DRAFT FEASIBILITY REPORT
FEASIBILITY ANALYSIS OF WATER SUPPLY FOR SMALL PUBLIC WATER SYSTEMS

CITY OF WELLMAN
PWS ID# 2230003, CCN# 10591

Prepared for:

THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Prepared by:

THE UNIVERSITY OF TEXAS BUREAU OF ECONOMIC GEOLOGY

AND

PARSONS

Preparation of this report was financed by the Texas Commission on Environmental Quality through the Drinking Water State Revolving Fund Small Systems Assistance Program

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AUGUST 2008

EXECUTIVE SUMMARY

INTRODUCTION

The University of Texas Bureau of Economic Geology (BEG) and its subcontractor, Parsons Transportation Group Inc. (Parsons), was contracted by the Texas Commission on Environmental Quality (TCEQ) to conduct a project to assist with identifying and analyzing alternatives for use by Public Water Systems (PWS) to meet and maintain Texas drinking water standards.

The overall goal of this project was to promote compliance using sound engineering and financial methods and data for PWSs that had recently recorded sample results exceeding maximum contaminant levels (MCL). The primary objectives of this project were to provide feasibility studies for PWSs and the TCEQ Water Supply Division that evaluate water supply compliance options, and to suggest a list of compliance alternatives that may be further investigated by the subject PWS for future implementation.

This feasibility report provides an evaluation of water supply alternatives for the City of Wellman PWS, ID# 2230003, Certificate of Convenience and Necessity (CCN) #10591, located in Terry County. The City of Wellman PWS has 97 water supply connections and serves a population of 225. The water source comes from five groundwater wells completed to depths ranging from 135 feet to 186 feet in the Ogallala Formation. Well #1 (G2230003A), Well #2 (G2230003B), Well #3 (G2230003C), and Well #4 (G2230003D) are all rated at 10 gallons per minute and Well #5 (G2230003E) is rated at 50 gpm.

The City of Wellman PWS recorded arsenic concentrations of 0.0165 milligrams per liter (mg/L) to 0.0436 mg/L between February 2004 and June 2005, which is exceeds the maximum contaminant level (MCL) of 0.010 mg/L that went into effect on January 23, 2006 (USEPA 2008a; TCEQ 2004). Wellman has installed a ferric oxide arsenic adsorption system. Fluoride has also been detected in concentrations of 4.0 to 7.3 mg/L between May 1995 and September 2002, exceeding the MCL of 4 mg/L. From April 1998 to January 1999, nitrate values ranged from 4.34 mg/L to 9.06 mg/L, and in February 2008 a nitrate concentration of 12.8 mg/L was detected, exceeding the MCL of 10 mg/L. More testing of nitrate is needed. Selenium concentrations range from 0.0412 to 0.0533 mg/L from April 1998 through February 2004, with the higher results exceeding the MCL of 0.05 mg/L. Therefore, it is likely the City of Wellman PWS would face compliance issues under the water quality standards for these contaminants.

Basic system information for the City of Wellman PWS is shown in Table ES.1.

Table ES.1 City of Wellman PWS
Basic System Information

Population served	225
Connections	97
Average daily flow rate	0.03 million gallons per day (mgd)
Peak demand flow rate	77.8 gallons per minute
Water system peak capacity	0.130 mgd
Typical arsenic range	0.0165 – 0.0436 mg/L
Typical fluoride range	4.0 - 7.3 mg/L
Typical selenium range	0.0412 – 0.0533 mg/L
Typical nitrate range	4.34 – 9.06 mg/L with one result of 12.8 mg/L

STUDY METHODS

The methods used for this project were based on a pilot project performed in 2004 and 2005 by TCEQ, BEG, and Parsons. Methods for identifying and analyzing compliance options were developed in the pilot project (a decision tree approach).

The process for developing the feasibility study used the following general steps:

- Gather data from the TCEQ and Texas Water Development Board databases, from TCEQ files, and from information maintained by the PWS;
- Conduct financial, managerial, and technical (FMT) evaluations of the PWS;
- Perform a geologic and hydrogeologic assessment of the study area;
- Develop treatment and non-treatment compliance alternatives which, in general, consist of the following possible options:
- Connecting to neighboring PWSs via new pipeline or by pumping water from a newly installed well or an available surface water supply within the jurisdiction of the neighboring PWS;
- Installing new wells within the vicinity of the PWS into other aquifers with confirmed water quality standards meeting the MCLs;
- Installing a new intake system within the vicinity of the PWS to obtain water from a surface water supply with confirmed water quality standards meeting the MCLs;

- Treating the existing non-compliant water supply by various methods depending on the type of contaminant; and
- Delivering potable water by way of a bottled water program or a treated water dispenser as an interim measure only.
- Assess each of the potential alternatives with respect to economic and non-economic criteria;
- Prepare a feasibility report and present the results to the PWS.

This basic approach is summarized in Figure ES.1.

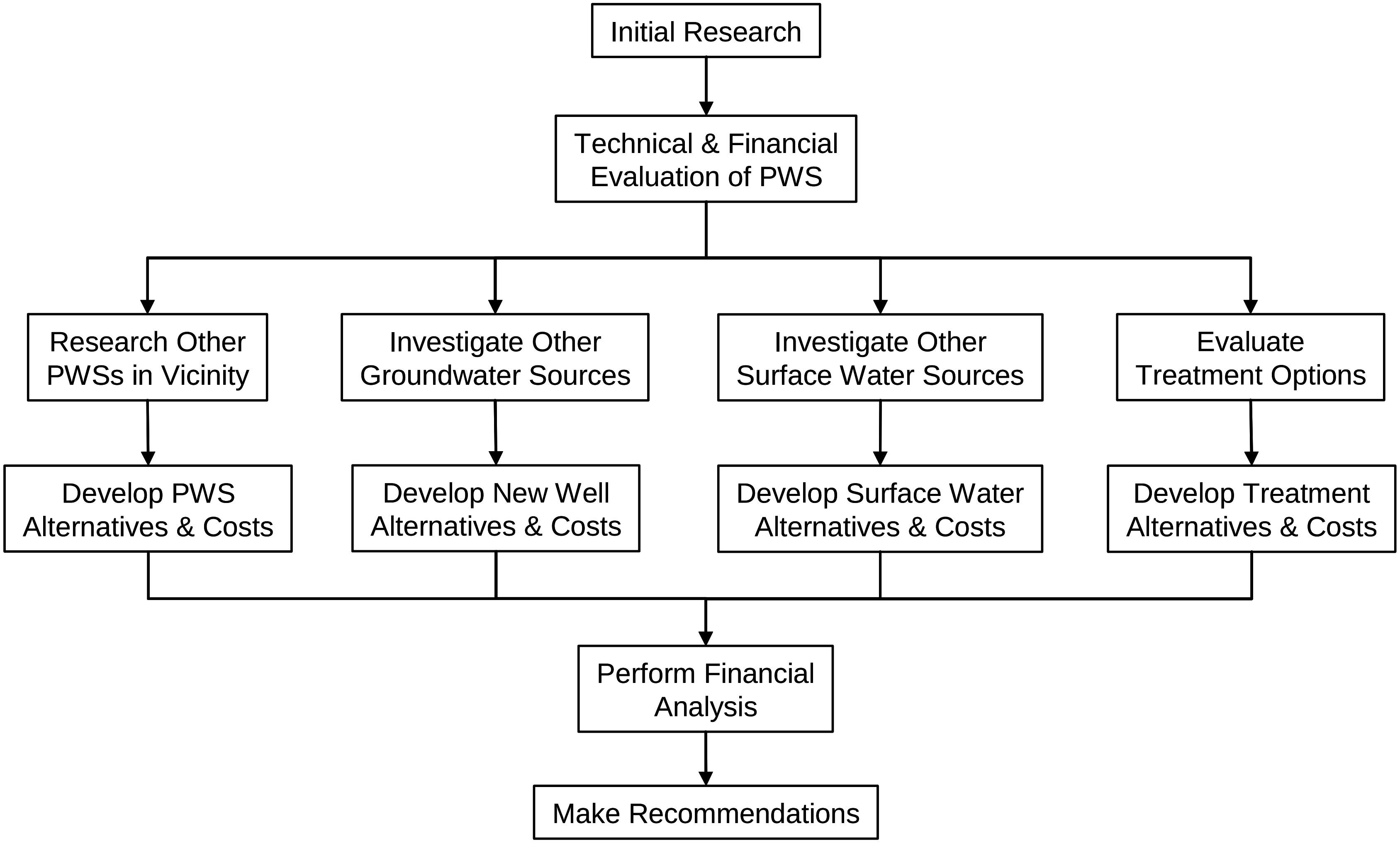
HYDROGEOLOGICAL ANALYSIS

The City of Wellman PWS obtains groundwater from the Ogallala-North Texas Aquifer. Arsenic, fluoride, selenium, and nitrate are commonly found in area wells at concentrations greater than the MCL. However, one nearby private irrigation well might provide an alternative source of water for the City of Wellman PWS, but this well has not been sampled since 1976, and would require sampling to verify that the water currently contains acceptable concentrations of all constituents of concern.

Regional analyses show that wells deeper than about 250 feet are more likely to contain acceptable levels of all constituents of concern. Because all of the City of Wellman wells are shallower than this, it is possible that deepening one or more of the wells would improve water quality, provided the aquifer is thick enough.

The water quality of each of the system wells should be characterized. If one of the wells is found to produce compliant water, as much production as possible should be shifted to that well as a method of achieving compliance. It may also be possible to do down-hole testing on non-compliant wells to determine the source of the contaminants. If the contaminants derive primarily from a single part of the formation, that part could be excluded by modifying the existing well, or avoided altogether by completing a new well.

Figure ES.1 Summary of Project Methods



COMPLIANCE ALTERNATIVES

Overall, the system had a good level of FMT capacity. The system had some areas that needed improvement to be able to address future compliance issues; however, the system does have many positive aspects, including participation in the EPA Arsenic Treatment Technologies Demonstration Program, and knowledgeable and dedicated Water Superintendent. Areas of concern for the system included lack of compliance with the fluoride standard, lack of capital improvement planning, lack of reliable maps, lack of preventative maintenance program, and need for additional staff.

There are several PWSs within 30 miles of City of Wellman. Many of these nearby systems also have water quality problems, but there are a few with good quality water. In general, feasibility alternatives were developed based on obtaining water from the nearest PWSs, either by directly purchasing water, or by expanding the existing well field. There is a minimum of surface water available in the area, and obtaining a new surface water source is considered through an alternative where surface water is obtained through the City of Brownfield from the Canadian River Municipal Water Authority (CRMWA) and treated by the City of Lubbock prior to distribution. .

Centralized treatment alternatives for arsenic, fluoride, selenium, and nitrate removal have been developed and were considered for this report; for example, reverse osmosis and electrodialysis reversal. Point-of-use (POU) and point-of-entry treatment alternatives were also considered. Temporary solutions such as providing bottled water or providing a centralized dispenser for treated or trucked-in water, were also considered as alternatives.

Developing a new well close to the City of Wellman is likely to be the best solution if compliant groundwater can be found. Having a new well close to the City of Wellman is likely to be one of the lower cost alternatives since the PWS already possesses the technical and managerial expertise needed to implement this option. The cost of new well alternatives quickly increases with pipeline length, making proximity of the alternate source a key concern. A new compliant well or obtaining water from a neighboring compliant PWS has the advantage of providing compliant water to all taps in the system.

Central treatment can be cost-competitive with the alternative of new nearby wells, but would require significant institutional changes to manage and operate. Similar to obtaining an alternate compliant water source, central treatment would provide compliant water to all water taps.

POU treatment can be cost competitive, but does not supply compliant water to all taps. Additionally, significant efforts would be required for maintenance and monitoring of the POU treatment units.

Providing compliant water through a central dispenser is significantly less expensive than providing bottled water to 100 percent of the population, but a significant effort is required for clients to fill their containers at the central dispenser.

FINANCIAL ANALYSIS

Financial analysis of the City of Wellman PWS indicated that current water rates are funding operations, and a rate increase is not necessary to meet operating expenses. The current average water bill represents approximately 1.7 percent of the median household income (MHI). Table ES.2 provides a summary of the financial impact of implementing selected compliance alternatives. The alternatives were selected to highlight results for the best alternatives from each different type or category.

Some of the compliance alternatives offer potential for shared or regional solutions. A group of PWSs could work together to implement alternatives for developing a new groundwater source or expanding an existing source, obtaining compliant water from a large regional provider, or for central treatment. Sharing the cost for implementation of these alternatives could reduce the cost on a per user basis. Additionally, merging PWSs or management of several PWSs by a single entity offers the potential for reduction in administrative costs.

Table ES.2 Selected Financial Analysis Results

Alternative	Funding Option	Average Annual Water Bill	Percent of MHI
Current	NA	$464	1.7
To meet current expenses	NA	$293	1.1
Purchase water from City of Brownfield	100% Grant	$464	1.7
	Loan/Bond	$1,861	6.7
Central RO treatment	100% Grant	$1,137	4.1
	Loan/Bond	$1,618	5.9
Point-of-use	100% Grant	$1,128	4.1
	Loan/Bond	$1,228	4.4
Public dispenser	100% Grant	$650	2.4
	Loan/Bond	$665	2.4

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ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per liter
°F	Degrees Fahrenheit
ANSI	American National Standards Institute
BAT	Best available technology
BEG	Bureau of Economic Geology
CA	cellulose acetate
CCN	Certificate of Convenience and Necessity
CD	Community Development
CDBG	Community Development Block Grants
CFR	Code of Federal Regulations
CRMWA	Canadian River Municipal Water Authority
DWSRF	Drinking Water State Revolving Fund
ED	Electrodialysis
EDAP	Economically Distressed Areas Program
EDR	Electrodialysis reversal
FMT	Financial, managerial, and technical
GAM	Groundwater Availability Model
gpd	gallons per day
gpm	Gallons per minute
HUD	U.S. Department of Housing and Urban Development
IX	Ion exchange
LARS	Lubbock Area Regional Solution
MCL	Maximum contaminant level
mg/L	Milligram per liter
mgd	Million gallons per day
MHI	Median household income
NF	nanofiltration
NMEFC	New Mexico Environmental Financial Center
NURE	National Uranium Resource Evaluation
NPDWR	National Primary Drinking Water Regulations
O&M	Operation and Maintenance
ORCA	Office of Rural Community Affairs
Parsons	Parsons Transportation Group, Inc.
POE	Point-of-entry
POU	Point-of-use
psi	pounds per square inch
PWS	Public Water Systems

RFP	Revolving Fund Program
RO	Reverse osmosis
RUS	Rural Utilities Service
RWAF	Economically Distressed Areas Program
SDWA	Safe Drinking Water Act
STEP	Small Towns Environment Program
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TCF	Texas Capital Fund
TDA	Texas Department of Agriculture
TDS	Total dissolved solids
TFC	thin film composite
TWDB	Texas Water Development Board
USC	United States Code
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WAM	Water Availability Model
WEP	Water and Environment Program

SECTION 1
INTRODUCTION

The University of Texas Bureau of Economic Geology (BEG) and its subcontractor, Parsons Transportation Group Inc. (Parsons), were contracted by the Texas Commission on Environmental Quality (TCEQ) to assist with identifying and analyzing compliance alternatives for use by Public Water Systems (PWS) to meet and maintain Texas drinking water standards.

