5. Proposed Project Facilities

The purpose of this chapter of the Final Engineering Report is to provide additional preliminary design details regarding the proposed components for the Lewis & Clark Rural Water System.

Several alternative components were evaluated for the proposed Lewis & Clark Rural Water System since the early 1990's. Based on the results of Chapter 4, and previous studies, the proposed project components include:

- Construction of one radial collector well, and a series of angle and vertical wells south and southwest of Vermillion, South Dakota;
- Construction of a Raw Water Pipeline consisting of approximately 14.3 miles of various size pipes to convey water from the wells to the Water Treatment Plant facilities;
- Construction of new Water Treatment Plant facilities north of Vermillion with a nominal capacity of 27.2 MGD (28.6 MGD, including an allowance for 5% pipeline losses). The plant will be a conventional treatment process (lime softening) with filtration; and
- Construction of a Treated Water Transmission Pipeline System consisting of approximately 385 miles (includes an allowance) of various size pipes, reservoirs, pump stations, service connections and other appurtenances.

In addition to the above facilities, two customer service lines will be constructed by the member systems. These include: 1) Sioux Falls' service line (approximately 6.8 miles of 30" pipe) to the Sioux Falls Water Purification Plant; and 2) Rock Rapid's service line (approximately 12.4 miles of 8" pipe) from the main transmission pipeline near the Iowa/Minnesota border to Rock Rapids' Water Treatment Plant (alternately, a shorter pipeline to a Lyon & Sioux RWS elevated reservoir).

5.1. Well Field

5.1.1. Hydrogeologic Investigation

A four-phase hydrogeologic investigation was conducted to determine the potential to develop a 29 to 32 MGD firm capacity water supply, enhanced by induced infiltration from the Missouri River, utilizing a series of horizontal radial collector wells, vertical wells and angle wells installed in the Mulberry Point area south of Vermillion, SD.

Nine test holes were drilled along the Missouri River in April and May 2001 to identify potential sites for construction wells. The test hole locations are shown in Figure 4.2-1. Test hole data show that Sites B and D (and Site C by inference) located on the east bank of the Missouri River and Site J1 located on the north bank of the river area appear to be the most favorable. Sites W and U are considered marginal for well production and Sites K1, F, V, and A are considered least favorable because of the large amount of silt and clay throughout the section. Based on test drilling, Sites B, D and J1 (and Site C by inference), appear most favorable for well production.

A test well and associated observation wells and a river well point were constructed in August and September 2001 at Site B to test the aquifer at this location. Site B offers the best geology and potential well yield. The layout of the wells is shown in Figure 4.2-2. The purpose of the test was to confirm hydraulic characteristics of the aquifer, recharge potential, yield assessment and ultimately preliminary collector well, vertical well and angle well design.

The investigation was conducted for two alternatives: 1) using only collector wells and 2) using a combination of collector well and vertical and angle wells. The investigation for each alternative is summarized below. In Section 4.2, the determination was made that the combination of a horizontal collector well and vertical and angle wells was more cost effective than horizontal collector wells only. Therefore, this Section will develop an implementation plan for the collection well, angle and vertical well plan.

5.1.2. Water Supply from a Combination of Vertical and Angle Wells and Horizontal Collector Well

In Section 4.2, it was concluded that a series of angle wells and vertical wells could be constructed to gain maximum benefit of both groundwater and surface water from the river for less cost as compared to using only collector wells. In this plan, vertical turbine pumps would be installed in the horizontal collector well and vertical wells, while submersible pumps would be installed in the angle wells.

As the name implies, an angle well is constructed at an angle to the horizontal (possibly 20 degrees on this project). The advantage of the angle well as compared to a vertical well is the well screen can be installed under the river bottom and gain the benefit of river recharge. A second advantage is the well screen is longer. These advantages result in higher well production as compared to a vertical well.

Both a collector well and two vertical wells could be placed in and near Site B. This site offers the best geology and potential well yield. The vertical wells should be placed at a minimum 1,000 feet north and south of the extent of the collector laterals. This distance was based on the Distance-Drawdown plot from the pumping test performed for the Site B collector well investigation. The plan offers the best use of the superior geologic conditions present at the site. The collector laterals are planned for a higher elevation due to the presence of large gravel, cobbles and boulders. The vertical wells will be screened below this elevation to make the best use of the resources at this level.

