kcmil		3,340	FT	$8.50	$28,390.00
		Subtotal - Sheet 1					**$141,107.00**

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi 3/2/05	BY G. Ruff Suiz	CHECKED Jed PR MM
DATE PREPARED 3/1/2005	APPROVED	DATE 4/14/2005	PRICE LEVEL Appraisal - Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 14-Apr-05

McLean Bottoms Site - Missouri River
44 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)
WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 44 C]

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Distribution Panelboard & Transformer (F&I)	D8430				
	14	75 kVA, 480-208Y/120 volt dry-type		2	EA	$5,700.00	$11,400.00
		transformer					
	15	250 ampere, 208Y/120 V panelboard		2	EA	$3,800.00	$7,600.00
		Motor Control Equipment (F&I)	D8430				
	16	600 volt motor control center:		2	EA	$70,000.00	$140,000.00
		1,600 amp bus; 42,000 amp short-circuit					
		Two 20 inch wide sections					
		Two 30 inch wide sections					
		Two NEMA size 6 FVNR starters w/					
		solid-state overload relay					
		(FVNR=full voltage non-reversing)					
		Lighting (F&I)	D8430				
		Interior luminaires:					
	17	120 VAC, 4 ft fluorescent fixture w/ 2 tubes		16	EA	$150.00	$2,400.00
		Exterior luminaries:					
	18	High-pressure sodium, wall-mounted,		8	EA	$500.00	$4,000.00
		outdoor, 70 watt, 120 VAC					
		Main Pump Motors (F&I)	D8430				
	19	400 HP, 480 volt, 3-phase, 1200 rpm		4	EA	$65,000.00	$260,000.00
		vertical induction motor					
		Subtotal - Sheet 2					**$425,400.00**
		Subtotal D-8430 (Schuh)					**$566,507.00**

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi 3/2/05	BY G. Ruff	CHECKED
DATE PREPARED 3/1/2005	APPROVED	DATE 4/14/2005	PRICE LEVEL Appraisal - Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 14-Apr-05

McLean Bottoms Site - Missouri River
44 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
Option 2 - Lower CFS

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJEC

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 44 CFS .xls]D-8440(Crawford)

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Re-conductor 10 miles of existing 7.2-kV overhead distribution line and provide 1.5 miles of new URD to site (Cost developed by Capital Electric Co-op)		For the Lump Sum of:			$520,000.00
	2	15-kV Outdoor Unit Substation USB1:	D-8440	1	ea	$200,000.00	$200,000.00
		a. Incoming Section (Outdoor, NEMA 4):					
		1 - 3P, 15-kV, 600A, interrupter switch.					
		2 - 3P, 15-kV, 600 A, disconnect switches					
		3 - 8.3-kV, 150-200E current-limiting power fuses.					
		3 - 7.2-kV current transformers, 200:5 A.					
		2 - 7.2-kV - 120V potential transformers					
		3 - 9-kV metal-oxide surge arresters.					
		b. Transformer Section:					
		One 3-Phase, 7.2-kV - 480 V, 750-kVA, OA soy-filled power transformer w/ throat connections.					
		c. Outgoing Section (Outdoor NEMA 4):					
		1 - 480V, 1200A, 3-pole, molded-case circuit breaker with ground fault protection.					
		1 - 480V, 225A, 3-pole molded-case CB.					
		Subtotal - Sheet 1					**$720,000.00**

QUANTITIES		PRICES	
BY Doug Crawford	CHECKED	BY G. Ruff GWR	CHECKED RC MM
DATE PREPARED 3/7/2005	APPROVED	DATE 4/14/2005	PRICE LEVEL Appraisal - Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 14-Apr-05

McLean Bottoms Site - Missouri River
44 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
Option 2 - Lower CFS

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJEC

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 44 CFS .xls]D-8440(Crawford)

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	3	15-kV Outdoor Unit Substation USB2:	D-8440	1	ea	$130,000.00	$130,000.00
		a. Incoming Section (Outdoor, NEMA 4):					
		1 - 3P, 15-kV, 600A, interrupter switch.					
		3 - 8.3-kV, 75E current-limiting power fuses.					
		3 - 9-kV metal-oxide surge arresters.					
		b. Transformer Section:					
		soy-filled power transformer w/ throat					
		c. Outgoing Section (Outdoor NEMA 4):					
		breaker with ground fault protection.					
		1 - 480V, 225A, 3-pole molded-case CB.					
	4	8-kV , 3/C, No. 2 AWG, EPR-insulated cable, buried in earth	D-8440	1550	lin ft	$33.00	$51,150.00
	5	4-inch, PVC-coated, rigid steel conduit	D-8440	15	lin ft	$95.00	$1,425.00
	6	600 V, 1200 A, outdoor, metal-enclosed busway	D-8440	30	lin ft	$1,250.00	$37,500.00
		30 linel feet					
		Subtotal - Sheet 2					**$220,075.00**
		Subtotal D-8440 (Crawford)					**$940,075.00**

QUANTITIES		PRICES	
BY Doug Crawford	CHECKED	BY G. Ruff GWR	CHECKED DCP-PR MH ME
DATE PREPARED 3/7/2005	APPROVED	DATE 4/14/2005	PRICE LEVEL Appraisal - Jan 05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 18-Apr-05