The overall goal of this project is to promote compliance using sound engineering and financial methods and data for PWSs that have recently had sample results that exceed maximum contaminant levels (MCL). The primary objectives of this project are to provide feasibility studies for PWSs and the TCEQ Water Supply Division that evaluate water supply compliance options, and to suggest a list of compliance alternatives that may be further investigated by the subject PWS with regard to future implementation. The feasibility studies identify a range of potential compliance alternatives, and present basic data that can be used for evaluating feasibility. The compliance alternatives addressed include a description of what would be required for implementation, conceptual cost estimates for implementation, and non-cost factors that could be used to differentiate between alternatives. The cost estimates are intended for comparing compliance alternatives, and to give a preliminary indication of potential impacts on water rates resulting from implementation.

It is anticipated the PWS will review the compliance alternatives in this report to determine if there are promising alternatives, and then select the most attractive alternative(s) for more detailed evaluation and possible subsequent implementation. This report contains a decision tree approach that guided the efforts for this project, and also contains steps to guide a PWS through the subsequent evaluation, selection, and implementation of a compliance alternative.

This feasibility report provides an evaluation of water supply compliance options for the City of Wellman PWS ID# 2230003, Certificate of Convenience and Necessity (CCN) #10591, located in Terry County, hereinafter referred to in this document as the "City of Wellman PWS." Recent sample results from the City of Wellman PWS exceeded the MCL for fluoride, selenium, fluoride, and arsenic , although treatment to remove arsenic has been implemented (USEPA 2008a; TCEQ 2004). The location of the City of Wellman PWS is shown on Figure 1.1. Various water supply and planning jurisdictions are shown on Figure 1.2. These water supply and planning jurisdictions are used in the evaluation of alternate water supplies that may be available in the area.

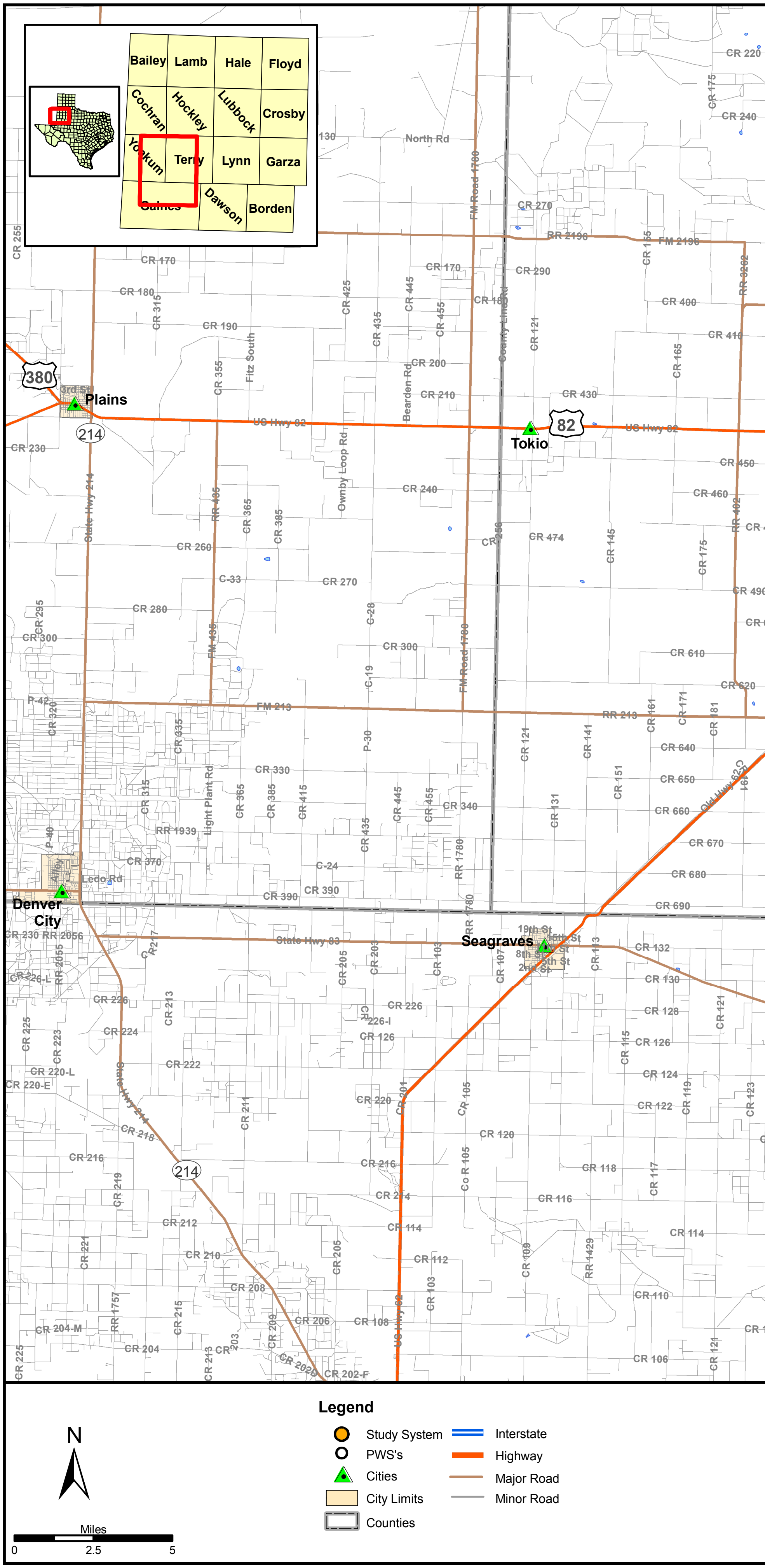

Figure 1.1

CITY OF WELLMAN

Location Map

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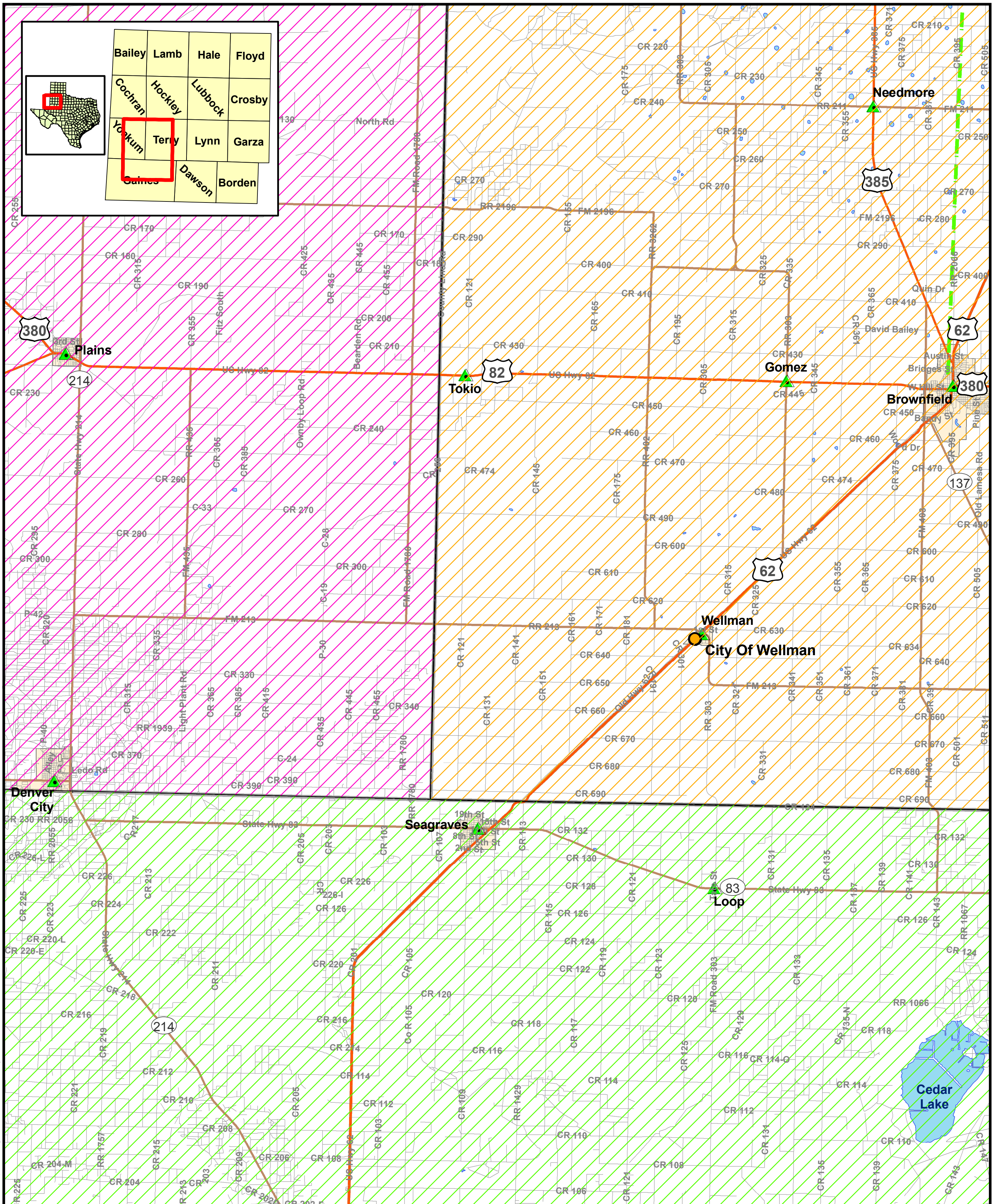

Legend

Study System	Interstate	Llano Estacado UWCD
PWS's	Highway	Sandy Land UWCD
Cities	Major Road	South Plains UWCD
City Limits	Minor Road	
Counties		

N

Miles
0 2.5 5

Figure 1.2

CITY OF WELLMAN

Groundwater Conservation Districts

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1.1 PUBLIC HEALTH AND COMPLIANCE WITH MCLS

The goal of this project is to promote compliance for PWSs that supply drinking water exceeding regulatory MCLs. This project only addresses those contaminants and does not address any other violations that may exist for a PWS. As mentioned above, the City of Wellman water system had recent sample results exceeding the MCL for arsenic, fluoride, selenium, and nitrate. In general, contaminant(s) in drinking water above the MCL(s) can have both short-term (acute) and long-term or lifetime (chronic) effects. Health concerns related to drinking water above MCLs for these chemicals are briefly described below.

Short-term effects of nitrate in drinking water above the MCL have caused serious illness and sometimes death. Drinking water health publications conclude that the most susceptible population to adverse nitrate health effects includes infants less than six months old; women who are pregnant or nursing; and individuals with enzyme deficiencies or a lack of free hydrochloric acid in the stomach. The serious illness in infants is due to the conversion of nitrate to nitrite by the body, which can interfere with the oxygen-carrying capacity of the child's blood. Symptoms include shortness of breath and blue-baby syndrome. Lifetime exposure to nitrates at levels above the MCL has the potential to cause the following effects: diuresis, increased starchy deposits, and hemorrhaging of the spleen (USEPA 2008e).

Potential health effects from the ingestion of water with levels of fluoride above the MCL (4 mg/L) over many years include bone disease, including pain and tenderness of the bones. Additionally, the U.S. Environmental Protection Agency (USEPA) has set a secondary fluoride standard of 2 mg/L to protect against dental fluorosis, which in its moderate or severe forms may result in a brown staining and/or pitting of the permanent teeth in children under nine years of age (USEPA 2008c).

Potential health effects from long-term ingestion of water with levels of arsenic above the MCL (0.010 mg/L) include non-cancerous effects, such as cardiovascular, pulmonary, immunological, neurological and endocrine effects, and cancerous effects, including skin, bladder, lung, kidney, nasal passage, liver and prostate cancer (USEPA 2008b).

Potential short-term health effects from the ingestion of water with levels of selenium above the MCL (0.050 mg/L) include hair and fingernail changes, damage to the peripheral nervous system, fatigue, and irritability. Long-term exposure of selenium has the potential to cause the following effects from a lifetime exposure at levels above the MCL; hair and fingernail loss; damage to kidney and liver tissue, and the nervous and circulatory systems (USEPA 2008d).

1.2 METHOD

The method for this project follows that of a pilot project performed by TCEQ, BEG, and Parsons. The pilot project evaluated water supply alternatives for PWSs that supplied drinking water with contaminant concentrations above USEPA and Texas drinking water standards. Three PWSs were evaluated in the pilot project to develop the method (*i.e.*, decision tree approach) for analyzing options for provision of compliant drinking water. This project is performed using the decision tree approach that was developed for the pilot project, and also used for subsequent projects.

Other tasks of the feasibility study are as follows:

- Identifying available data sources;
- Gathering and compiling data;
- Conducting financial, managerial, and technical (FMT) evaluations of the selected PWSs;
- Performing a geologic and hydrogeologic assessment of the area;
- Developing treatment and non-treatment compliance alternatives;
- Assessing potential alternatives with respect to economic and non-economic criteria;
- Preparing a feasibility report; and

Suggesting refinements to the approach for future studies.

The remainder of Section 1 of this report addresses the regulatory background, and provides a summary of arsenic, fluoride, nitrate, and selenium abatement options. Section 2 describes the method used to develop and assess compliance alternatives. The groundwater sources of arsenic, fluoride, nitrate, and selenium are addressed in Section 3. Findings for the City of Wellman PWS, along with compliance alternatives development and evaluation, can be found in Section 4. Section 5 references the sources used in this report.

1.3 REGULATORY PERSPECTIVE

The Utilities & Districts and Public Drinking Water Sections of the TCEQ Water Supply Division are responsible for implementing requirements of the Federal Safe Drinking Water Act (SDWA), which include oversight of PWSs and water utilities. These responsibilities include:

- Monitoring public drinking water quality;
- Processing enforcement referrals for MCL violators;
- Tracking and analyzing compliance options for MCL violators;
- Providing FMT assessment and assistance to PWSs;
- Participating in the Drinking Water State Revolving Fund program to assist PWSs in achieving regulatory compliance; and
- Setting rates for privately owned water utilities.

This project was conducted to assist in achieving these responsibilities.

1.4 ABATEMENT OPTIONS

When a PWS exceeds a regulatory MCL, the PWS must take action to correct the violation. The MCL exceedances at the City of Wellman PWS involve arsenic, fluoride, nitrate, and selenium. The following subsections explore alternatives considered as potential options for obtaining/providing compliant drinking water.

1.4.1 Existing Public Water Supply Systems

A common approach to achieving compliance is for the PWS to make arrangements with a neighboring PWS for water supply. For this arrangement to work, the PWS from which water is being purchased (supplier PWS) must have water in sufficient quantity and quality, the political will must exist, and it must be economically feasible.

1.4.1.1 Quantity

For purposes of this report, quantity refers to water volume, flowrate, and pressure. Before approaching a potential supplier PWS, the non-compliant PWS should determine its water demand on the basis of average day and maximum day. Peak instantaneous demands can be met through proper sizing of storage facilities. Further, the potential for obtaining the appropriate quantity of water to blend to achieve compliance should be considered. The concept of blending involves combining water with low levels of contaminants with non-compliant water in sufficient quantity that the resulting blended water is compliant. The exact blend ratio would depend on the quality of the water a potential supplier PWS can provide, and would likely vary over time. If high quality water is purchased, produced or otherwise obtained, blending can reduce the amount of high quality water required. Implementation of blending will require a control system to ensure the blended water is compliant.