Sites C and D each could be developed using two angle gravel-packed wells at each site. An angle of 20° to horizontal will increase the screen length of 73 feet. A screen length of only 25 feet would be possible in a traditional vertical well. The well diameter is limited to 24 inches when utilizing a Barbar rig. The screen casing will be 16 inches or 18 inches if a pre-pack screen is used. In this scenario, collector wells would not be constructed at either site.

Site J1 appears to offer excellent geology, but sand sieve information is not available. Relying on professional experience, a vertical well should be capable of at least 2.8 MGD. An angle well would be capable of much more because of the increased screen length but the construction would be considerably more difficult because of the presence of cobbles and boulders. Therefore, as many as three vertical wells could be constructed at this site.

Two double gravel wall wells could be constructed at Sites W and U. For each of these sites, the recommended well yield was limited by the screen slot possible with a traditional or angle well construction. The double gravel wall will allow the screen slot size to be increased and thus screen slot size is not the limiting factor in the well yield.

Table 5.1-1 summarizes the estimated yield for each type of well construction evaluated.

Table 5.1-1
Estimated Yield by Site

	Estimated Capacity Each Well (MGD)
Site B	
Collector Well	9.2
Vertical Well (north)	4.3
Vertical Well (south)	3.0
Sites D & C	
Angle Well	2.3
Site J1	
Vertical Well	2.8
Site W	
Double Pack Vertical	2
Site U	
Double Pack Vertical	2

5.1.3. Site Stabilization

The Missouri River at the project location is a dynamic system which has experienced channel degradation and bank erosion. Mechanisms for further erosion include continued channel degradation and subsequent lateral migration, which can result in outflanking the well structures. The potential for damage due to ice and debris also exists. Any design must consider these and other factors. Part of the riverbank was stabilized during construction of South Dakota Highway 19. The area stabilized includes Sites D, E and F as shown on Figure 4.2-1. Stabilization construction was the buried riprap windrow type. Sites B, C, J1, U and W are in the area that has not been stabilized. Sites B and C are in an area that stabilization is likely. Sites J1, U and W are on the northern bank around the bend. They may require stabilization; however, it is much less probable. Possible remedial measures include rock riprap, permeable dikes, spur dikes, articulated grout filled mattresses, brush mat revetment, timber and vegetation bulkheads, sheet piling, or any combination of these. Missouri River bank stabilization measures will require the necessary permits and be subject to an environmental review.

5.1.4. Ground Water Quality

Two water samples were collected from the test well at Site B during the aquifer test. The results of the testing show that the water quality is typical of a ground water along the Missouri River. Based on the water quality from Table 4.2-7, the water can be characterized as hard and well buffered with high iron and manganese. EPA priority pollutants were also analyzed. These pollutants are either substantially below regulated MCLs or below detection limits.

5.1.5. Water Rights

Discussion regarding water rights in included in Section 4.2.7. Lewis & Clark will apply for another Future Use Permit for wells located in the area north and west of the Mulberry Point area to allow appropriation of water from wells at Sites J1, U or W. It is recommended Lewis & Clark request an appropriation of approximately 7,000 to 9,500 acre-feet annually from the area north and west of Mulberry Point. Also, Lewis & Clark will pursue renewal and extension of Future Water Use Permit No. 5832-3 during its review period in July 2002.

5.1.6. Pump and Driver Design

Vertical turbine pumps will be installed in the collector well with electric motors. Preliminary pump design features are summarized below in Table 5.1-2, Pump Design Summary – Collector Well.

Table 5.1-2
Pump Design Summary – Collector Well[(1)]

Design Item	Value
Number of pumps/well (one spare)	3
Pump capacity each	One-half of well capacity
Total dynamic head	240 FT[(2)]
Brake horsepower per pump	230[(2)]
Pump speed	1,770 rpm
Pump lubrication	Water
Pump driver type	Electric motor

Notes:
(1) Design summary is preliminary and will be verified during final design.
(2) Assumes well capacity of 9.0 MGD with each pump at 3,125 gpm (4.5 MGD) capacity.

Vertical turbine pumps will be installed in the vertical wells while submersible pumps will be installed in the angle wells. Both pump types will have electric motors. Preliminary pump design features are summarized in Table 5.1-3, Pump Design Summary – Vertical and Angle Wells.

Table 5.1-3
Pump Design Summary – Vertical and Angle Wells(1)

Design Item	Value
Number of Pumps Per Well	1
Pump Capacity	Well Capacity
Total Dynamic Head	240 FT
Brake Horsepower Per Well	100 to 200(2)
Pump Speed	1770 RPM
Pump Lubrication	Water
Pump Driver Type	Electric Motor

Notes:
(1) Design summary is preliminary and will be verified during final design.
(2) Varies based on well capacity.