McLean Bottoms PP
63 CFS Pumping Plant Option
Includes Discharge Line to WTP
(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\Missouri River\[Red River - McLean 63 CFS Summary.xls]Summary

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		SUMMARY SHEET					
		Subtotal D-8120 (Pattie)					$7,350,680.00
		Subtotal D-8140 (Robertson)					$2,243,200.00
		Subtotal D-8410 (Grass)					$146,400.00
		Subtotal D-8420 (Fehr)					$930,000.00
		Subtotal D-8420 (Frisz)					$1,142,726.00
		Subtotal D-8430 (Schuh)					$848,980.00
		Subtotal D-8440 (Crawford)					$1,057,175.00
		Subtotal					$13,719,161.00
		***Additional Unlisted Item % (>5%) broken out per client direction**					$1,300,000.00
		Subtotal					$15,019,161.00
		Mobilization	+/-	5.00%			$750,000.00
		Subtotal					$15,769,161.00
		*Unlisted Items	+/-	5.00%			$730,839.00
		CONTRACT COST					$16,500,000.00
		Contingencies	+/-	25.00%			$4,500,000.00
		FIELD COSTS					$21,000,000.00
		Noncontract					$5,000,000.00
		Construction Cost	+/-	25.00%			$26,000,000.00

QUANTITIES		PRICES	
BY	CHECKED	BY G. Ruff, K. Copeland	CHECKED HJ-fR CJ
DATE PREPARED	APPROVED	DATE 4/18/2005	PRICE LEVEL Jan-2005 Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

SHEET__1__ OF __1__

FEATURE: 15-Apr-05

McLean Bottoms Site - Missouri River
63 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\Missouri R

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8120				
		Service Yard					
	1	6-in gravel surface		580	CY	$30.00	$17,400.00
	2	7 ft. chain link fence		1,252	LF	$25.00	$31,300.00
	3	7 ft. x 24 ft. access gate		4	Ea.	$3,000.00	$12,000.00
	4	Concrete transformer & air chamber pads		28	CY	$700.00	$19,600.00
	4a	Clearing & minor grading		144,710	CY	$3.00	$434,130.00
	4b	6 in. gravel surface for 16' access road		550	CY	$30.00	$16,500.00
	4c	Construct earthen berms from excavated material		16,000	CY	$5.00	$80,000.00
	5	Construct 20 ft. I.D. Ranney Collector Well					
		Each well = 115 ft. deep, 26 ft. O.D.		3	Ea.	$2,100,000.00	$6,300,000.00
	5a	Excavation req'd to sink 26 ft. O.D. caisson		6,930	CY	included	
	5b	Concrete for caisson		2,772	CY	included	
	5c	Cement (0.282 tons / CY)		783	Tons	included	
	5d	Reinforcement (115 lbs / CY of concrete)		318,780	Lbs	included	
	5e	Concrete req'd for superstructure		372	CY	$650.00	$241,800.00
	5d	Cement (0.282 tons / CY)		210	Tons	$140.00	$29,400.00
	5f	Reinforcement (130 lbs / CY of concrete)		96,720	Lbs	$1.25	$120,900.00
	5g	Unwatering req'd for construction of wells &					
		jacking of pipe laterals					
	5h	Pipe Jacking from within caisson					
		12 in. dia. pipe laterals					
		12 laterals * 150 lf ea. * 3 caissons		5,400	LF	included	
	5h	Pipe Jacking from within caisson					
		12 in. dia. pipe laterals					
		12 laterals * 150 lf ea. * 3 caissons		5,400	LF	included	
	6	Seeding		6.7	AC	$2,500.00	$16,750.00
	7	Excavation for manifold pipe trench		1,200	CY	$6.00	$7,200.00
		(Common excavation)					
	8	Compacted backfill for manifold pipe trench		1,185	CY	$20.00	$23,700.00
		SUBTOTAL					**$7,350,680.00**

QUANTITIES		PRICES	
BY: JF Pattie	CHECKED: M. R. O'Shea	BY: K. Copeland	CHECKED: CJ DCM PRV 4/15/05
DATE PREPARED: 6-Mar-05	APPROVED:	DATE: 4/15/05	PRICE LEVEL: Jan-2005 Appraisal

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

SHEET 1 OF

FEATURE:

McLean Bottoms Site
63 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: Missouri River

REGION

PRICE LEVEL April 05 - Appraisal

FILE: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\Missouri River\[D8140 44 & 63 CFS.xls]63 Cfs

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Symbol Pipe 8,810					
		(Need cathodic monitoring and protertion)					
		fs allow = 15,000 psi					
		t (steel) AWWA M-11					
		30B300 0.1345 (D8420 covers first 2200 ft)		1000	lnft	$110.00	$110,000.00
		36B300 0.1345		1100	lnft	$130.00	$143,000.00
		48B250 0.25		6710	lnft	$250.00	$1,677,500.00
		Excavation (5 ft cover) (Vertical trench)		27,800	yd3	$4.00	$111,200.00
		Pipe embedment material		4,200	yd3	$20.00	$84,000.00
		Pipe trench backfill above embedment		23,500	yd3	$5.00	$117,500.00
		SUBTOTAL					**$2,243,200.00**

QUANTITIES		PRICES	
BY Steve Robertson	CHECKED Richard Fuerst	BY K. Copeland	CHECKED CJ
DATE PREPARED March 7, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW DCM 4/15/05