If the supplier PWS does not have sufficient quantity, the non-compliant community could pay for the facilities necessary to increase the quantity to the extent necessary to supply the needs of the non-compliant PWS. Potential improvements might include, but are not limited to:

- Additional wells;
- Developing a new surface water supply,
- Additional or larger-diameter piping;
- Increasing water treatment plant capacity
- Additional storage tank volume;
- Reduction of system losses,
- Higher-pressure pumps; or
- Upsized, or additional, disinfection equipment.

In addition to the necessary improvements, a transmission pipeline would need to be constructed to tie the two PWSs together. The pipeline must tie-in at a point in the supplier PWS where all the upstream pipes and appurtenances are of sufficient capacity to handle the new demand. In the non-compliant PWS, the pipeline must tie in at a point where no down stream bottlenecks are present. If blending is the selected method of operation, the tie-in point must be selected to ensure all the water in the system is blended to achieve regulatory compliance.

1.4.1.2 Quality

If a potential supplier PWS obtains its water from the same aquifer (or same portion of the aquifer) as the non-compliant PWS, the quality of water may not be significantly better. However, water quality can vary significantly due to well location, even within the same aquifer. If localized areas with good water quality cannot be identified, the non-compliant PWS would need to find a potential supplier PWS that obtains its water from a different aquifer or from a surface water source. Additionally, a potential supplier PWS may treat non-compliant raw water to an acceptable level.

Surface water sources may offer a potential higher-quality source. Since there are significant treatment requirements, utilization of surface water for drinking water is typically most feasible for larger local or regional authorities or other entities that may provide water to several PWSs. Where PWSs that obtain surface water are neighbors, the non-compliant PWS may need to deal with those systems as well as with the water authorities that supply the surface water.

1.4.2 Potential for New Groundwater Sources

1.4.2.1 Existing Non-Public Supply Wells

Often there are wells not associated with PWSs located in the vicinity of the non-compliant PWS. The current use of these wells may be for irrigation, industrial purposes, domestic supply, stock watering, and other purposes. The process for investigating existing wells is as follows:

- Existing data sources (see below) will be used to identify wells in the areas that have satisfactory quality. For the City of Wellman PWS, the following standards could be used in a rough screening to identify compliant groundwater in surrounding systems:
    - Nitrate (measured as nitrogen) concentrations less than 8 mg/L (below the MCL of 10 mg/L);
    - Fluoride concentration less than 2.0 mg/L (below the Secondary MCL of 2 mg/L);
    - Arsenic concentration less than 0.008 mg/L (below the MCL of 0.01 mg/L);
    - Uranium concentration less than 0.024 mg/L (below the MCL of 0.030 mg/L; and

- Selenium concentration less than 0.04 mg/L (below the MCL of 0.05 mg/L).

- The recorded well information will be reviewed to eliminate those wells that appear to be unsuitable for the application. Often, the "Remarks" column in the Texas Water Development Board (TWDB) hard-copy database provides helpful information. Wells eliminated from consideration generally include domestic and stock wells, dug wells, test holes, observation wells, seeps and springs, destroyed wells, wells used by other communities, etc.
- Wells of sufficient size are identified. Some may be used for industrial or irrigation purposes. Often the TWDB database will include well yields, which may indicate the likelihood that a particular well is a satisfactory source.
- At this point in the process, the local groundwater control district (if one exists) should be contacted to obtain information about pumping restrictions. Also, preliminary cost estimates should be made to establish the feasibility of pursuing further well development options.
- If particular wells appear to be acceptable, the owner(s) should be contacted to ascertain their willingness to work with the PWS. Once the owner agrees to participate in the program, questions should be asked about the wells. Many owners have more than one well, and would probably be the best source of information regarding the latest test dates, who tested the water, flowrates, and other well characteristics.
- After collecting as much information as possible from cooperative owners, the PWS would then narrow the selection of wells and sample and analyze them for quality. Wells with good quality water would then be potential candidates for test pumping. In some cases, a particular well may need to be refurbished before test pumping. Information obtained from test pumping would then be used in combination with information about the general characteristics of the aquifer to determine whether a well at that location would be suitable as a supply source.
- It is recommended that new wells be installed instead of using existing wells to ensure the well characteristics are known and the well meets construction standards.
- Permit(s) would then be obtained from the groundwater control district or other regulatory authority, and an agreement with the owner (purchase or lease, access easements, etc.) would then be negotiated.

1.4.2.2 Develop New Wells

If no existing wells are available for development, the PWS or group of PWSs has an option of developing new wells. Records of existing wells, along with other hydrogeologic information and modern geophysical techniques, should be used to identify potential locations for new wells. In some areas, the TWDB's Groundwater Availability Model (GAM) may be applied to indicate potential sources. Once a general area is identified, land owners and regulatory agencies should be contacted to determine an exact location for a new well or well field. Pump tests and water quality tests would be required to determine if a new well will produce an adequate quantity of good quality water. Permits from the local groundwater control district or other regulatory authority could also be required for a new well.

1.4.3 Potential for Surface Water Sources

Water rights law dominates the acquisition of water from surface water sources. For a PWS, 100 percent availability of water is required, except where a back-up source is available. For PWSs with an existing water source, although it may be non-compliant because of elevated concentrations of one or more parameters, water rights may not need to be 100 percent available.

1.4.3.1 Existing Surface Water Sources

"Existing surface water sources" of water refers to municipal water authorities and cities that obtain water from surface water sources. The process of obtaining water from such a source is generally less time consuming and less costly than the process of developing a new source; therefore, it should be a primary course of investigation. An existing source would be limited by its water rights, the safe yield of a reservoir or river, or by its water treatment or water conveyance capability. The source must be able to meet the current demand and honor contracts with communities it currently supplies. In many cases, the contract amounts reflect projected future water demand based on population or industrial growth.

A non-compliant PWS would look for a source with sufficient spare capacity. Where no such capacity exists, the non-compliant PWS could offer to fund the improvements necessary to obtain the capacity. This approach would work only where the safe yield could be increased (perhaps by enlarging a reservoir) or where treatment capacity could be increased. In some instances water rights, where they are available, could possibly be purchased.

In addition to securing the water supply from an existing source, the non-compliant PWS would need to arrange for transmission of the water to the PWS. In some cases, that could require negotiations with, contracts with, and payments to an intermediate PWS (an intermediate PWS is one where the infrastructure is used to transmit water from a "supplier" PWS to a "supplied" PWS, but does not provide any additional treatment to the supplied water). The non-compliant PWS could be faced with having to fund improvements to the intermediate PWS in addition to constructing its own necessary transmission facilities.

1.4.3.2 New Surface Water Sources

Communication with the TCEQ and relevant planning groups from the beginning is essential in the process of obtaining a new surface water source. Preliminary assessment of the potential for acquiring new rights may be based on surface water availability maps located on the TWDB website. Where water rights appear to be available, the following activities need to occur:

- Discussions with TCEQ to indicate the likelihood of obtaining those rights. The TCEQ may use the Water Availability Model (WAM) to assist in the determination.

- Discussions with land owners to indicate potential treatment plant locations.
- Coordination with U.S. Army Corps of Engineers and local river authorities.
- Preliminary engineering design to determine the feasibility, costs, and environmental issues of a new treatment plant.

Should these discussions indicate that a new surface water source is the best option, the community would proceed with more intensive planning (initially obtaining funding), permitting, land acquisition, and detailed designs.

1.4.4 Identification of Treatment Technologies

Various treatment technologies were also investigated as compliance alternatives for treatment of fluoride, selenium, arsenic, and uranium to regulatory levels (*i.e.*, MCLs). Numerous options have been identified by the USEPA as best available technologies (BAT) for non-compliant constituents. Identification and descriptions of the various BATs are provided in the following sections.

1.4.4.1 Treatment Technologies for Fluoride

Fluoride is a soluble anion and is not removed by particle filtration. The secondary MCL for fluoride is 2 mg/L and the primary MCL is 4 mg/L. The USEPA BATs for fluoride removal include activated alumina adsorption and reverse osmosis. Other treatment technologies that can potentially remove fluoride from water include lime softening (modified), alum coagulation, electrodialysis (ED or EDR) and anion exchange.

1.4.4.2 Treatment Technologies for Selenium

In natural waters, selenium exists in four different oxidation states (-II, 0, +IV, and +VI). Among these, Se(IV), selenite and Se(VI), selenate are the most common species in ground water and surface water (Levander 1985). The MCL for selenium in drinking water is 50 µg/L. The USEPA BATs for selenium include activated alumina adsorption, reverse osmosis, ED or EDR, lime softening and coagulation/filtration. Lime softening is not recommended for water systems with less than 500 connections due to process complexities and the use of large amounts of chemicals. Coagulation/filtration is only effective for removing Se(IV), selenite. Other potential treatment technologies include adsorption by different specialty media such as granular iron oxide, granular ferric hydroxide, and the newly commercialized granular titanium oxide media (*e.g.,* Dow ADSORSIA™ GTO™). These adsorption media are effective for removing arsenic (III and V) and selenium (IV).

1.4.4.3 Treatment Technologies for Arsenic

In January 2001, the USEPA published a final rule in the Federal Register that established an MCL for arsenic of 0.010 mg/L (USEPA 2008b). The regulation applies to all community water systems and non-transient, non-community water systems, regardless of size.

The new arsenic MCL of 0.01 mg/L became effective January 23, 2006, at which time the running average annual arsenic level would have to be at or below 0.01 mg/L at each entry point to the distribution system, although point-of-use (POU) treatment could be instituted in place of centralized treatment. All surface water systems had to complete initial monitoring for the new arsenic MCL or have a state-approved waiver by December 31, 2006. All groundwater systems need to complete initial monitoring or have a state-approved waiver by December 31, 2007.

Various treatment technologies were investigated as compliance alternatives for treatment of arsenic to regulatory levels (*i.e.*, MCL). According to a recent USEPA report for small water systems with less than 10,000 customers (EPA/600/R-05/001) a number of drinking water treatment technologies are available to reduce arsenic concentrations in source water to below the new MCL of 0.010 mg/L, including:

- Ion exchange (IX);
- Reverse osmosis (RO);
- Electrodialysis reversal (EDR);
- Adsorption; and
- Coagulation/filtration.

1.4.4.4 Treatment Technologies for Nitrate

The MCL for nitrate (as nitrogen) was set at 10 mg/L by the USEPA on January 30, 1992, as part of the Phase II Rules, and became effective on July 30, 1992 (USEPA 2008e). This MCL applies to all community water systems, regardless of size.

BATs identified by USEPA for removal of nitrates include:

- Reverse Osmosis;
- Ion Exchange; and
- Electrodialysis Reversal.

1.4.5 Treatment Technologies Description

Reverse Osmosis and EDR are the only two BAT technologies that are common for the four contaminants. While it may be possible to remove all four contaminants by using two processes in series, this cannot be recommended without pilot testing. RO is also a viable option for POE and POU systems. A description of these technologies follows.

Descriptions of the RO and EDR technologies are presented in the following paragraphs.

1.4.5.1 Reverse Osmosis

Process. RO is a physical process in which contaminants are removed by applying pressure on the feed water to force it through a semi-permeable membrane. RO membranes reject ions based on size and electrical charge. The raw water is typically called feed; the product water is called permeate; and the concentrated reject is called concentrate. Common RO membrane materials include asymmetric cellulose acetate (CA) or polyamide thin film composite (TFC). The TFC membrane operates at much lower pressure and can achieve higher salt rejection than the CA membranes but is less chlorine resistant. Each material has specific benefits and limitations depending on the raw water characteristics and pre-treatment. Spiral wound has been the dominant media type in typical RO systems. A newer, lower pressure type membrane that is similar in operation to spiral wound type RO, is nanofiltration (NF), which has higher rejection for divalent ions than mono-valent ions. NF is sometimes used instead of spiral wound type RO for treating water with high hardness and sulfate concentrations.

A typical RO installation includes a high pressure feed pump; parallel first and second stage membrane elements (in pressure vessels); and valves and piping for feed, permeate, and concentrate streams. Factors influencing membrane selection are cost, recovery, rejection, raw water characteristics, and pre-treatment. Factors influencing performance are raw water characteristics, pressure, temperature, and regular monitoring and maintenance. Depending on the membrane type and operating pressure, RO is capable of removing 85-95 percent of fluoride, and over 95 percent of nitrate, selenium, arsenic, and uranium. The treatment process is relatively insensitive to pH. Water recovery is 60-80 percent, depending on raw water characteristics. The concentrate volume for disposal can be significant. The conventional RO treatment train for well water uses anti-scalant addition, cartridge filtration, RO membranes, chlorine disinfection, and clearwell storage.

Pre-treatment. RO requires careful review of raw water characteristics, and pre-treatment needs to prevent membranes from fouling, scaling, or other membrane degradation. Removal or sequestering of suspended solids is necessary to prevent colloidal and bio-fouling, and removal of sparingly soluble constituents such as calcium, magnesium, silica, sulfate, barium, *etc*., may be required to prevent scaling. Pretreatment can include media filters to remove suspended particles; IX softening to remove hardness; antiscalant feed; temperature and pH adjustment to maintain efficiency; acid to prevent scaling and membrane damage; activated carbon or bisulfite to remove chlorine (post-disinfection may be required); and cartridge filters to remove any remaining suspended particles to protect membranes from upsets.

Maintenance. Rejection percentages must be monitored to ensure contaminant removal below MCLs. Regular monitoring of membrane performance is necessary to determine fouling, scaling, or other membrane degradation. Use of monitoring equipment to track membrane performance is recommended. Acidic or caustic solutions are regularly flushed through the system at high volume/low pressure with a cleaning agent to remove fouling and scaling. The system is flushed and returned to service. RO stages are cleaned sequentially. Frequency of membrane replacement is dependent on raw water characteristics, pre-treatment, and maintenance.

Waste Disposal. Pre-treatment waste streams, concentrate flows, and spent filters and membrane elements all require approved disposal methods. Disposal of the significant volume of the concentrate stream is a problem for many utilities.

Advantages (RO)

- Produces the highest water quality.
- Can effectively treat a wide range of dissolved salts and minerals, turbidity, health and aesthetic contaminants, and certain organics. Some highly maintained units are capable of treating biological contaminants.
- Low pressure - less than 100 pounds per square inch (psi), compact, self-contained, single membrane units are available for small installations.

Disadvantages (RO)

- Relatively expensive to install and operate.
- Frequent membrane monitoring and maintenance; pressure, temperature, and pH requirements to meet membrane tolerances. Membranes can be chemically sensitive.
- Additional water usage depending on rejection rate.
- Concentrate disposal required.

A concern with RO for treatment of inorganics is that if the full stream is treated, then most of the alkalinity and hardness would also be removed. In that event, post-treatment may be necessary to avoid corrosion problems. If feasible, a way to avoid this issue is to treat a slip stream of raw water and blend the slip stream back with the raw water rather than treat the full stream. The amount of water rejected is also an issue with RO. Discharge concentrate can be between 10 and 50 percent of the influent flow.