In this alternative, VFD's will not be used. The number of wells in this proposal (up to 13) and the manner they are operated will allow flexibility in the quantity of water pumped to the water treatment plant.

5.1.7. Electrical System

Clay-Union Electrical Cooperative will provide electrical power to the well fields. It has been determined that the system should have a standby capability for average day demands. This recommendation is based on a reasonable assumption of major events that could occur and impact the facility's operation.

System storage could be used during power outages. There are seven proposed storage tanks in the system with a total capacity of 29.5 MG. In addition, there are 3 MG of storage in the water treatment plant clearwell. If each tank is 70 percent full, 22.75 MG are available during a power outage, approximately equal to the 22 to 23 MG required for average day conditions.

Discussions with the power company indicated that the maximum outage at the well field would be less than 12 hours and most outages would be two hours or less.

Based on the estimated quantity of system storage available of 22.75 MG and that power outages are expected to be less than 12 hours and usually less than two hours, about 16 MGD of the well field capacity will be provided with standby power.

The recommendation for the collector well, vertical and angle well alternative, is a 750 kW standby generator be located at Site B (one collector well and two vertical wells).

5.1.8. Telemetry and Control System Description

Power will be fed to each well through locally mounted loop feed switches. These switches provide a means to isolate each well from the electrical distribution system to perform maintenance. From the load side of the loop feed switch, a fusible disconnect feeds a locally mounted transformer used to step-down the primary system voltage to 480 volt for use at the motor. A circuit breaker in the secondary side feed from the transformer serves as the 480 V service disconnect at the pump station.

Auxiliary equipment at each pump station consists of a motor starter with provisions to power motor space heaters; a packaged mini-load center consisting of a transformer to step down the 480 V service to 120 V for utilization by the control panel, instrumentation, lights and receptacles; and a local control panel.

The control panel includes the remote communications equipment, local indication and control. The ultimate development of the well field will result in several wells being constructed. A system of remotely controlling and monitoring these wells is essential. The wells will be controlled remotely from the water treatment plant with the option of local control. The monitoring of various operational parameters will be done at each well and the water treatment plant.

The proposed control and monitoring at each well are described as follows:

?	Pump Control	Run/Stop
?	Pump Power Failure	Alarm
?	Well Water Level	0 to 100 ft & Alarms

- ? Pump Operating Pressure 0 to 150 psi
- ? Pumping Rate 0 to 7 MGD
- ? Primary Power Failure Alarm
- ? HOA Switch “Hand” Status
- ? HOA Switch “Auto” Status
- ? Power Consumption 0 to 300 kW
- ? Standby Generator Failure Alarm
- ? Standby Generator Status Run/Stop

5.1.9. Access Road Design

Access to each site will be from State Highway 19 and other local/county roadways. In general, the access roads will be about 2 to 3 feet higher than existing grade in the area. Roads in the floodway will be constructed flush with the existing grade to conform with floodway construction requirements.

All access roads will be constructed of crushed limestone or gravel 4 inches thick on top of a compacted subgrade.

Roads will have a minimum width of 12 feet. Elevated roads will have 3:1 backslopes.

5.1.10. Well Costs

Costs for developing the horizontal collector well, vertical wells and angle wells were provided in detail in Section 4.2-13.

Estimated cost for developing a horizontal collector well at Site B is $2,971,000 including a 750 kW generator but excluding contingencies. The generator would provide standby power for the collector well and two vertical wells at Site B. The costs do not include site stabilization. Add $200,000 per site for stabilization.

Estimated costs for developing vertical wells and vertical double gravel pack wells at the other sites are $341,000 and $375,000 respectively. The estimated cost for constructing angle wells at the other sites is $417,000. These costs do not include standby power, site stabilization or contingencies. Add $200,000 per site for stabilization.

5.1.11. Well Field Conclusions and Recommendations

The recommended development plan and costs for a well field using a combination of a horizontal collector well and vertical and angle wells are shown below in Table 5.1-4.