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 15-Apr-05

McLean Bottoms Site - Missouri River
63 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 63 CFS .xls]D-8410(Grass)

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Gravity Drainage System: Consists of	D-8410	3	L.S.	$16,000.00	$48,000.00
		8 - Cast iron floor drains					
		1,500 lbs. of cast iron soil pipe and fittings					
	2	Fire Suppression System: Consists of	D-8410	3	L.S.	$400.00	$1,200.00
		3 - Portable 20# multi-purpose extinguishers					
	3	Compressed Air System: Consists of	D-8410	3	L.S.	$3,400.00	$10,200.00
		1 - 5 cfm @ 125 psi compressor w/ 30 gallon					
		receiver tank and 50 feet of air hose					
	4	HVAC System: Consists of	D-8410	3	L.S.	$13,000.00	$39,000.00
		Ventilation and heating system for approx.					
		10,000 ft^3 pump motor room and approx.					
		4,800 ft^3 pump discharge and valve room.					
		Outdoor temperature extremes during plant					
		operation can be from less than 30 degrees F					
		to over 110 degrees F. HVAC equipment					
		will consist of fans, louvers, dampers, ductwork,					
		unit heaters, instrumentation, controls and					
		accessories.					
	5	Electromagnetic Flowmeter System: Consists of	D-8410	3	L.S.	$16,000.00	$48,000.00
		single sensor electromagnetic flowmeter sensors,					
		flowmeter consule each equipped with a					
		alphanumeric display, totalizer, 4-20 ma signal					
		output, Nema 4X rated enclosure, 120 Vac,					
		60 Hz, 50-ft length of signal cable, furnished					
		with all necessary equipment to mount sensors					
		and console, MarshMcBirney Model 282 or equal					
		Subtotal D-8410 (Grass)					**$146,400.00**

QUANTITIES		PRICES	
BY J. Grass, D-8410	CHECKED C. Lee	BY G. Ruff	CHECKED DCM RR 4/15/05
DATE PREPARED 4-Mar-05	APPROVED	DATE 4/15/2005	PRICE LEVEL Jan-05 Appraisal

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 15-Apr-05

McLean Bottoms Site - Missouri River

63 CFS Intake & Pumping Plant

Includes Discharge Line to WTP

(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 63 CFS .xls]D-8410(Grass)

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Pumps - Vertical turbine rated 7000 gpm @ 177 ft	D-8420	6	ea.	$155,000.00	$930,000.00
		TDH. Underground discharge head, 14 ft					
		between pump base and motor base. With					
		oversized sole plate and base plate. Minimum 36"					
		Column 18" diameter flanged, 85 ft.length					
		Pump based on Johnston 24CC two-stage.					
		Calculated pump weight, 13,500 lb / pump					
		Subtotal D-8420 (Fehr)					**$930,000.00**

QUANTITIES		PRICES	
BY Richard Fehr	CHECKED	BY G. Ruff	CHECKED DCM PR 4/15/05 DCM
DATE PREPARED 7-Mar-05	APPROVED	DATE 4/15/2005	PRICE LEVEL Jan-05 Appraisal

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE: Appraisal
McLean Bottoms Site - Missouri River
63 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)
WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION GP **PRICE LEVEL:** Jan-05

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 63 CFS .xls]D-8420(Frisz)

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Hydraulic Equipment	D8420				
		Steel Manifold (furnish and install)					
	1	18-inch Dia., t= 0.25", Wt= 48 lb/ft					
		110 linear feet		5,280	LBS	$4.00	$21,120.00
	2	30-inch Dia., t= 0.25", Wt= 80 lb/ft					
		2010 linear feet		160,800	LBS	$4.00	$643,200.00
		Valves (fuurnish and install)					
	3	ANSI Class 125, Tilting disk, dampened, check valves:					
		6 -18" Diameter valves for pumps					
		with bottom mounted dampener, 1535 lb. per valve		9,210	LBS	$7.00	$64,470.00
	4	AWWA Class 150, Manually operated butterfly valves:					
		6 -18" Diameter valves for pumps					
		640 lb. per valve		3,840	LBS	$8.00	$30,720.00
	5	Air Valve Assemblies					
		12 - 3" Combination type valves, 120 lb. per valve		1,440	LBS	$13.00	$18,720.00
	6	Ball valves					
		12 - 3" diameter, 16 lb. per valve		192	LBS	$13.00	$2,496.00
		Air Chamber					
	7	Air Chamber	D8420				
		14-ft diameter cylinder with elliptical dished end heads					
		designed for 152 psig, Tank wall thickness = 1"					
		volume = 4414 cubic feet					
		Vertical orientation monted on cylinder skirt		68,000	LBS	$4.00	$272,000.00
	8	Air Compressor					
		100 horsepower motor					
		175 psig pressure @ 300 cfm free air displacement					
		Piston-reciprocal type compressor, air cooled	D8420	1	LS	$90,000.00	$90,000.00
		3750 Lbs.					
		Subtotal D-8420 (Frisz)					**$1,142,726.00**

QUANTITIES		PRICES	
BY Rick Frisz, D8420	CHECKED	BY G. Ruff Ruff	CHECKED CJ
DATE PREPARED 3/1/05	PEER REVIEW	DATE PREPARED 04/15/05	PEER REVIEW RKC 4/16/05