1.4.5.2 Electrodialysis Reversal

Process. EDR is an electrochemical process in which ions migrate through ion-selective semi-permeable membranes as a result of their attraction to two electrically charged electrodes. A typical EDR system includes a membrane stack with a number of cell pairs, each consisting of a cation transfer membrane, a demineralized flow spacer, an anion transfer membrane, and a concentrate flow spacer. Electrode compartments are at opposite ends of the stack. The influent feed water (chemically treated to prevent precipitation) and the concentrated reject flow in parallel across the membranes and through the demineralized and concentrate flow spacers, respectively. The electrodes are continually flushed to reduce fouling or scaling. Careful consideration of flush feed water is required. Typically, the membranes are cation or anion exchange resins cast in sheet form; the spacers are high density polyethylene; and the electrodes are inert metal. EDR stacks are tank-contained and often staged. Membrane selection is based on review of raw water characteristics. A single-stage EDR system usually removes 40-50 percent of fluoride, nitrate, selenium, arsenic, uranium, and TDS. Additional stages are required to achieve higher removal efficiency (85-95% for fluoride). EDR uses the technique of regularly reversing the polarity of the electrodes, thereby freeing accumulated ions on the membrane surface. This process requires additional plumbing and electrical controls, but it increases membrane life, may require less added chemicals, and eases cleaning. The conventional EDR treatment train typically includes EDR membranes, chlorine disinfection, and clearwell storage. Treatment of surface water may also require pre-treatment steps such as raw water pumps, debris screens, rapid mix with addition of an anti-scalant, slow mix flocculator, sedimentation basin or clarifier, and gravity filters. Microfiltration could be used in place of flocculation, sedimentation, and filtration. Additional treatment or management of the concentrate and the removed solids would be necessary prior to disposal.

Pre-treatment**.** There are pretreatment requirements for pH, organics, turbidity, and other raw water characteristics. EDR typically requires chemical feed to prevent scaling, acid addition for pH adjustment, and a cartridge filter for prefiltration. . If arsenite [As(III)] occurs, oxidation via pre-chlorination is required since the arsenite specie at pH below 9 has no ionic charge and will not be removed by EDR.

Maintenance. EDR membranes are durable, can tolerate a pH range from 1 to 10, and temperatures to 115 degrees Fahrenheit (^{o}F) for cleaning. They can be removed from the unit and scrubbed. Solids can be washed off by turning the power off and letting water circulate through the stack. Electrode washes flush out byproducts of electrode reaction. The byproducts are hydrogen, formed in the cathode space, and oxygen and chlorine gas, formed in the anode space. If the chlorine is not removed, toxic chlorine gas may form. Depending on raw water characteristics, the membranes would require regular maintenance or replacement. EDR requires reversing the polarity. Flushing at high volume/low pressure continuously is required to clean electrodes. If used, pre-treatment filter replacement and backwashing would be required. The EDR stack must be disassembled, mechanically cleaned, and reassembled at regular intervals.

Waste Disposal. Highly concentrated reject flows, electrode cleaning flows, and spent membranes require approved disposal methods. Pre-treatment processes and spent materials also require approved disposal methods.

Advantages (EDR)

- EDR can operate with minimal fouling or scaling, or chemical addition.
- Low pressure requirements; typically quieter than RO.
- Long membrane life expectancy; EDR extends membrane life and reduces maintenance.
- More flexible than RO in tailoring treated water quality requirements.

Disadvantages (EDR)

- Not suitable for high levels of iron, manganese, and hydrogen sulfide.
- High energy usage at higher total dissolved solids (TDS) water.

- Waste of water because of the significant concentrate flows.
- Generates relatively large saline waste stream requiring disposal.
- Pre-oxidation required for arsenite (if present).

EDR can be quite expensive to run because of the energy it uses. However, because it is generally automated and allows for part-time operation, it may be an appropriate technology for small systems. It can be used to simultaneously reduce fluoride, selenium, nitrate, arsenic and TDS.

1.4.6 Point-of-Entry and Point-of-Use Treatment Systems

Point-of-entry (POE) and POU treatment devices or systems rely on many of the same treatment technologies used in central treatment plants. However, while central treatment plants treat all water distributed to consumers to the same level, POU and POE treatment devices are designed to treat only a portion of the total flow. POU devices treat only the water intended for direct consumption, typically at a single tap or limited number of taps, while POE treatment devices are typically installed to treat all water entering a single home, business, school, or facility. POU and POE treatment systems may be an option for PWSs where central treatment is not affordable. Updated USEPA guidance on use of POU and POE treatment devices is provided in "*Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems,"* EPA 815-R-06-010, April 2006 (USEPA 2006).

Point-of-entry and POU treatment systems can be used to provide compliant drinking water. These systems typically use small adsorption or reverse osmosis treatment units installed "under the sink" in the case of POU, and where water enters a house or building in the case of POE. It should be noted that the POU treatment units would need to be more complex than units typically found in commercial retail outlets to meet regulatory requirements, making purchase and installation more expensive. Point-of-entry and POU treatment units would be purchased and owned by the PWS. These solutions are decentralized in nature, and require utility personnel entry into houses or at least onto private property for installation, maintenance, and testing. Due to the large number of treatment units that would be employed and would be largely out of the control of the PWS, it is very difficult to ensure 100 percent compliance. Prior to selection of a POE or POU program for implementation, consultation with TCEQ would be required to address measurement and determination of level of compliance.

The National Primary Drinking Water Regulations (NPDWR), 40 CFR Section 141.100, covers criteria and procedures for PWSs using POE devices and sets limits on the use of these devices. According to the regulations (July 2005 Edition), the PWS must develop and obtain TCEQ approval for a monitoring plan before POE devices are installed for compliance with an MCL. Under the plan, POE devices must provide health protection equivalent to central water treatment meaning the water must meet all NPDWR and would be of acceptable quality similar to water distributed by a well-operated central treatment plant. In addition, monitoring must include physical measurements and observations such as total flow treated and mechanical condition of the treatment equipment. The system would have to track the POE flow for a given time period, such as monthly, and maintain records of device inspection. The monitoring plan should include frequency of monitoring for the contaminant of concern and number of units to be monitored. For instance, the system may propose to monitor every POE device during the first year for the contaminant of concern and then monitor one-third of the units annually, each on a rotating schedule, such that each unit would be monitored every three years. To satisfy the requirement that POE devices must provide health protection, the water system may be required to conduct a pilot study to verify the POE device can provide treatment equivalent to central treatment. Every building connected to the system must have a POE device installed, maintained, and properly monitored. Additionally, TCEQ must be assured that every building is subject to treatment and monitoring, and that the rights and responsibilities of the PWS customer convey with title upon sale of property.

Effective technology for POE devices must be properly applied under the monitoring plan approved by TCEQ and the microbiological safety of the water must be maintained. TCEQ requires adequate certification of performance, field testing, and, if not included in the certification process, a rigorous engineering design review of the POE devices. The design and application of the POE devices must consider the tendency for increase in heterotrophic bacteria concentrations in water treated with activated carbon. It may be necessary to use frequent backwashing, post-contactor disinfection, and Heterotrophic Plate Count monitoring to ensure that the microbiological safety of the water is not compromised.

The SDWA [§1412(b)(4)(E)(ii)] regulates the design, management and operation of POU and POE treatment units used to achieve compliance with an MCL. These restrictions, relevant to MCL compliance are:

- POU and POE treatment units must be owned, controlled, and maintained by the water system, although the utility may hire a contractor to ensure proper operation and maintenance (O&M) and MCL compliance. The water system must retain unit ownership and oversight of unit installation, maintenance and sampling; the utility ultimately is the responsible party for regulatory compliance. The water system staff need not perform all installation, maintenance, or management functions, as these tasks may be contracted to a third party-but the final responsibility for the quality and quantity of the water supplied to the community resides with the water system, and the utility must monitor all contractors closely. Responsibility for O&M of POU or POE devices installed for SDWA compliance may not be delegated to homeowners.
- POU and POE units must have mechanical warning systems to automatically notify customers of operational problems. Each POU or POE treatment device must be equipped with a warning device (e.g., alarm, light) that would alert users when their unit is no longer adequately treating their water. As an alternative, units may be equipped with an automatic shut-off mechanism to meet this requirement.
- If the American National Standards Institute (ANSI) issued product standards for a specific type of POU or POE treatment unit, only those units that have been

independently certified according to those standards may be used as part of a compliance strategy.

The following observations with regard to using POE and POU devices for SDWA compliance were made by Raucher, *et al.* (2004):

- If POU devices are used as an SDWA compliance strategy, certain consumer behavioral changes will be necessary (e.g., encouraging people to drink water only from certain treated taps) to ensure comprehensive consumer health protection.
- Although not explicitly prohibited in the SDWA, USEPA indicates that POU treatment devices should not be used to treat for radon or for most volatile organic contaminants (VOC) to achieve compliance, because POU devices do not provide 100 percent protection against inhalation or contact exposure to those contaminants at untreated taps (e.g., shower heads).
- Liability – PWSs considering unconventional treatment options (POU, POE, or bottled water) must address liability issues. These could be meeting drinking water standards, property entry and ensuing liabilities, and damage arising from improper installation or improper function of the POU and POE devices.

1.4.7 Water Delivery or Central Drinking Water Dispensers

Current USEPA regulations 40 Code of Federal Regulations (CFR) 141.101 prohibit the use of bottled water to achieve compliance with an MCL, except on a temporary basis. State regulations do not directly address the use of bottled water. Use of bottled water at a non-compliant PWS would be on a temporary basis. Every 3 years, the PWSs that employ interim measures are required to present the TCEQ with estimates of costs for piping compliant water to their systems. As long as the projected costs remain prohibitively high, the bottled water interim measure is extended. Until USEPA amends the noted regulation, the TCEQ is unable to accept water delivery or central drinking water dispensers as compliance solutions.

Central provision of compliant drinking water would consist of having one or more dispensers of compliant water where customers could come to fill containers with drinking water. The centralized water source could be from small to medium-sized treatment units or could be compliant water delivered to the central point by truck.

Water delivery is an interim measure for providing compliant water. As an interim measure for a small impacted population, providing delivered drinking water may be cost effective. If the susceptible population is large, the cost of water delivery would increase significantly.

Water delivery programs require consumer participation to a varying degree. Ideally, consumers would have to do no more than they currently do for a piped-water delivery system. Least desirable are those systems that require maximum effort on the part of the customer (*e.g.,* customer has to travel to get the water, transport the water, and physically handle the bottles).

SECTION 2
EVALUATION METHOD

2.1 DECISION TREE

The decision tree is a flow chart for conducting feasibility studies for a non-compliant PWS. The decision tree is shown in Figures 2.1 through 2.4. The tree guides the user through a series of phases in the design process. Figure 2.1 shows Tree 1, which outlines the process for defining the existing system parameters, followed by optimizing the existing treatment system operation. If optimizing the existing system does not correct the deficiency, the tree leads to six alternative preliminary branches for investigation. The groundwater branch leads through investigating existing wells to developing a new well field. The treatment alternatives address centralized and on-site treatment. The objective of this phase is to develop conceptual designs and cost estimates for the six types of alternatives. The work done for this report follows through Tree 1 and Tree 2, as well as a preliminary pass through Tree 4.

Tree 3, which begins at the conclusion of the work for this report, starts with a comparison of the conceptual designs, selecting the two or three alternatives that appear to be most promising, and eliminating those alternatives that are obviously infeasible. It is envisaged that a process similar to this would be used by the study PWS to refine the list of viable alternatives. The selected alternatives are then subjected to intensive investigation, and highlighted by an investigation into the socio-political aspects of implementation. Designs are further refined and compared, resulting in the selection of a preferred alternative. The steps for assessing the financial and economic aspects of the alternatives (one of the steps in Tree 3) are given in Tree 4 in Figure 2.4.

2.2 DATA SOURCES AND DATA COLLECTION

2.2.1 Data Search

2.2.1.1 Water Supply Systems

The TCEQ maintains a set of files on public water systems, utilities, and districts at its headquarters in Austin, Texas. The files are organized under two identifiers: a PWS identification number and a CCN number. The PWS identification number is used to retrieve four types of files:

- CO – Correspondence,
- CA – Chemical analysis,
- MOR – Monthly operating reports (quality/quantity), and
- FMT – Financial, managerial and technical issues.