Table 5.1-4
Well Development Plan and Estimated Costs
Horizontal, Vertical and Angle Wells

Site		Capacity, MGD		Estimated Costs[5]	
	Well Construction	Each Site[3]	Cumulative	Each Site	Cumulative
B	One collector well	9.2	9.2	$2,971,000[1]	$2,971,000
	Two vertical wells Stabilization	7.3	16.5	$880,000[2] $600,000	$3,851,000 $4,451,000
C	Two angle wells Stabilization	4.6	21.1	$834,000 $400,000	$5,285,000 $5,685,000
D	Two angle wells Already stabilized	4.6	25.7	$834,000	$6,519,000
J1	Two vertical wells[4]	5.6	31.3	$682,000	$7,201,000
U	Two vertical double pack wells[4]	4.0	35.3	$750,000	$7,951,000
W	Two vertical double pack wells[4]	4.0	39.3	$750,000	$8,701,000

Notes:
(1) Includes standby electrical generator (750 kW).
(2) Includes collector piping to connect each vertical well to collector well piping.
(3) Only Site B has been tested, therefore, other site capacities are very preliminary.
(4) Stabilization not likely and therefore costs not included.
(5) Costs do not include contingencies.

The estimated cost to develop a well field using a collector well and combination of vertical and angle wells with a firm capacity of 30 MGD is $8,701,000. This cost includes bank stabilization, but no contingencies.

Standby electrical generators will be included at Site B so that about 16 MGD of water could be provided to the water treatment plant during a power outage.

The recommended well field development plan for testing and construction priority is summarized in Table 5.1-5 and in Figure 5.1-1, "Well Field Development Plan."

Table 5.1-5
Recommended Well Testing and Construction Priority

Well Location	Activity	Estimated Capacity	Cumulative Capacity
Site C, D, A	Up to 12 test holes/MWs for well design, evaluate potential of Site A and select best of Sites A, C or D		
Best of Sites A, C or D	Test/production well and Aquifer Test with 2 additional MWs	2.3	
Site J1 & U	4 test holes for well design		
Site B	Collector well construction	9.2 MGD	11.5 MGD
Site B	2 test holes for vertical well design		
Site B	2 vertical well constructions and tested	7.3 MGD	18.8 MGD
Best of Sites A, C or D	Additional angle well with 3 TH/MWs and aquifer testing	2.3 MGD	21.1 MGD
2nd Best Site of A, C or D	2 angle wells and aquifer test with 4 additional MWs	4.6 MGD	25.7 MGD
Site W & U	4 Test holes for well design and select best site		
Site J1	2 Test/production wells and aquifer test with 2 additional MWs	5.6 MGD	31.3 MGD
Site U	2 Test/production double gravel wall wells and aquifer test with 4 additional MWs	4 MGD	35.3 MGD
2nd Site W	2 Test/production double gravel wall wells and aquifer test	4 MGD	39.3 MGD

Note:
Well capacities based on theoretical calculations only (except collector well). Only Site B collector well site has been tested, therefore, all others are preliminary. The potential yield at Site A could impact the testing and construction priority of wells at the northern sites.

Source: United States Geological Survey; Meckling, S. Dak.-Nebr., 1994, Maskell, Nebr.-S. Dak., 1994, Vermillion, S. Dak.-Nebr., 1994, Obert, Nebr., 1968 Quadrangles

Banner Associates, Inc. **HDR Engineering, Inc.** **TRC Mariah Associates, Inc.**	**FINAL ENGINEERING REPORT**	**FIGURE 5.1-1**
	LEWIS AND CLARK RURAL WATER SYSTEM	**Well Field Development Plan**

5.2. Raw Water Delivery System

Evaluation of the alignment and preliminary details regarding the Raw Water Delivery System are discussed in Section 4.3. The raw water delivery system includes the individual well collector laterals and the raw water delivery pipeline connecting the well field to the water treatment plant north of Vermillion.