CODF:D-8170

ESTIMATE WORKSHEET

FEATURE: 14-Apr-05

McLean Bottoms Site - Missouri River

63 CFS Intake & Pumping Plant

Includes Discharge Line to WTP

(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 63 CFS .xls]Summary

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Plant Grounding System (F&I)	D8430				
		Ground rods:					
	1	10 ft. 3/4" dia., copper-clad		18	EA	$230.00	$4,140.00
		Stranded bare-copper conductor:					
	2	4/0 AWG		600	FT	$6.00	$3,600.00
	3	3/0 AWG		300	FT	$5.00	$1,500.00
	4	4 AWG		400	FT	$1.80	$720.00
		Electrical Conduit (F&I)	D8430				
		Rigid steel:					
	5	3/4"		700	FT	$17.00	$11,900.00
	6	1"		600	FT	$23.00	$13,800.00
	7	2"		600	FT	$36.00	$21,600.00
	8	3 1/2"		700	FT	$84.00	$58,800.00
		Schedule 80 PVC:					
	9	3 1/2"		1,000	FT	$30.00	$30,000.00
		600 Volt Insulated Conductors (F&I)	D8430				
		Single conductor, stranded copper:					
	10	12 AWG		2,500	FT	$0.90	$2,250.00
	11	2 AWG		500	FT	$2.70	$1,350.00
	12	3/0 AWG		3,600	FT	$5.20	$18,720.00
	13	350 kcmil		5,000	FT	$8.50	$42,500.00
		Subtotal - Sheet 1					**$210,880.00**

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi 3/2/05	BY G. Ruff GRuff	CHECKED Ord. Pk MM mc
DATE PREPARED 3/1/2005	APPROVED	DATE 4/14/2005	PRICE LEVEL Appraisal - Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 14-Apr-05

McLean Bottoms Site - Missouri River
63 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 63 CFS .xls]Summary

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Distribution Panelboard & Transformer (F&I)	D8430				
	14	75 kVA, 480-208Y/120 volt dry-type		3	EA	$5,700.00	$17,100.00
		transformer					
	15	250 ampere, 208Y/120 V panelboard		3	EA	$3,800.00	$11,400.00
		Motor Control Equipment (F&I)	D8430				
	16	600 volt motor control center:		3	EA	$70,000.00	$210,000.00
		1,600 amp bus; 42,000 amp short-circuit					
		Two 20 inch wide sections					
		Two 30 inch wide sections					
		Two NEMA size 6 FVNR starters w/					
		solid-state overload relay					
		(FVNR=full voltage non-reversing)					
		Lighting (F&I)	D8430				
		Interior luminaires:					
	17	120 VAC, 4 ft fluorescent fixture w/ 2 tubes		24	EA	$150.00	$3,600.00
		Exterior luminaries:					
	18	High-pressure sodium, wall-mounted,		12	EA	$500.00	$6,000.00
		outdoor, 70 watt, 120 VAC					
		Main Pump Motors (F&I)	D8430				
	19	400 HP, 480 volt, 3-phase, 1200 rpm		6	EA	$65,000.00	$390,000.00
		vertical induction motor					
		Subtotal - Sheet 2					**$638,100.00**
		Subtotal D-8430 (Schuh)					**$848,980.00**
		Subtotal D-8430 (Schuh)					

QUANTITIES		PRICES	
BY M. Schuh D-8430	CHECKED L. Rossi 3/2/05	BY G. Ruff	CHECKED Dcl. PR MC
DATE PREPARED 3/1/2005	APPROVED	DATE 4/14/2005	PRICE LEVEL Appraisal - Jan-05

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 14-Apr-05

McLean Bottoms Site - Missouri River
63 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
Option 1 - Full CFS

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 63 CFS .xls]Summary

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	1	Re-conductor 10 miles of existing 7.2-kV overhead distribution line and provide 1.5 miles of new URD to site (Cost developed by Capital Electric Co-op)		For the Lump Sum of:			$430,000.00
	2	15-kV Outdoor Unit Substation USB1:	D-8440	1	ea	$200,000.00	$200,000.00
		a. Incoming Section (Outdoor, NEMA 4):					
		1 - 3P, 15-kV, 600A, interrupter switch.					
		2 - 3P, 15-kV, 600 A, disconnect switches					
		3 - 8.3-kV, 150-200E current-limiting power fuses.					
		3 - 7.2-kV current transformers, 200:5 A.					
		2 - 7.2-kV - 120V potential transformers					
		3 - 9-kV metal-oxide surge arresters.					
		b. Transformer Section:					
		One 3-Phase, 7.2-kV - 480 V, 750-kVA, OA soy-filled power transformer w/ throat connections.					
		c. Outgoing Section (Outdoor NEMA 4):					
		1 - 480V, 1200A, 3-pole, molded-case circuit breaker with ground fault protection.					
		1 - 480V, 225A, 3-pole molded-case CB.					
		Subtotal - Sheet 1					**$630,000.00**

QUANTITIES		PRICES	
BY Doug Crawford	CHECKED	BY G. Ruff	CHECKED DCP RKC MC
DATE PREPARED 3/7/2005	APPROVED	DATE 4/14/2005	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

FEATURE: 14-Apr-05

McLean Bottoms Site - Missouri River
63 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
Option 1 - Full CFS

WOID: 6B657

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILE: V:\EST\Spreadsheet\Ruff\GP Region\[Red River - McLean 63 CFS .xls]Summary