Figure 2.1
TREE 1 – EXISTING FACILITY ANALYSIS

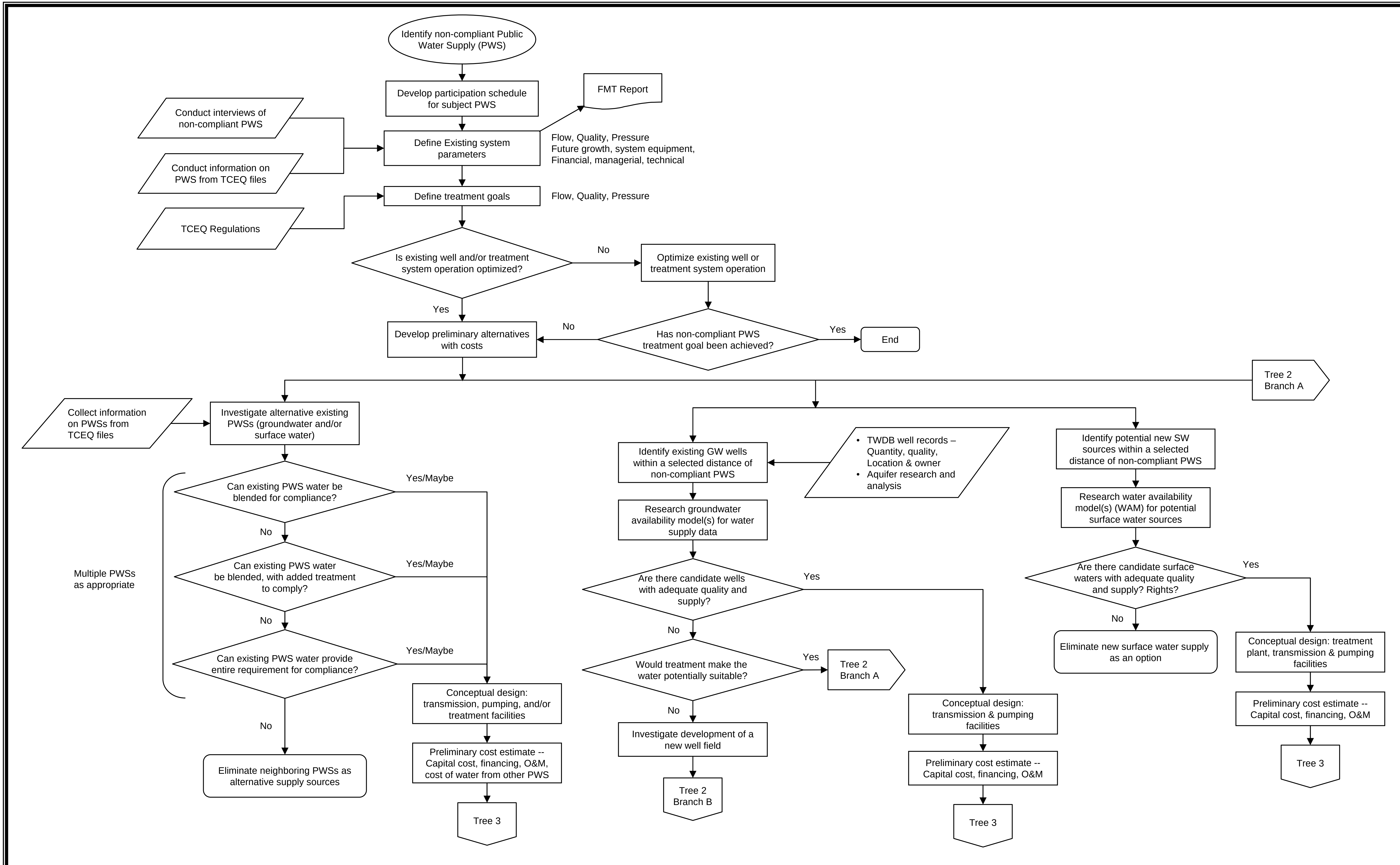


Figure 2.2
TREE 2 – DEVELOP TREATMENT ALTERNATIVES

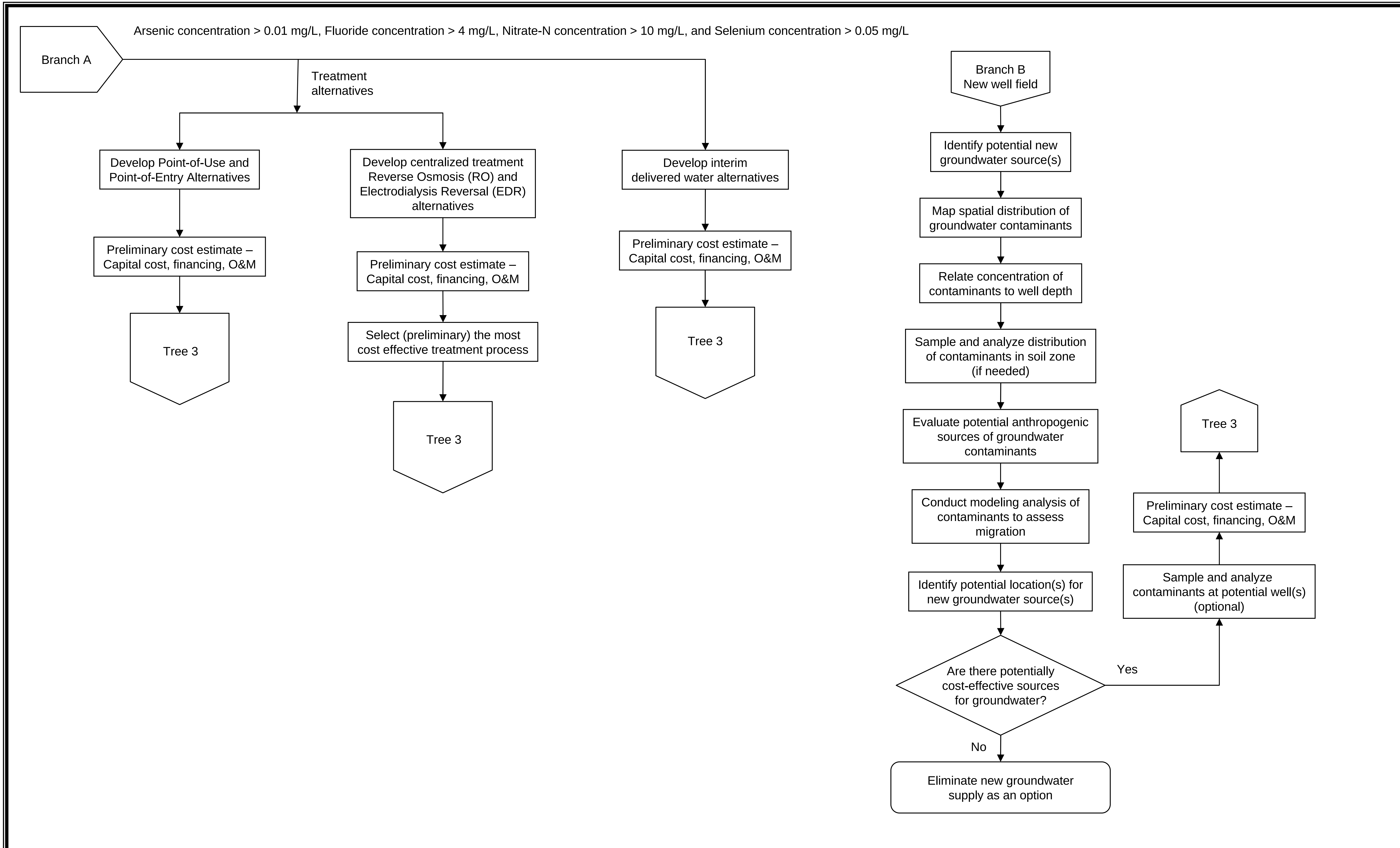


Figure 2.3
Tree 3 – PRELIMINARY ANALYSIS

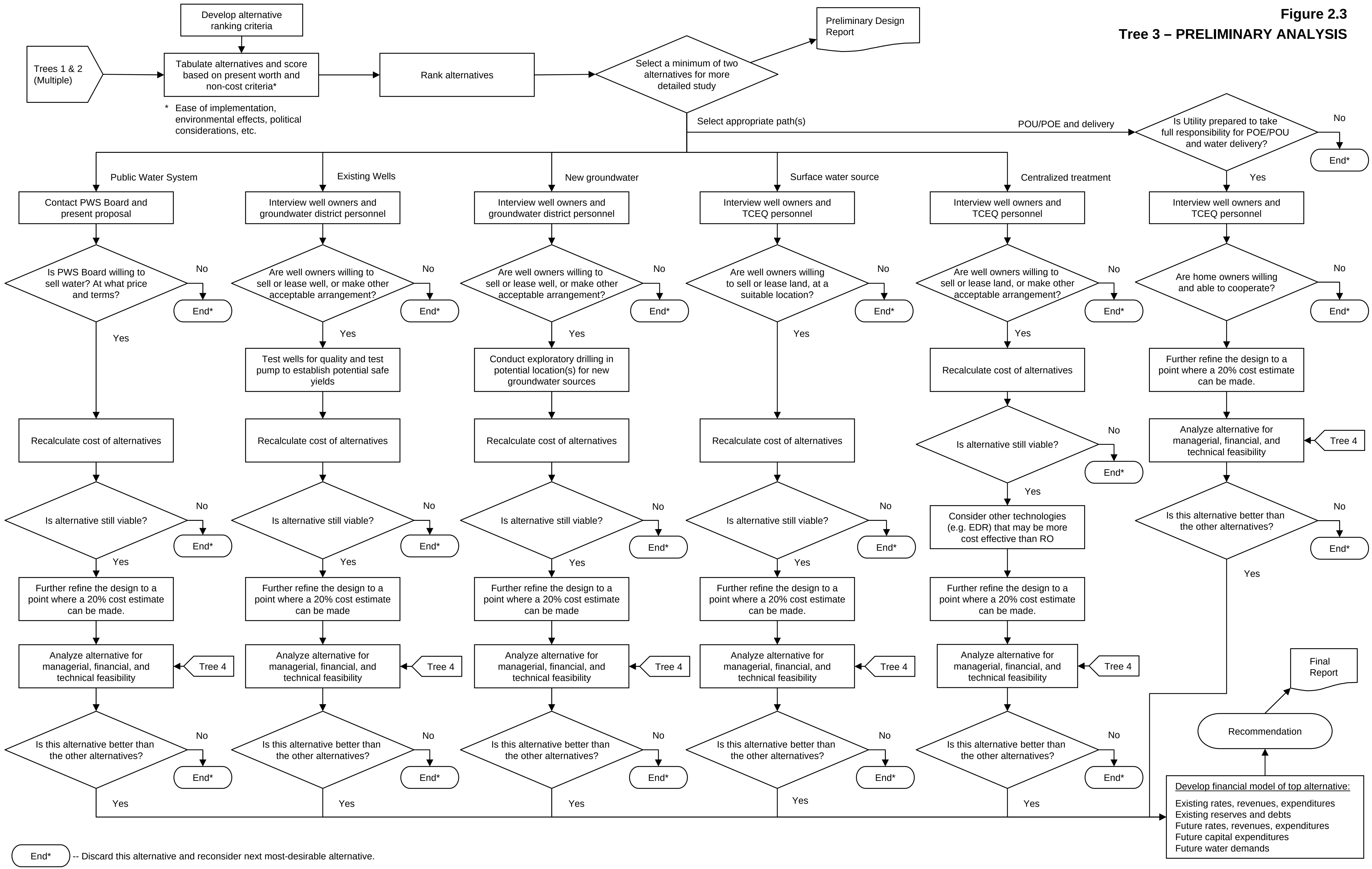
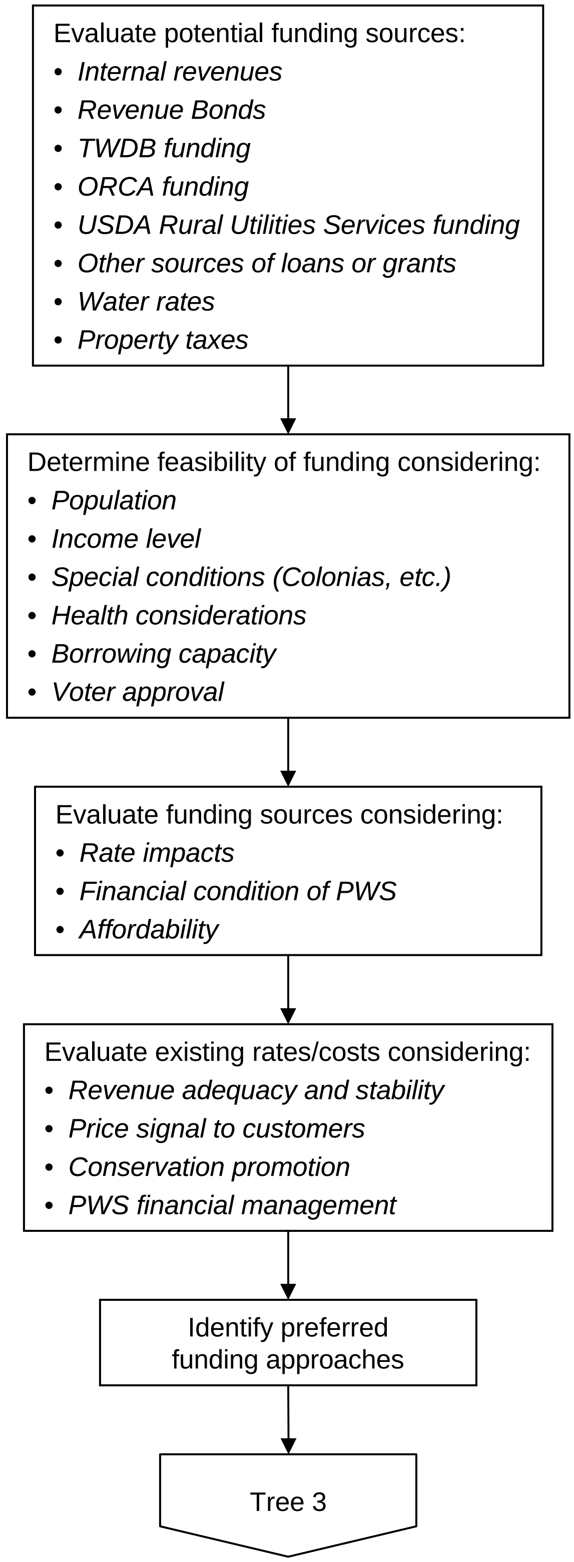


Figure 2.4
TREE 4 – FINANCIAL



The CCN files generally contain a copy of the system's Certificate of Convenience and Necessity, along with maps and other technical data.

These files were reviewed for the PWS and surrounding systems.

The following websites were consulted to identify the water supply systems in the area:

- Texas Commission on Environmental Quality
  www3.tceq.state.tx.us/iwud/.
- USEPA Safe Drinking Water Information System
  www.epa.gov/safewater/data/getdata.html

Groundwater Control Districts were identified on the TWDB web site, which has a series of maps covering various groundwater and surface water subjects. One of those maps shows groundwater control districts in the State of Texas.

2.2.1.2 Existing Wells

The TWDB maintains a groundwater database available at www.twdb.state.tx.us that has two tables with helpful information. The "Well Data Table" provides a physical description of the well, owner, location in terms of latitude and longitude, current use, and for some wells, items such as flowrate, and nature of the surrounding formation. The "Water Quality Table" provides information on the aquifer and the various chemical concentrations in the water. For this project, it was assumed the nitrate concentration given in this database was the concentration of nitrate, with a molecular weight of 62. To convert to the same basis used for the MCL (Nitrate-N), the value given in the TWDB database was divided by 4.5.

2.2.1.3 Surface Water Sources

Regional planning documents were consulted for lists of surface water sources.

2.2.1.4 Groundwater Availability Model

GAMs, developed by the TWDB, are planning tools and should be consulted as part of a search for new or supplementary water sources. The GAM for the Ogallala Aquifer was investigated as a potential tool for identifying available and suitable groundwater resources.

2.2.1.5 Water Availability Model

The WAM is a computer-based simulation predicting the amount of water that would be in a river or stream under a specified set of conditions. WAMs are used to determine whether water would be available for a newly requested water right or amendment. If water is available, these models estimate how often the applicant could count on water under various conditions (*e.g.*, whether water would be available only one month out of the year, half the year, or all year, and whether that water would be available in a repeat of the drought of record).

WAMs provide information that assist TCEQ staff in determining whether to recommend the granting or denial of an application.

2.2.1.6 Financial Data

An evaluation of existing data will yield an up-to-date assessment of the financial condition of the water system. As part of a site visit, financial data were collected in various forms such as electronic files, hard copy documents, and focused interviews. Data sought included:

- Annual Budget
- Audited Financial Statements
    - Balance Sheet
    - Income & Expense Statement
    - Cash Flow Statement
    - Debt Schedule
- Water Rate Structure
- Water Use Data
    - Production
    - Billing
    - Customer Counts

2.2.1.7 Demographic Data

Basic demographic data were collected from the 2000 Census to establish incomes and eligibility for potential low cost funding for capital improvements. Median household income (MHI) and number of families below poverty level were the primary data points of significance. If available, MHI for the customers of the PWS should be used. In addition, unemployment data were collected from current U.S. Bureau of Labor Statistics. These data were collected for the following levels: national, state, and county.

2.2.2 PWS Interviews

2.2.2.1 PWS Capacity Assessment Process

Capacity assessment is the industry standard term for evaluation of a water system's FMT capacity to effectively deliver safe drinking water to its customers now and in the future at a reasonable cost, and to achieve, maintain and plan for compliance with applicable regulations. The assessment process involves interviews with staff and management who have a responsibility in the operations and management of the system.

Financial, managerial, and technical capacity are individual yet highly interrelated components of a system's capacity. A system cannot sustain capacity without maintaining adequate capability in all three components.

Financial capacity is a water system's ability to acquire and manage sufficient financial resources to allow the system to achieve and maintain compliance with SDWA regulations. Financial capacity refers to the financial resources of the water system, including but not limited to, revenue sufficiency, credit worthiness, and fiscal controls.

Managerial capacity is the ability of a water system to conduct its affairs so the system is able to achieve and maintain compliance with SDWA requirements. Managerial capacity refers to the management structure of the water system, including but not limited to, ownership accountability, staffing and organization, and effective relationships with customers and regulatory agencies.

Technical capacity is the physical and operational ability of a water system to achieve and maintain compliance with SDWA regulations. It refers to the physical infrastructure of the water system, including the adequacy of the source water, treatment, storage and distribution infrastructure. It also refers to the ability of system personnel to effectively operate and maintain the system and to otherwise implement essential technical knowledge.