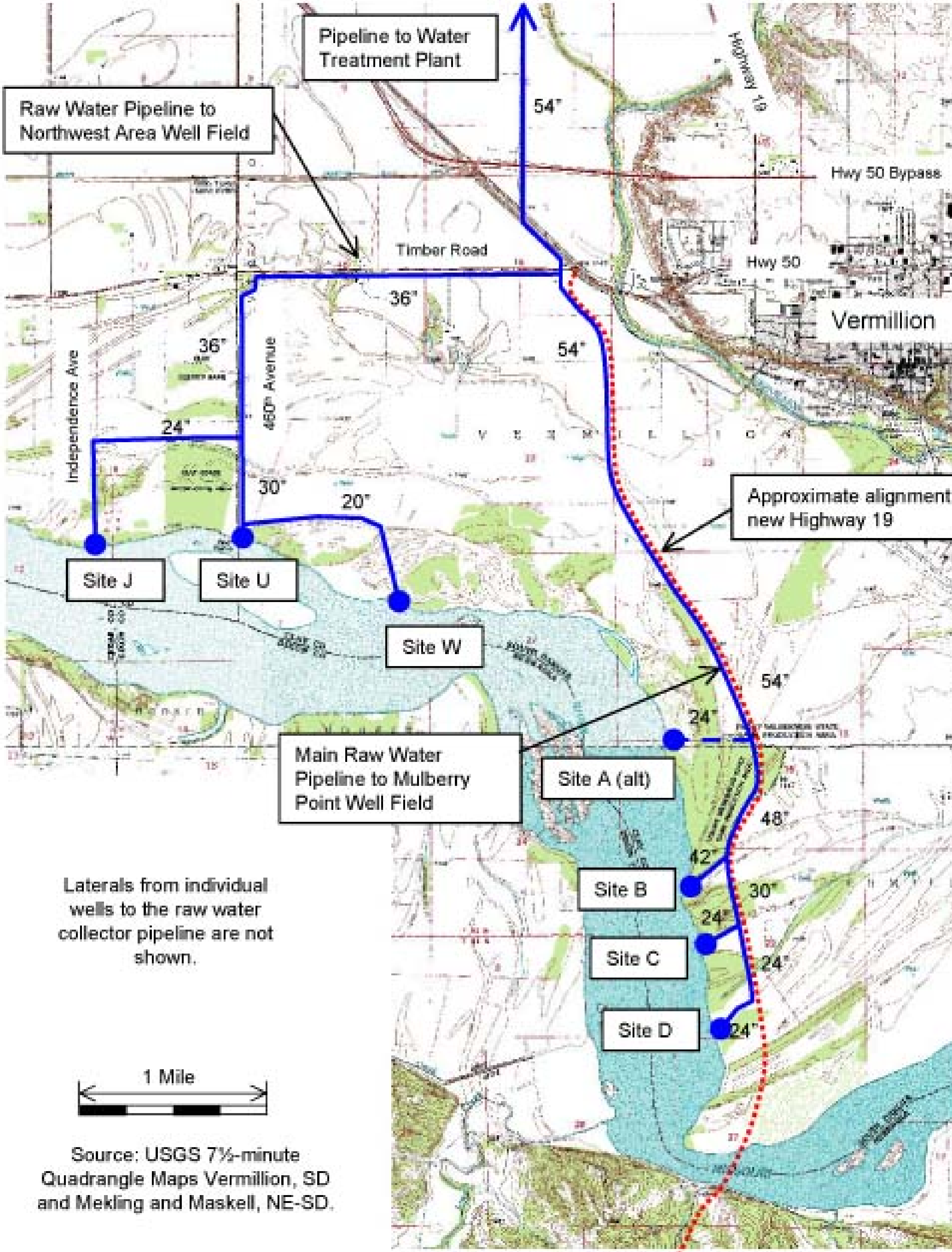
5.2.1. Proposed Raw Water Pipeline

Lewis & Clark's raw water source will be from a series of horizontal radial collector wells, vertical wells and angle wells installed in the Mulberry Point area south of Vermillion, South Dakota. Section 5.1 provides a description of investigations and recommendations regarding development of raw water sources along Mulberry Point and a supplemental area to the northwest of Mulberry point and west of Vermillion.

A general location map of the potential collector wells and pipeline routes are shown on Figure 5.2-1. Based on the results of test drilling activities and hydrogeologic evaluations, the potential yield of collector wells is projected in Tables 5.1-1 and 5.1-4 and summarized below (long-term seasonal average to seasonal average)

? Mulberry Point Site B – 16.5 MGD
? Mulberry Point Site C – 4.6 MGD (preliminary)
? Mulberry Point Site D – 4.6 MGD (preliminary)
? Northwest Site J1 – 5.6 MGD (very preliminary)
? Northwest Sites U – 4.0 MGD (very preliminary)
? Northwest Sites W – 4.0 MGD (very preliminary)

The highest producing well sites are projected to be along Mulberry Point at Sites B, C and D between Highway 19 and the Missouri River. The design criteria (paragraph 3.1.2.1) for the collector well system should be the ability to deliver approximately 29 to 32 MGD with the highest yielding well in standby mode. It is currently envisioned that five to six well sites will need to be developed. The actual number of wells and yields will not be known until additional pumping tests have been performed throughout the area of the well fields.