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	3	15-kV Outdoor Unit Substation USB2,3:	D-8440	2	ea	$130,000.00	$260,000.00
		a. Incoming Section (Outdoor, NEMA 4):					
		1 - 3P, 15-kV, 600A, interrupter switch.					
		3 - 8.3-kV, 75E current-limiting power fuses.					
		3 - 9-kV metal-oxide surge arresters.					
		b. Transformer Section:					
		soy-filled power transformer w/ throat					
		c. Outgoing Section (Outdoor NEMA 4):					
		breaker with ground fault protection.					
		1 - 480V, 225A, 3-pole molded-case CB.					
	4	8-kV , 3/C, No. 2 AWG, EPR-insulated cable, buried in earth	D-8440	3100	lin ft	$33.00	$102,300.00
	5	4-inch, PVC-coated, rigid steel conduit	D-8440	25	lin ft	$95.00	$2,375.00
	6	600 V, 1200 A, outdoor, metal-enclosed busway	D-8440	50	lin ft	$1,250.00	$62,500.00
		50 lineal feet					
		Subtotal - Sheet 2					**$427,175.00**
		Subtotal D-8440 (Crawford)					**$1,057,175.00**

QUANTITIES		PRICES	
BY Doug Crawford	CHECKED	BY G. Ruff	CHECKED NCD.PR RKC MC
DATE PREPARED 3/7/2005	APPROVED	DATE 4/14/2005	PRICE LEVEL

CODE:D-8170

ESTIMATE WORKSHEET

SHEET 1 OF 1

FEATURE: 15-Apr-05

McLean Bottoms Site - Missouri River
63 CFS Intake & Pumping Plant
Includes Discharge Line to WTP
(WTP not included in these worksheets)

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION: GP

FILENAME: H:\D8170\EST\Spreadsheet\Copeland\RED RIVER 2005\Missouri R

PLANT ACCT.	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
			D-8120				
		Service Yard					
	1	6-in gravel surface		580	CY	$30.00	$17,400.00
	2	7 ft. chain link fence		1,252	LF	$25.00	$31,300.00
	3	7 ft. x 24 ft. access gate		4	Ea.	$3,000.00	$12,000.00
	4	Concrete transformer & air chamber pads		28	CY	$700.00	$19,600.00
	4a	Clearing & minor grading		144,710	CY	$3.00	$434,130.00
	4b	6 in. gravel surface for 16' access road		550	CY	$30.00	$16,500.00
	4c	Construct earthen berms from excavated material		16,000	CY	$5.00	$80,000.00
	5	Construct 20 ft. I.D. Ranney Collector Well					
		Each well = 115 ft. deep, 26 ft. O.D.		3	Ea.	$2,100,000.00	$6,300,000.00
	5a	Excavation req'd to sink 26 ft. O.D. caisson		6,930	CY	included	
	5b	Concrete for caisson		2,772	CY	included	
	5c	Cement (0.282 tons / CY)		783	Tons	included	
	5d	Reinforcement (115 lbs / CY of concrete)		318,780	Lbs	included	
	5e	Concrete req'd for superstructure		372	CY	$650.00	$241,800.00
	5d	Cement (0.282 tons / CY)		210	Tons	$140.00	$29,400.00
	5f	Reinforcement (130 lbs / CY of concrete)		96,720	Lbs	$1.25	$120,900.00
	5g	Unwatering req'd for construction of wells & jacking of pipe laterals					
	5h	Pipe Jacking from within caisson					
		12 in. dia. pipe laterals					
		12 laterals * 150 lf ea. * 3 caissons		5,400	LF	included	
	5h	Pipe Jacking from within caisson					
		12 in. dia. pipe laterals					
		12 laterals * 150 lf ea. * 3 caissons		5,400	LF	included	
	6	Seeding		6.7	AC	$2,500.00	$16,750.00
	7	Excavation for manifold pipe trench (Common excavation)		1,200	CY	$6.00	$7,200.00
	8	Compacted backfill for manifold pipe trench		1,185	CY	$20.00	$23,700.00
		SUBTOTAL					**$7,350,680.00**

QUANTITIES		PRICES	
BY: JF Pattie	CHECKED: M. R. O'Shea	BY: K. Copeland	CHECKED: CJ DCM PRV 4/15/05
DATE PREPARED: 6-Mar-05	APPROVED:	DATE: 4/15/05	PRICE LEVEL: Jan-2005 Appraisal

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Estimate Summary Sheet
with Generic Earthwork in lieu of
Sitework Items #1 and #2

WOID = 6B657 *Appraisal Estimate*

PROJECT:

RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL:** January, 2005

FILE: C:\Documents and Settings\jwzander\My Documents\JWZ Estimates\Red River ND-WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Est Summary

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Sheets 1 - 3 - (Generic sitework and buildings) - Total =					$ 28,781,490.00
		Sheets 1 - 8 - (Yard Piping) - Total =					$ 3,818,425.30
		Sheets 1 - 6 - (Process Equipment) - Total =					$ 29,518,000.00
		Sheets 1 - 4 - (Mechanical Equipment) - Total =					$ 1,388,700.00
		Sheet 1 - (Pumps, Motors, Valves & Misc.) - Total =					$ 2,888,530.00
		All Sheets - Electrical - Total =					$ 1,843,495.00
		Subtotal					$ 68,238,640.30
		* Additonal Unlisted Item % (< 5%) broken out per client direction =					$ 3,400,000.00
		Subtotal					$ 71,638,640.30
		Mobilization (+/-5%)					$ 3,600,000.00
		Subtotal					$ 75,238,640.30
		* Unlisted items (+/- 5%)					$ 3,761,359.70
		CONTRACT COST					$ 79,000,000.00
		Contingencies (+/-25%)					$ 20,000,000.00
		FIELD COST					$ 99,000,000.00
		Noncontract					$ 26,000,000.00
		Construction Cost (+/-25%)					$125,000,000.00