Many aspects of water system operations involve more than one component of capacity. Infrastructure replacement or improvement, for example, requires financial resources, management planning and oversight, and technical knowledge. A deficiency in any one area could disrupt the entire operation. A system that is able to meet both its immediate and long-term challenges demonstrates that it has sufficient FMT capacity.

Assessment of FMT capacity of the PWS was based on an approach developed by the New Mexico Environmental Finance Center (NMEFC), which is consistent with the TCEQ FMT assessment process. This method was developed from work the NMEFC did while assisting USEPA Region 6 in developing and piloting groundwater comprehensive performance evaluations. The NMEFC developed a standard list of questions that could be asked of water system personnel. The list was then tailored slightly to have two sets of questions – one for managerial and financial personnel, and one for operations personnel (the questions are included in Appendix A). Each person with a role in the FMT capacity of the system was asked the applicable standard set of questions individually. The interviewees were not given the questions in advance and were not told the answers others provided. Also, most of the questions are open ended type questions so they were not asked in a fashion to indicate what would be the "right" or "wrong" answer. The interviews lasted between 45 minutes to 75 minutes depending on the individual's role in the system and the length of the individual's answers.

In addition to the interview process, visual observations of the physical components of the system were made. A technical information form was created to capture this information. This form is also contained in Appendix A. This information was considered supplemental to the interviews because it served as a check on information provided in the interviews. For example, if an interviewee stated he or she had an excellent preventative maintenance schedule and the visit to the facility indicated a significant amount of deterioration (more than would be expected for the age of the facility) then the preventative maintenance program could be further investigated or the assessor could decide that the preventative maintenance program was inadequate.

Following interviews and observations of the facility, answers that all personnel provided were compared and contrasted to provide a clearer picture of the true operations at the water system. The intent was to go beyond simply asking the question, "Do you have a budget?" to actually finding out if the budget was developed and being used appropriately. For example, if a water system manager was asked the question, "Do you have a budget?" he or she may say, "yes" and the capacity assessor would be left with the impression that the system is doing well in this area. However, if several different people are asked about the budget in more detail, the assessor may find that although a budget is present, operations personnel do not have input into the budget, the budget is not used by the financial personnel, the budget is not updated regularly, or the budget is not used in setting or evaluating rates. With this approach, the inadequacy of the budget would be discovered and the capacity deficiency in this area would be noted.

Following the comparison of answers, the next step was to determine which items noted as a potential deficiency truly had a negative effect on the system's operations. If a system had what appeared to be a deficiency, but this deficiency was not creating a problem in terms of the operations or management of the system, it was not considered critical and may not have needed to be addressed as a high priority. As an example, the assessment may have revealed an insufficient number of staff members to operate the facility. However, it may also have been revealed that the system was able to work around that problem by receiving assistance from a neighboring system, so no severe problems resulted from the number of staff members. Although staffing may not be ideal, the system does not need to focus on this particular issue. The system needs to focus on items that are truly affecting operations. As an example of this type of deficiency, a system may lack a reserve account that can then lead the system to delay much-needed maintenance or repair on its storage tank. In this case, the system needs to address the reserve account issue so that proper maintenance can be completed.

The intent was to develop a list of capacity deficiencies with the greatest impact on the system's overall capacity. Those were the most critical items to address through follow-up technical assistance or by the system itself.

2.2.2.2 Interview Process

PWS personnel were interviewed by the project team, and each was interviewed separately. Interview forms were completed during each interview.

2.3 ALTERNATIVE DEVELOPMENT AND ANALYSIS

The initial objective for developing alternatives to address compliance issues is to identify a comprehensive range of possible options that can be evaluated to determine the most promising for implementation. Once the possible alternatives are identified, they must be defined in sufficient detail so a conceptual cost estimate (capital and O&M costs) can be developed. These conceptual cost estimates are used to compare the affordability of compliance alternatives, and to give a preliminary indication of rate impacts. Consequently, these costs are pre-planning level and should not be viewed as final estimated costs for alternative implementation. The basis for the unit costs used for the compliance alternative cost estimates is summarized in Appendix B. Other non-economic factors for the alternatives, such as reliability and ease of implementation, are also addressed

2.3.1 Existing PWS

The neighboring PWSs were identified, and the extents of their systems were investigated. PWSs farther than 30 miles from the non-compliant PWSs were not considered because the length of the pipeline required would make the alternative cost prohibitive. The quality of water provided was also investigated. For neighboring PWSs with compliant water, options for water purchase and/or expansion of existing well fields were considered. The neighboring PWSs with non-compliant water were considered as possible partners in sharing the cost for obtaining compliant water either through treatment or developing an alternate source.

The neighboring PWSs were investigated to get an idea of the water sources in use and the quantity of water that might be available for sale. They were contacted to identify key locations in their systems where a connection might be made to obtain water, and to explore on a preliminary basis their willingness to partner or sell water. Then, the major system components that would be required to provide compliant water were identified. The major system components included treatment units, wells, storage tanks, pump stations, and pipelines.

Once the major components were identified, a preliminary design was developed to identify sizing requirements and routings. A capital cost estimate was then developed based on the preliminary design of the required system components. An annual O&M cost was also estimated to reflect the change in O&M expenditures that would be needed if the alternative was implemented.

Non-economic factors were also identified. Ease of implementation was considered, as well as the reliability for providing adequate quantities of compliant water. Additional factors were whether implementation of an alternative would require significant increase in the management or technical capability of the PWS, and whether the alternative had the potential for regionalization.

2.3.2 New Groundwater Source

It was not possible in the scope of this project to determine conclusively whether new wells could be installed to provide compliant drinking water. To evaluate potential new groundwater source alternatives, three test cases were developed based on distance from the PWS intake point. The test cases were based on distances of 10 miles, 5 miles, and 1 mile. It was assumed that a pipeline would be required for all three test cases, and a storage tank and pump station would be required for the 10-mile and 5-mile alternatives. It was also assumed that new wells would be installed, and that their depths would be similar to the depths of the existing wells, or other existing drinking water wells in the area.

A preliminary design was developed to identify sizing requirements for the required system components. A capital cost estimate was then developed based on the preliminary design of the required system components. An annual O&M cost was also estimated to reflect the change (*i.e.*, from current expenditures) in O&M expenditures that would be needed if the alternative was implemented.

Non-economic factors were also identified. Ease of implementation was considered, as well as the reliability for providing adequate quantities of compliant water. Additional factors were whether implementation of an alternative would require significant increase in the management or technical capability of the PWS, and whether the alternative had the potential for regionalization.

2.3.3 New Surface Water Source

New surface water sources were investigated. Availability of adequate quality water was investigated for the main rivers in the area, as well as the major reservoirs. TCEQ WAMs were inspected, and the WAM was run, where appropriate.

2.3.4 Treatment

The only common treatment technologies considered potentially applicable for removal of fluoride, selenium, arsenic, and nitrate are RO and EDR. These two processes can remove fluoride as well as arsenic, selenium, uranium, nitrate, TDS, and other dissolved constituents. RO treatment is considered for central treatment alternatives, as well as POU and POE alternatives. EDR is considered for central treatment only.

Both RO and EDR treatments produce a liquid waste: a reject stream from RO process and a concentrate stream from EDR process. As a result, volume of raw water (well water) is greater than the volume of potable water produced. The EDR can operate at a slightly greater recovery rate (conversion rate of raw water to potable water) than RO, especially if recovery is limited by silica or low solubility salts. Partial RO treatment and blending treated and untreated water might be feasible while meeting all MCLs. However for a relatively small 50-gpm system, the complexities of a blending system may offset its benefits. The EDR operation can be tailored to provide a desired constituent effluent concentration by controlling the electrical energy applied. The treatment units were sized based on flow rates, and capital and annual O&M cost estimates were made based on the size of the treatment equipment required and the average water consumption rate, respectively. Neighboring non-compliant PWSs were identified to look for opportunities where the costs and benefits of central treatment could be shared between systems.

Non-economic factors were also identified. Ease of implementation was considered, as well as reliability for providing adequate quantities of compliant water. Additional factors were whether implementation of an alternative would require significant increase in the management or technical capability of the PWS, and whether the alternative had the potential for regionalization.

2.4 COST OF SERVICE AND FUNDING ANALYSIS

The primary purpose of the cost of service and funding analysis is to determine the financial impact of implementing compliance alternatives, primarily by examining the required rate increases, and also the fraction of household income that water bills represent. The current financial situation is also reviewed to determine what rate increases are necessary for the PWS to achieve or maintain financial viability.

2.4.1 Financial Feasibility

A key financial metric is the comparison of an average annual household water bill for a PWS customer to the MHI for the area. MHI data from the 2000 census are used at the most detailed level available for the community. Typically, county level data are used for small rural water utilities due to small population sizes. Annual water bills are determined for existing base conditions, including consideration of additional rate increases needed under current conditions. Annual water bills are also calculated after adding incremental capital and operating costs for each of the alternatives to determine feasibility under several potential funding sources. It has been suggested by agencies such as USEPA that federal and state programs consider several criteria to determine "disadvantaged communities" with one based on the typical residential water bill as a percentage of MHI.

Additionally, the use of standard ratios provides insight into the financial condition of any business. Three ratios are particularly significant for water utilities:

- Current Ratio = current assets (items that could be converted to cash) divided by current liabilities (accounts payable, accrued expenses, and debt) provides insight into the ability to meet short-term payments. For a healthy utility, the value should be greater than 1.0.
- Debt to Net Worth Ratio = total debt (total amount of money borrowed) divided by net worth (total assets minus total liabilities) shows to what degree assets of the company have been funded through borrowing. A lower ratio indicates a healthier condition.
- Operating Ratio = total operating revenues divided by total operating expenses show the degree to which revenues cover ongoing expenses. The value is greater than 1.0 if the utility is covering its expenses.

2.4.2 Median Household Income

The 2000 U.S. Census is used as the basis for MHI. In addition to consideration of affordability, the annual MHI may also be an important factor for sources of funds for capital programs needed to resolve water quality issues. Many grant and loan programs are available to lower income rural areas, based on comparisons of local income to statewide incomes. In the 2000 Census, MHI for the State of Texas was $39,927, compared to the U.S. level of

$41,994. The census broke down MHIs geographically by block group and ZIP code. The MHIs can vary significantly for the same location, depending on the geographic subdivision chosen. The MHI for each PWS was estimated by selecting the most appropriate value based on block group or ZIP code based on results of the site interview and a comparison with the surrounding area.

2.4.3 Annual Average Water Bill

The annual average household water bill was calculated for existing conditions and for future conditions incorporating the alternative solutions. Average residential consumption is estimated and applied to the existing rate structure to estimate the annual water bill. The estimates are generated from a long-term financial planning model that details annual revenue, expenditure, and cash reserve requirements over a 30-year period.

2.4.4 Financial Plan Development

The financial planning model uses available data to establish base conditions under which the system operates. The model includes, as available:

- Accounts and consumption data
- Water tariff structure
- Beginning available cash balance
- Sources of receipts:
    - Customer billings
    - Membership fees
    - Capital Funding receipts from:
        - Grants
        - Proceeds from borrowing
- Operating expenditures:
    - Water purchases
    - Utilities
    - Administrative costs
    - Salaries
- Capital expenditures
- Debt service:
    - Existing principal and interest payments
    - Future principal and interest necessary to fund viable operations

- Net cash flow
- Restricted or desired cash balances:
    - Working capital reserve (based on 1-4 months of operating expenses)
    - Replacement reserves to provide funding for planned and unplanned repairs and replacements

From the model, changes in water rates are determined for existing conditions and for implementing the compliance alternatives.

2.4.5 Financial Plan Results

Results from the financial planning model are summarized in two areas: percentage of household income and total water rate increase necessary to implement the alternatives and maintain financial viability.

2.4.5.1 Funding Options

Results are summarized in a table that shows the following according to alternative and funding source:

- Percentage of the median annual household income the average annual residential water bill represents.
- The first year in which a water rate increase would be required
- The total increase in water rates required, compared to current rates

Water rates resulting from the incremental capital costs of the alternative solutions are examined under a number of funding options. The first alternative examined is always funding from existing reserves plus future rate increases. Several funding options were analyzed to frame a range of possible outcomes.

- Grant funds for 100 percent of required capital. In this case, the PWS is only responsible for the associated O&M costs.
- Grant funds for 75 percent of required capital, with the balance treated as if revenue bond funded.
- Grant funds for 50 percent of required capital, with the balance treated as if revenue bond funded.
- State revolving fund loan at the most favorable available rates and terms applicable to the communities.
- If local MHI > 75 percent of state MHI, standard terms, currently at 3.8 percent interest for non-rated entities. Additionally:
    - If local MHI = 70-75 percent of state MHI, 1 percent interest rate on loan.
    - If local MHI = 60-70 percent of state MHI, 0 percent interest rate on loan.

  - If local MHI = 50-60 percent of state MHI, 0 percent interest and 15 percent forgiveness of principal.
  - If local MHI less than 50 percent of state MHI, 0 percent interest and 35 percent forgiveness of principal.
- Terms of revenue bonds assumed to be 25-year term at 6.0 percent interest rate.

2.4.5.2 General Assumptions Embodied in Financial Plan Results

The basis used to project future financial performance for the financial plan model includes:

- No account growth (either positive or negative).
- No change in estimate of uncollectible revenues over time.
- Average consumption per account unchanged over time.
- No change in unaccounted for water as percentage of total (more efficient water use would lower total water requirements and costs).
- No inflation included in the analyses (although the model has provisions to add escalation of O&M costs, doing so would mix water rate impacts from inflation with the impacts from the alternatives being examined).
- Minimum working capital fund established for each district, based on specified months of O&M expenditures.
- O&M for alternatives begins 1 year after capital implementation.
- Balance of capital expenditures not funded from primary grant program is funded through debt (bond equivalent).
- Cash balance drives rate increases, unless provision chosen to override where current net cash flow is positive.

2.4.5.3 Interpretation of Financial Plan Results

Results from the financial plan model are presented in a Table 4.4, which shows the percentage of MHI represented by the annual water bill that results from any rate increases necessary to maintain financial viability over time. In some cases, this may require rate increases even without implementing a compliance alternative (the no action alternative). The table shows any increases such as these separately. The results table shows the total increase in rates necessary, including both the no-action alternative increase and any increase required for the alternative. For example, if the no action alternative requires a 10 percent increase in rates and the results table shows a rate increase of 25 percent, then the impact from the alternative is an increase in water rates of 15 percent. Likewise, the percentage of household income in the table reflects the total impact from all rate increases.