Banner Associates, Inc. HDR Engineering, Inc. TRC Mariah Associates Inc.	**FINAL ENGINEERING REPORT** **LEWIS AND CLARK RURAL WATER SYSTEM**	**FIGURE 5.2-1** **General Location of Raw Water Pipelines**

The main Raw Water Pipeline would parallel the recently constructed Highway 19 from Site D to the intersection of new Highway 19, Highway 50 (the extension of West Cherry and West Main Streets) and Timber Road. Three well sites, Sites B, C and D, would be constructed in the Mulberry Point area. Site A would be an alternate site. Preliminary pipeline sizing is based on Table 3.3-1 and the following assumed collector well yields:

- Site D Lateral to main Raw Water Pipeline – 4.6 MGD – 24”
- Site C Lateral to main Raw Water Pipeline – 4.6 MGD – 24”
- Main line from Site C Lateral to Site B Lateral – 9.2 MGD – 30”
- Site B Lateral to main Raw Water Pipeline – 16.5 MGD – 42”
- Main line from Site B Lateral to Potential Site A Lateral – 25.7 MGD – 48” (this well site is an alternative site)
- Site A Lateral to main Raw Water Pipeline – 24” (not included in project estimate)
- Main line from Site A Lateral to Timber Road – 25.7 (or greater) MGD – 54” (this portion may be evaluated in the future, it may be possible to reduce to 48”)
- Site J1 Lateral to main (460^{th} Avenue) – 5.6 MGD – 24”
- Site U and W Laterals to the collector – 4.0 MGD (each site) – 20”
- Site U/W collector to main (460^{th} Avenue) – 8.0 MGD – 30”
- Main from intersection of J1/U/W Laterals, along Timber Road to new Highway 19 – 13.6 MGD – 36”
- Timber Road to Water Treatment Plant – 29 to 32 MGD – 54”

Pipeline sizes may vary from the initial sizing, based on actual well yields and hydraulic modeling. An evaluation will be performed as additional information regarding well yield is developed. The locations of the various wells may vary as more is known regarding well development.

Preliminary hydraulic evaluations have been made to determine pumping head requirements to lift water from the wells to the water treatment plant. As indicated in Section 4.2.8.1, the estimated total head required for pumping is estimated to be 240 feet from the wells to the water treatment plant. This 240 foot lift assumes the pumping level is 80 feet below ground, a static lift of approximately 80 feet is required from the well site to the treatment plant and another 80 feet for head loss and pressure head required at the plant.

The raw water lines and wells at Sites J1, U, and W will be constructed as needed to meet raw water demands. It is recommended the wells at Site W be held in reserve and would be the lowest priority site to pursue.

The laterals from Sites B, C and D to the main Raw Water Pipeline would be constructed on lands owned and administered by the State of South Dakota through its Department of Game, Fish and Parks (SDGF&P). The preferred lateral routing would be adjacent to the edge of the trees in these areas to avoid cutting trees and to stay out of borrow areas used during construction of Highway 19. Care should be taken in these areas as construction debris was encountered adjacent to Site B during the well testing program. Roads to provide access to the individual wells could be constructed over the laterals. The routing and access control for the roads will need to be coordinated with the SDGF&P – initial conversations have been held with regard to access.

The Raw Water Pipeline would be constructed in the road right-of-way for the newly constructed Highway 19 from the Site D lateral to approximately 2 miles north. This area is heavily timbered and the lands outside the highway right-of-way are owned and administered by SDGF&P for a significant portion of this segment. The construction area would be relatively narrow and a construction easement will be pursued to permit construction activities outside the highway right-of-way on SDGF&P lands. North of the lands owned and administered by SDGF&P, it is recommended the pipeline be constructed inside the Highway 19 right-of-way but utilize construction easements on privately owned lands to facilitate construction, if easement agreements can be obtained.