QUANTITIES		PRICES	
BY Ken Yokoyama, D-8230	CHECKED	BY JZ Jerry Zander, D-8170	CHECKED CJ
DATE PREPARED April 20, 2005	PEER REVIEW	DATE PREPARED April 20, 2005	PEER REVIEW

BUREAU OF RECLAMATION

ESTIMATE WORKSHEET

FEATURE:

128 CFS Water Treatment Plant
Generic Water Treatment Plant Site Work
TSC Design Group: D-8230

WOID = 6B657 *Appraisal Estimate*

PROJECT: RED RIVER VALLEY WATER SUPPLY PROJECT

REGION Great Plains **PRICE LEVEL** January, 2005

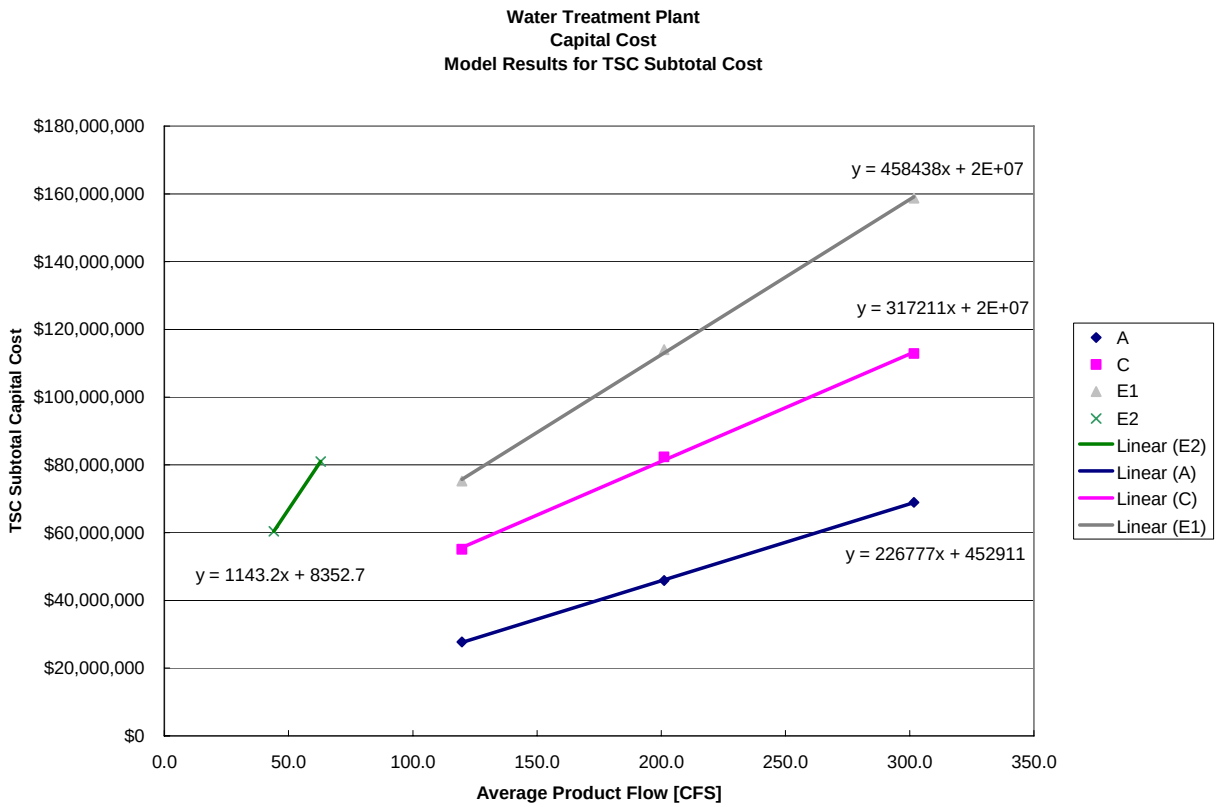
FILE: J:\Red River ND- WTP\[Red River WTP - Civil, Mech, HVAC Estimate.xls]Est Summary