2.4.5.4 Potential Funding Sources

A number of potential funding sources exist for rural utilities, which typically provide service to less than 50,000 people. Both state and federal agencies offer grant and loan programs to assist rural communities in meeting their infrastructure needs. Most are available to "political subdivisions" such as counties, municipalities, school districts, special districts, or authorities of the state with some programs providing access to private individuals. Grant funds are made more available with demonstration of economic stress, typically indicated with MHI below 80 percent that of the state. The funds may be used for planning, design, and construction of water supply construction projects including, but not limited to, line extensions, elevated storage, purchase of well fields, and purchase or lease of rights to produce groundwater. Interim financing of water projects and water quality enhancement projects such as wastewater collection and treatment projects are also eligible. Some funds are used to enable a rural water utility to obtain water or wastewater service supplied by a larger utility or to finance the consolidation or regionalization of neighboring utilities. Three Texas agencies that offer financial assistance for water infrastructure are:

- Texas Water Development Board has several programs that offer loans at interest rates lower than the market offers to finance projects for public drinking water systems that facilitate compliance with primary drinking water regulations. Additional subsidies may be available for disadvantaged communities. Low interest rate loans with short and long-term finance options at tax exempt rates for water or water-related projects give an added benefit by making construction purchases qualify for a sales tax exemption. Generally, the program targets customers with eligible water supply projects for all political subdivisions of the state (at tax exempt rates) and Water Supply Corporations (at taxable rates) with projects.
- Office of Rural Community Affairs (ORCA) is a Texas state agency with a focus on rural Texas by making state and federal resources accessible to rural communities. Funds from the U.S. Department of Housing and Urban Development Community Development Block Grants (CDBG) are administered by ORCA for small, rural communities with populations less than 50,000 that cannot directly receive federal grants. These communities are known as non-entitlement areas. One of the program objectives is to meet a need having a particular urgency, which represents an immediate threat to the health and safety of residents, principally for low- and moderate-income persons.
- U.S. Department of Agriculture Rural Development Texas (Texas Rural Development) coordinates federal assistance to rural Texas to help rural Americans improve their quality of life. The Rural Utilities Service (RUS) programs provide funding for water and wastewater disposal systems.

The application process, eligibility requirements, and funding structure vary for each of these programs. There are many conditions that must be considered by each agency to determine eligibility and ranking of projects. The principal factors that affect this choice are population, percent of the population under the state MHI, health concerns, compliance with standards, Colonia status, and compatibility with regional and state plans.

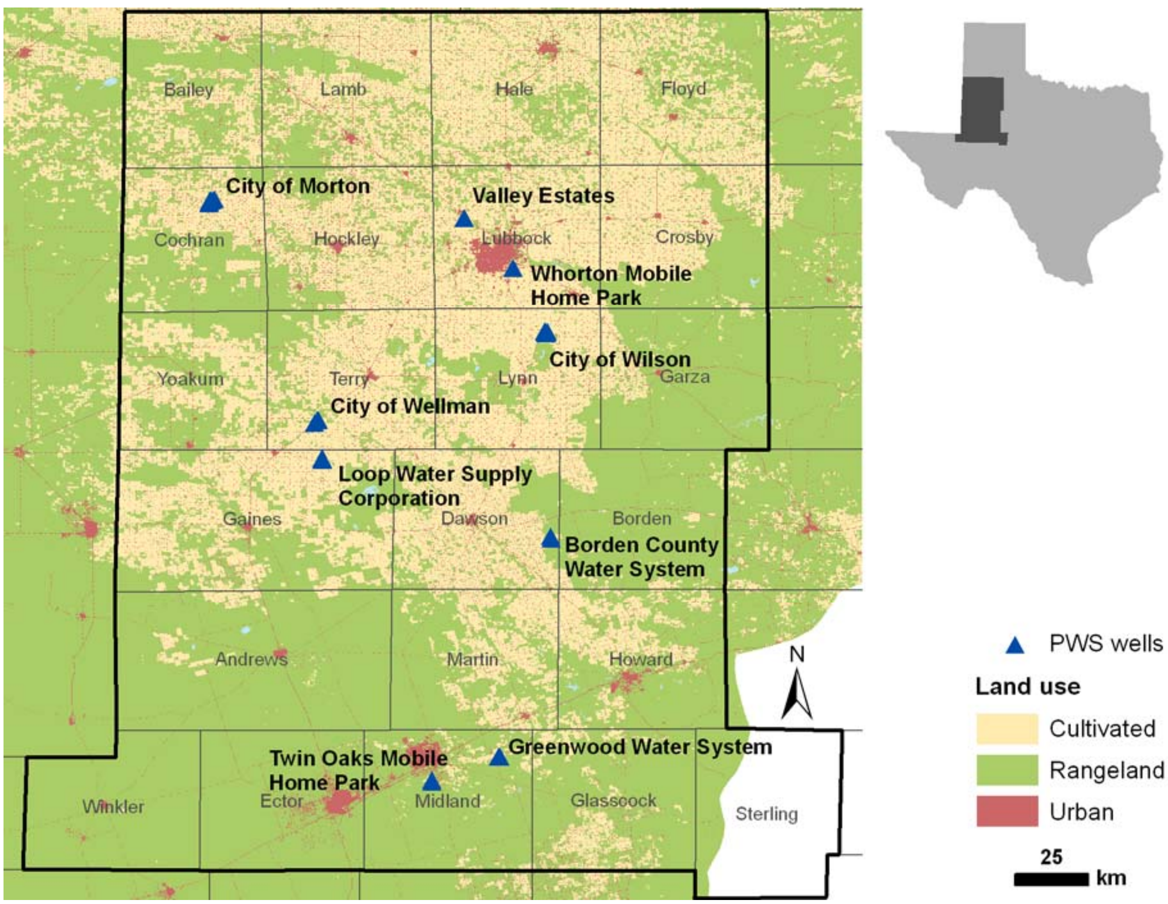
SECTION 3
UNDERSTANDING SOURCES OF CONTAMINANTS

3.1 REGIONAL ANALYSIS

3.1.1 Overview of the Study Area

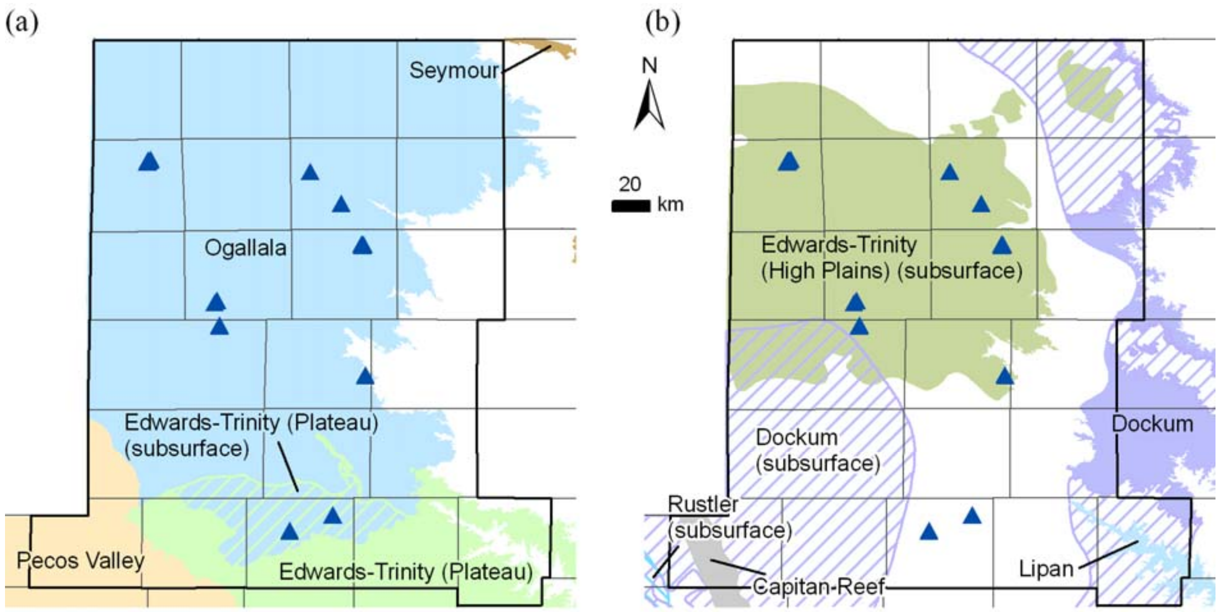
The regional analysis described below includes data from 23 counties in the High Plains within Texas: Andrews, Bailey, Borden, Cochran, Crosby, Dawson, Ector, Floyd, Gaines, Garza, Glasscock, Hale, Hockley, Howard, Lamb, Lubbock, Lynn, Martin, Midland, Sterling, Terry, Winkler, and Yoakum(Figure 3.1).

Figure 3.1 Regional Study Area and Locations of the PWS Wells Assessed



The major and minor aquifers within the region are shown in Figure 3.2. Most of the PWS wells of concern are drilled within the Tertiary sediments of the Ogallala aquifer. Other aquifers in the region that may locally be hydraulically connected to the Ogallala aquifer include younger alluvial and fluvial deposits of Quaternary age (Blackwater Draw Formation, not shown) and underlying older aquifers, including the Cretaceous-age Edwards-Trinity (Plateau) aquifer, the Edwards-Trinity (High Plains) aquifer of Cretaceous age, the Dockum aquifer of Triassic age, and undifferentiated Permian aquifers (not shown). Other aquifers in the area, including the Capitan Reef, Lipan, Pecos Valley, Rustler, and Seymour aquifers, are not located near any of the wells in this analysis.

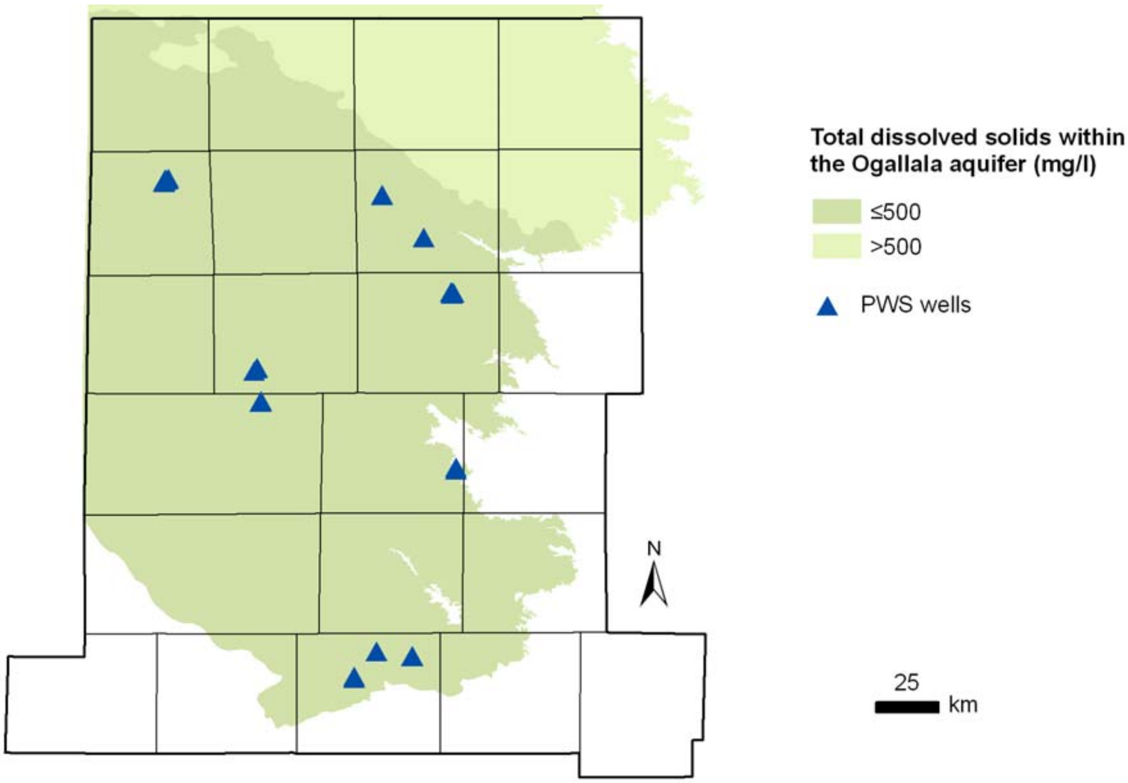
Figure 3.2 Major (a) and Minor (b) Aquifers in the Study Area



"Subsurface" indicates a portion of an aquifer that underlies other formations. All other labels indicate a portion of an aquifer that lies at the land surface.

Water quality in the Ogallala aquifer is distinctively different in the northern portion of the study area. Thus, this study analyzes the Ogallala aquifer in two parts: Ogallala-North (TDS ≤ 500 mg/L) and Ogallala-South (TDS > 500 mg/L) (Figure 3.3).

Figure 3.3 Water Quality Zones in the Study Area



Data used for this study include information from three sources:

- Texas Water Development Board groundwater database available at www.twdb.state.tx.us. The database includes information on the location and construction of wells throughout the state as well as historical measurements of water chemistry and levels in the wells.
- Texas Commission on Environmental Quality Public Water Supply database (not publicly available). The database includes information on the location, type, and construction of water sources used by PWS in Texas, along with historical measurements of water levels and chemistry.
- National Uranium Resource Evaluation (NURE) database available at: tin.er.usgs.gov/nure/water. The NURE dataset includes groundwater quality data collected between 1975 and 1980. The database provides well locations and depths with an array of analyzed chemical data. The NURE dataset covers only the eastern part of the study area.

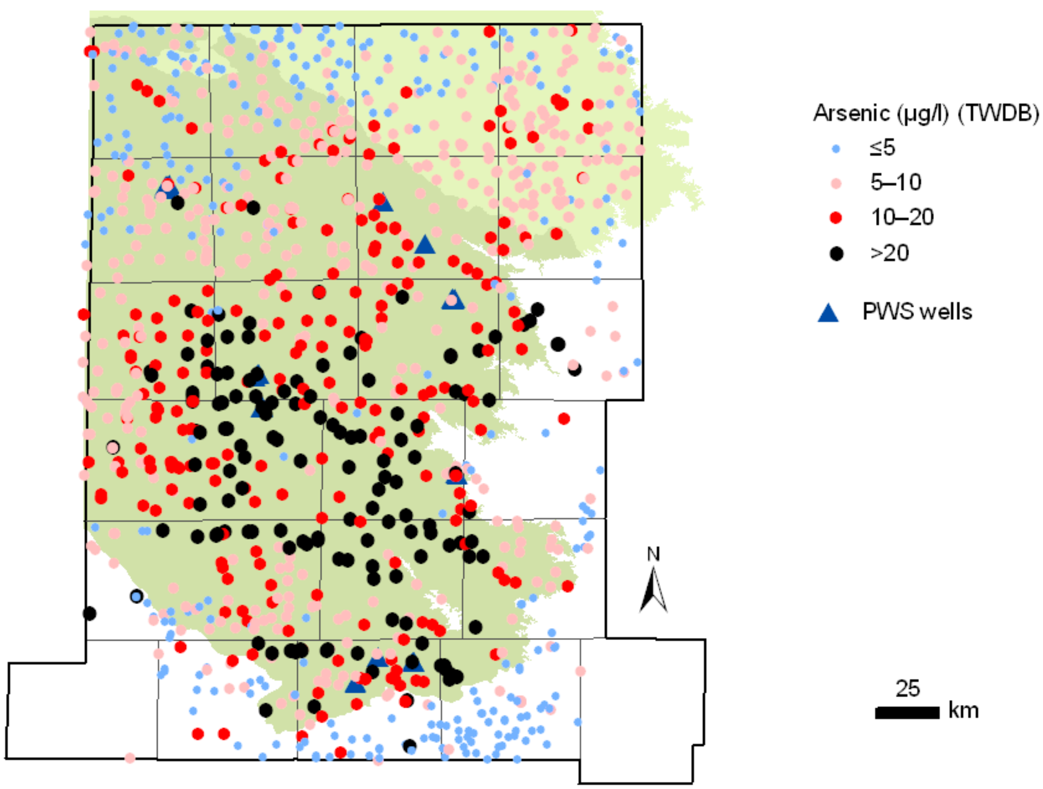
3.1.2 Contaminants of Concern in the Study Area

Contaminants addressed include arsenic, fluoride, nitrate, selenium, and uranium. In PWSs in the area, water sampling shows that one or more of these solutes exceeds the USEPA's MCL.