Raw water lines would be constructed from Sites U, W and J1, when system water demand indicates the need for the capacity. These lines would be constructed in easements on privately owned land. This line would join the main Raw Water Line at the intersection of Timber Road and new Highway 19. The arrangement shown on Figure 5.2-1 includes the lateral from Site J1 connecting to the lateral from Site U on 460th Avenue between Clay State Recreation Area and Clay County Park

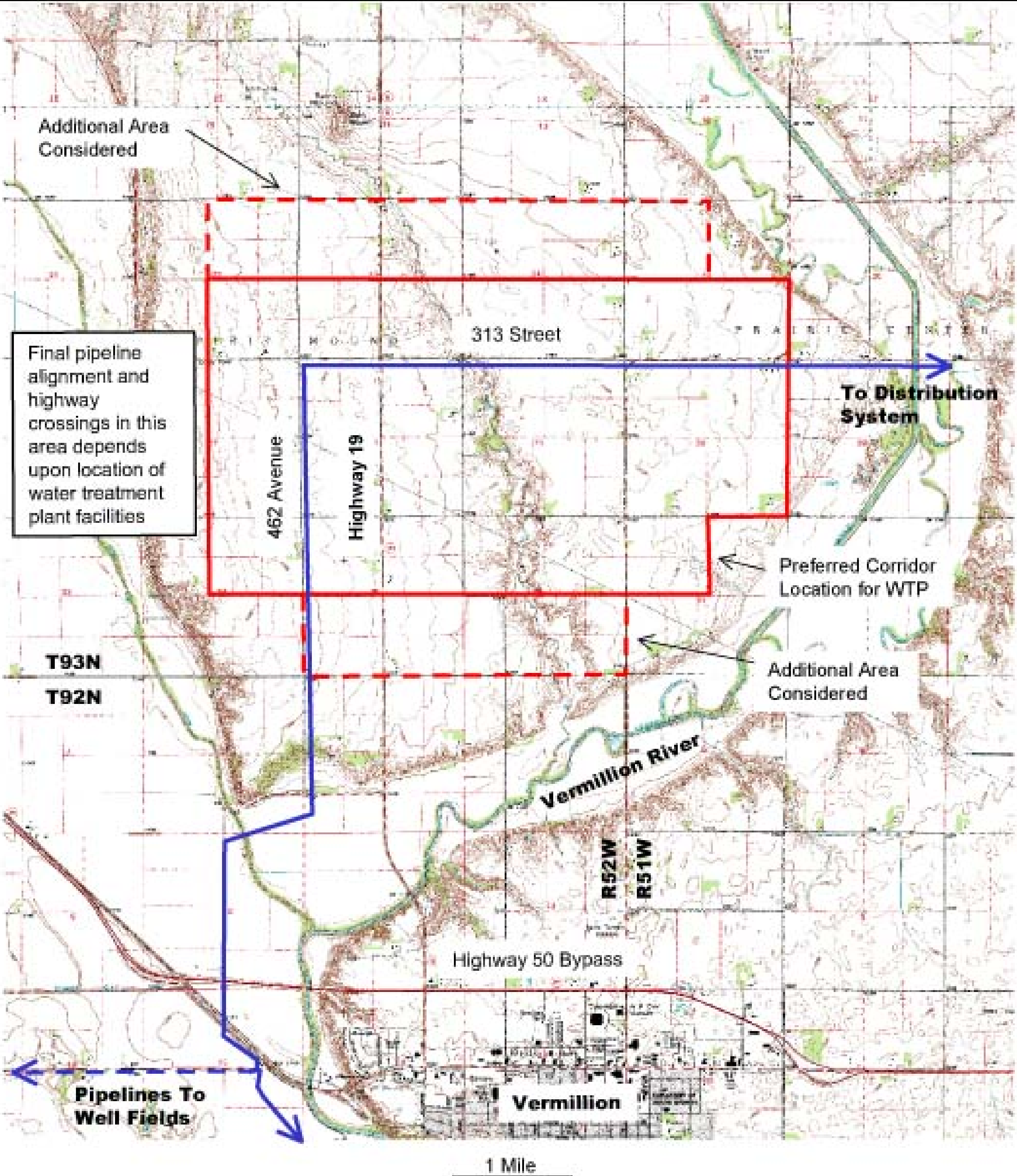
The Raw Water Pipeline would continue northward to deliver water to the water treatment facility located north of Vermillion. Figure 5.2-2 is a map showing the general area considered for the site of Lewis & Clarks' Water Treatment Plant facility. After crossing Clay Ditch, the Main Raw Water Pipeline would follow 462nd Avenue to the general area selected for the Water Treatment Plant. 462nd Avenue is a section line road ½-mile west of Highway 19. The actual routing of the Raw Water Pipeline may vary depending upon the final selected location of the Water Treatment Plant. Currently, it is envisioned the plant would be located in the southwest corner of the preferred corridor for the Water Treatment Plant as shown on Figure 5.2-2.