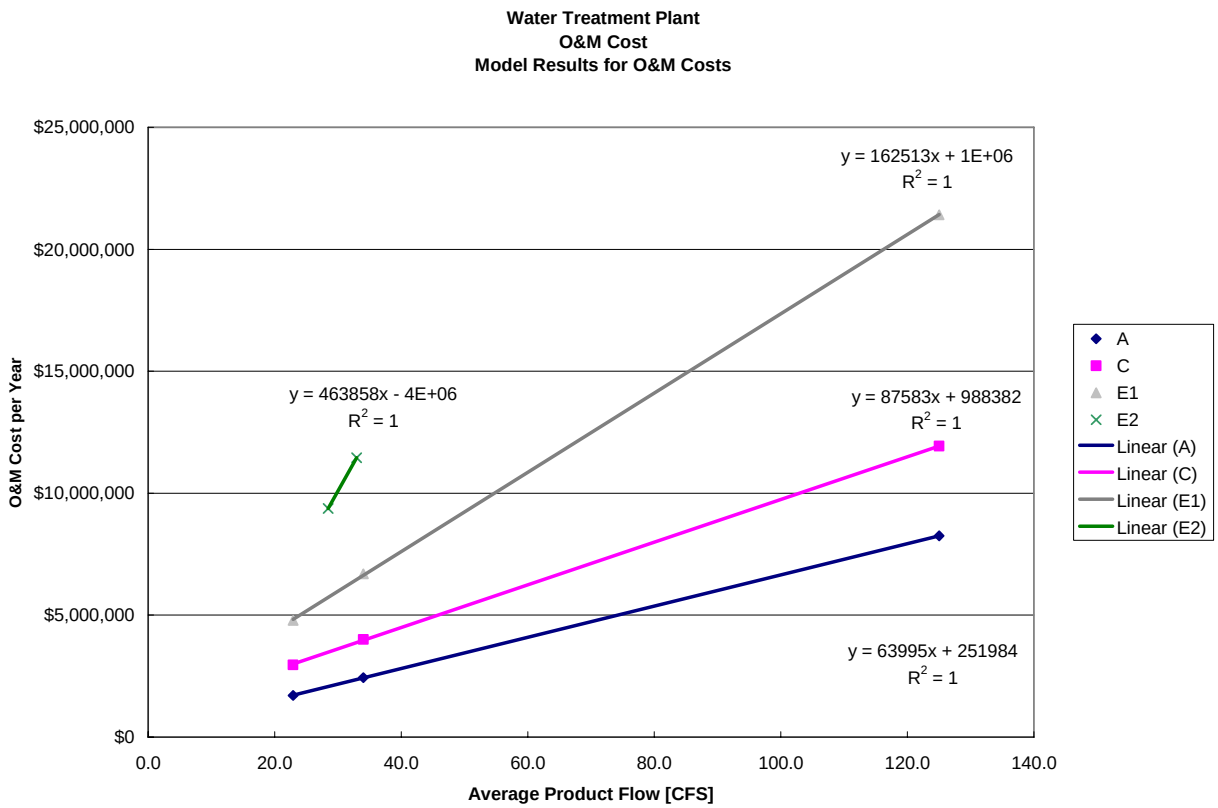
PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	AMOUNT
		Site Preparation	D-8230				
		Buildings and Tank Site Preparation					
	1	Excavation		49,540	CY	$ 5.00	$ 247,700.00
	2	Compacted Gravel		3,850	CY	$ 30.00	$ 115,500.00
	3	Compacted Backfill		23,790	CY	$ 7.00	$ 166,530.00
		Upflow Clarifier Site Preparation					
	4	Excavation		141,140	CY	$ 4.00	$ 564,560.00
	5	Compacted Gravel		4,370	CY	$ 30.00	$ 131,100.00
	6	Compacted Backfill		86,850	CY	$ 7.00	$ 607,950.00
		Upflow Clarifier Berm					
	7	Compacted Backfill		79,960	CY	$ 7.00	$ 559,720.00
		Pipe Trenches					
	8	Excavation		11,730	CY	$ 7.00	$ 82,110.00
	9	Compacted Backfill		11,650	CY	$ 9.50	$ 110,675.00
		Subtotal (Generic WTP Site) - Sheet 1 =					**$ 2,585,845.00**

QUANTITIES		PRICES	
BY Ken Yokoyama D-8230	CHECKED	BY Jerry Zander, D-8170	CHECKED MH
DATE PREPARED April 10, 2005	PEER REVIEW	DATE PREPARED April 15, 2005	PEER REVIEW RCA