Highway 19, north of Vermillion, is scheduled for reconstruction in the year 2003. It would be beneficial to the Lewis & Clark project to work closely with the South Dakota Department of Transportation to coordinate the Highway 19 crossing and include a casing into the highway construction contract. Depending on location of the Water Treatment Plant, this crossing may be part of the treated water pipeline.

5.2.2. Opinion of Probable Construction Cost for Raw Water Pipeline

The following opinion of probable construction cost includes the main Raw Water Pipeline and the lines to wells at Sites J1, U and W. The following does not include costs for contingencies, engineering, legal/administrative costs and other miscellaneous project costs. A more detailed evaluation of costs is included in Chapter 7.

The opinion of probable construction cost for the Raw Water Pipeline is shown in Table 5.2-1. Unit costs from the 1993 Feasibility Study are used and the resulting sums are indexed to year 2001 costs. An evaluation was made of the 1993 unit pipe costs and the unit costs were found to be applicable, with indexing.



Source: USGS 7½-minute
Quadrangle Map Vermillion, SD

Banner Associates, Inc.	FINAL ENGINEERING REPORT	FIGURE 5.2-2
HDR Engineering, Inc. TRC Mariah Associates Inc.	LEWIS AND CLARK RURAL WATER SYSTEM	General Location of Raw Water Pipeline and Potential Water Treatment Plant Sites

Table 5.2-1
Opinion of Probable Construction Cost
Raw Water Pipeline

Item	Description	Total Quantity [1]	Units	Unit Cost [2]	Cost [2,4]
1	54" Pipeline	36,200	L.F.	$ 230	$ 8,326,000
2	48" Pipeline	3,400	L.F.	$ 192	$ 652,800
3	42" Pipeline	1,700	L.F.	$ 155	$ 263,500
4	36" Pipeline	-	L.F.	$ 122	$ -
5	30" Pipeline	2,100	L.F.	$ 94	$ 197,400
6	24" Pipeline	5,100	L.F.	$ 72	$ 367,200
7	Traffic Control	1	L.S.	$ 38,000	$ 38,000
8	Rock Excavation	1	L.S.	$ 40,000	$ 40,000
9	Casing for 54" Pipe	485	L.F.	$ 750	$ 363,750
10	54" River Crossing	1	Each	$ 125,000	$ 125,000
11	Unlisted Items	1	L.S.	$ 311,000	$ 311,000
				Unadjusted Subtotal	$ 10,684,650

Northwest Area Raw Water Lines					
10	36" Pipeline	13,300	L.F.	$ 122	$ 1,622,600
11	30" Pipeline	2,200	L.F.	$ 94	$ 206,800
12	24" Pipeline	7,200	L.F.	$ 72	$ 518,400
13	20" Pipeline	4,500	L.F.	$ 58	$ 261,000
12	Traffic Control	1	L.S.	$ 10,000	$ 10,000
13	Rock Excavation	1	L.S.	$ 11,000	$ 11,000
14	Unlisted Items	1	L.S.	$ 79,000	$ 79,000
				Unadjusted Subtotal	$ 2,708,800

Total (1993 Cost) - Raw Water Pipeline	$ 13,393,450
Total Cost - Raw Water Pipeline Indexed to October 2001 [3]	$ 17,312,000

Notes:

[1] Pipeline lengths are measured from USGS quad maps without adjustment.

[2] Unit cost and extended cost shown in table are 1993 costs.

[3] Cost Index Factor 10/93 to 10/01 = 1.292559 (See Chapter 7)

[4] This estimate does not include pipe to Site A

5.2.3. Opinion of Probable OM&R Costs for Raw Water Pipeline System

The operation, maintenance and replacement (OM&R) costs for the proposed Raw Water Pipeline System. OM&R costs include the following key assumptions.

- Electric power costs based on rates provided by the local power system in the service area for the pump station.
- Total pumping head is 240 feet (104 psi), 70% wire to water efficiency
- Hourly labor rates average $20.00 per hour plus 40% for payroll costs; staff of one (half-time).
- Project operating at average capacity, 22 to 23 MGD finished water produced (2030 average daily flow).
- R & R account includes equipment repair and replacement at 5% of the equipment cost.
- Miscellaneous expenses include vehicle costs, fuel (diesel, natural gas), disposable materials and consumable maintenance items.

The annual OM&R costs for the Raw Water Pipeline System are summarized as follows:

Power costs	$ 630,000
Chemical costs	$ --
Labor	$ 29,000
R & R Account	$ 90,000
Miscellaneous	$ 20,000
Total Estimated Annual Cost	$ 769,000