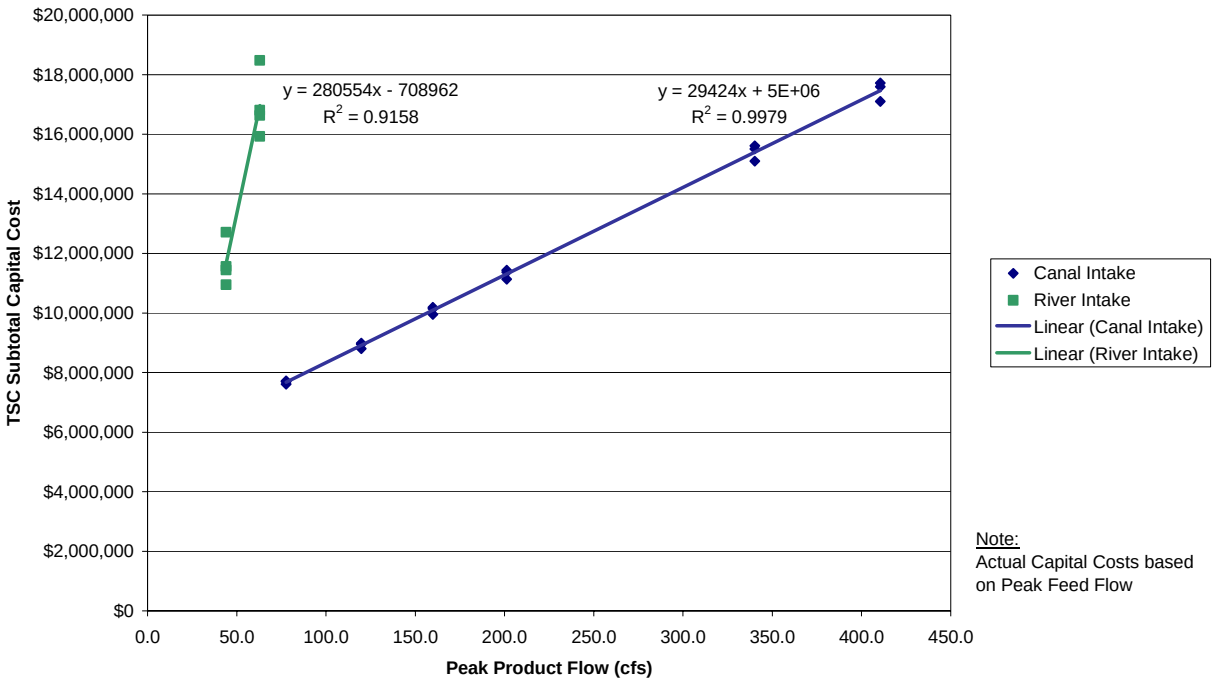
Attachment G

Cost Curves


Water Treatment Plant
Capital Cost
Model Results for TSC Subtotal Cost
TSC Subtotal Capital Cost
$180,000,000
$160,000,000
$140,000,000
$120,000,000
$100,000,000
$80,000,000
$60,000,000
$40,000,000
$20,000,000
$0
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
Average Product Flow [CFS]
y = 458438x + 2E+07
y = 317211x + 2E+07
y = 226777x + 452911
y = 1143.2x + 8352.7
A
C
E1
E2
Linear (E2)
Linear (A)
Linear (C)
Linear (E1)

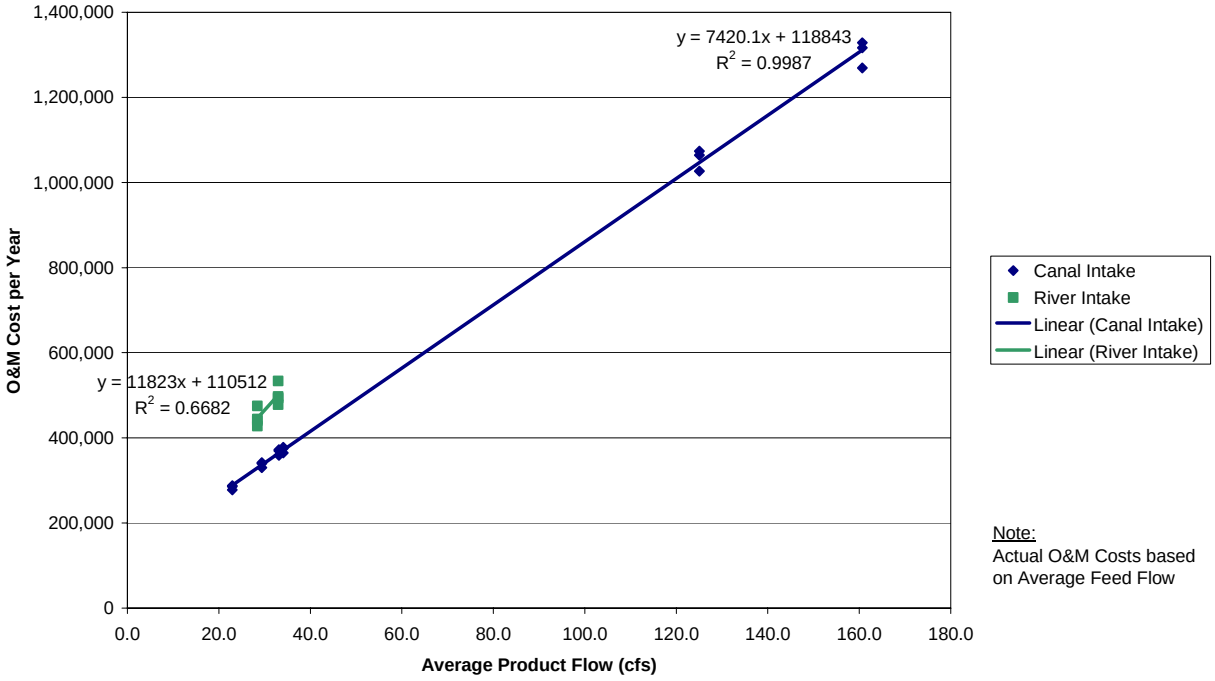

Water Treatment Plant
O&M Cost
Model Results for O&M Costs
O&M Cost per Year
$25,000,000
$20,000,000
$15,000,000
$10,000,000
$5,000,000
$0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
Average Product Flow [CFS]
y = 162513x + 1E+06
R2 = 1
y = 463858x - 4E+06
R2 = 1
y = 87583x + 988382
R2 = 1
y = 63995x + 251984
R2 = 1
A
C
E1
E2
Linear (A)
Linear (C)
Linear (E1)
Linear (E2)

Intake
Capital Costs
Model of TSC Subtotal Costs



Note:
Actual Capital Costs based on Peak Feed Flow

Intake
O&M Costs
Model Results



Note:
Actual O&M Costs based on Average Feed Flow