Arsenic

Arsenic concentrations exceed the USEPA's MCL (10 µg/L) throughout the study area, especially in the Ogallala-South area (Figure 3.4). Half of the wells in the Ogallala-South aquifer and one-fifth of wells in the Edwards-Trinity (High Plains) aquifer contain arsenic levels above the MCL. In contrast, only 10 percent or less of wells in the Ogallala-North, Edwards-Trinity (Plateau), and Dockum aquifers exceed the MCL for arsenic.

Figure 3.4 Spatial Distribution of Arsenic Concentrations



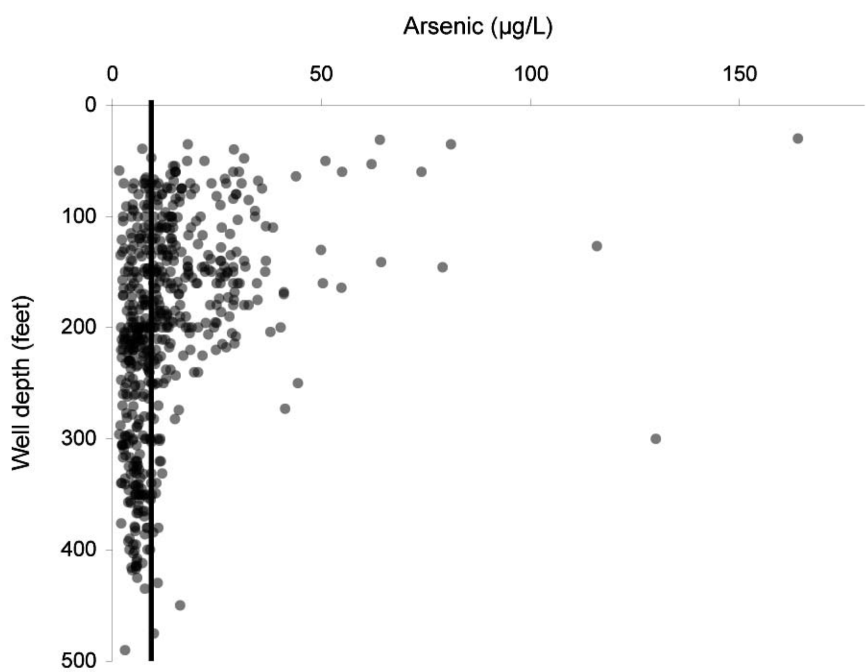
Data presented here are from the TWDB database. The most recent sample for each well is shown. Table 3.1 gives the percentage of wells with arsenic exceeding the MCL (10 µg/L) in each of the major aquifers in the study area.

Table 3.1 Summary of Wells that Exceed the MCL for Arsenic, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 10 µg/L	Percentage of wells that exceed 10 µg/L
Ogallala-North	228	15	7%
Ogallala-South	642	323	50%
Edwards-Trinity (Plateau)	127	13	10%
Edwards-Trinity (High Plains)	16	3	19%
Dockum	70	4	6%
Other	5	0	0%

There is a clear stratification of arsenic concentrations with depth in the study area (Figure 3.5), with arsenic concentrations decreasing with depth. This suggests that tapping deeper water by deepening shallow wells or casing off shallower parts of wells might decrease arsenic concentrations.

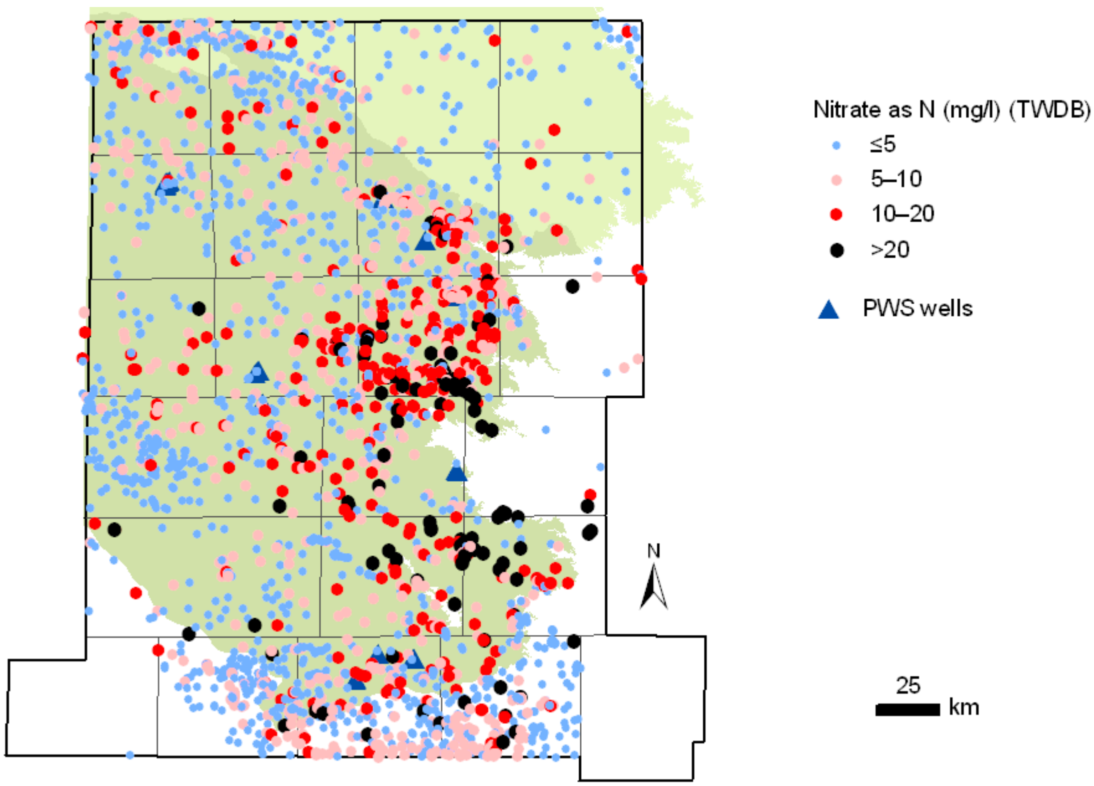
Figure 3.5 Arsenic Concentrations and Well Depths in the Ogallala Aquifer



Nitrate

Nitrate concentrations exceed the MCL (10 mg/L) throughout the study area, especially in the eastern part of the Ogallala-South aquifer (Figure 3.6). In the Ogallala-North, only one percent of wells have nitrate concentrations above the MCL.

Figure 3.6 Spatial Distribution of Nitrate Concentrations



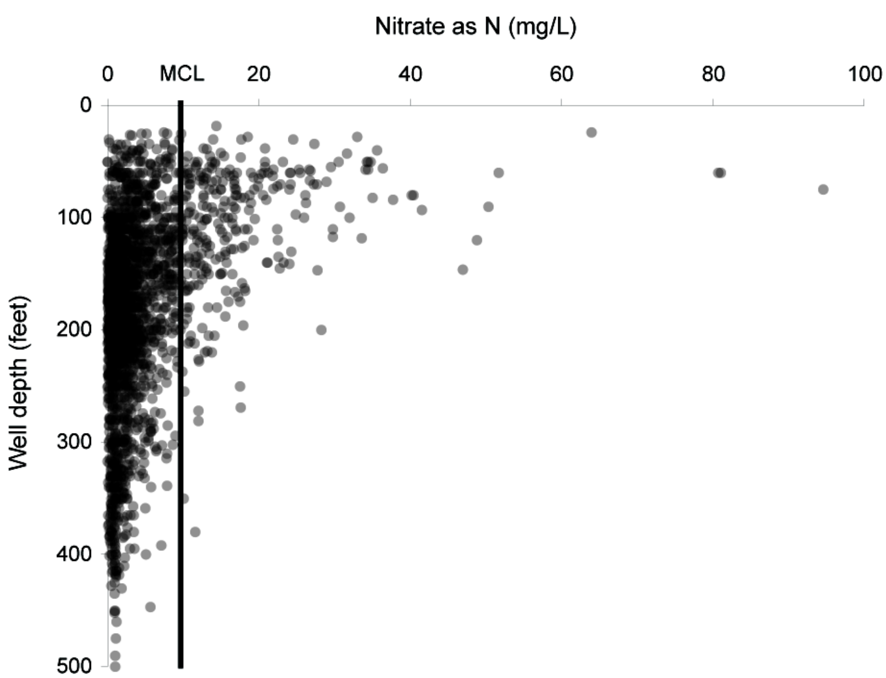
Data presented here are from the TWDB database. The most recent measurement from each well is shown. Table 3.2 shows the percentage of wells with nitrate as N exceeding the MCL (10 mg/L).

Table 3.2 Summary of Wells that Exceed the MCL for Nitrate, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 10 mg/L	Percentage of wells that exceed 10 mg/L
Ogallala-North	590	6	1%
Ogallala-South	2826	370	13%
Edwards-Trinity (Plateau)	642	39	6%
Edwards-Trinity (High Plains)	76	3	4%
Dockum	149	9	6%
Seymour	1	1	100%
other	40	5	13%

Within the study area, the concentration of nitrate as N tends to decrease with well depth (Figure 3.7). Nearly all wells in the Ogallala aquifer deeper than 250 feet have acceptable nitrate levels. Therefore, deepening shallow wells or casing the upper portions of problematic wells might decrease nitrate concentrations.

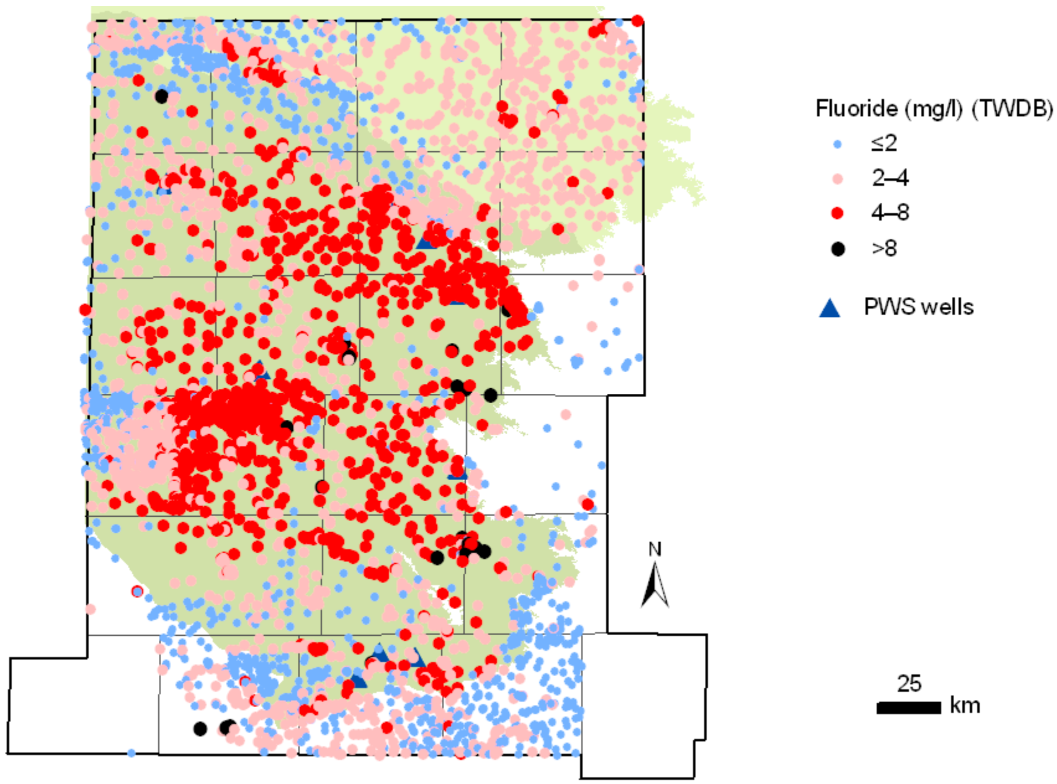
Figure 3.7 Nitrate as N Concentrations and Well Depths in the Ogallala Aquifer within the Study Area



Fluoride

Fluoride concentrations above the MCL (4 mg/L) are widespread in the Ogallala-South area (42% of wells) and relatively rare in the Ogallala-North area (2% of wells) (Figure 3.8, Table 3.3). Fluoride levels are also high in the Edwards-Trinity (High Plains) aquifer, with over half of wells in the aquifer containing fluoride in excess of the MCL.

Figure 3.8 Spatial Distribution of Fluoride Concentrations



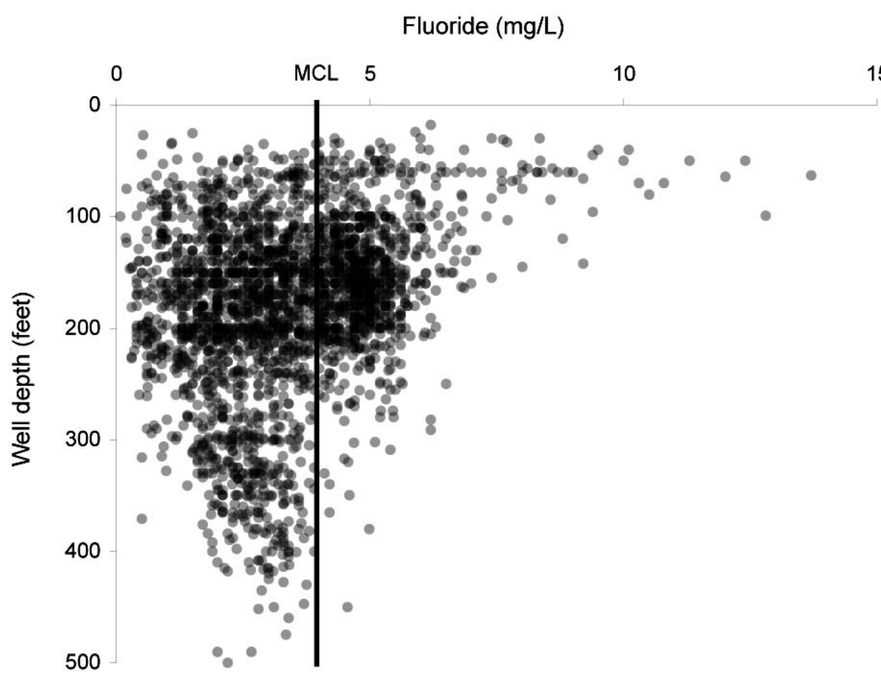
Data presented here are from the TWDB database. The most recent measurement from each well is shown. Table 3.3 shows the percentage of wells with fluoride exceeding the MCL (4 mg/L).

Table 3.3 Summary of Wells that Exceed the MCL for Fluoride, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 4 mg/L	Percentage of wells that exceed 4 mg/L
Ogallala-North	588	13	2%
Ogallala-South	2622	1098	42%
Edwards-Trinity (Plateau)	626	5	1%
Edwards-Trinity (High Plains)	76	40	53%
Dockum	144	10	7%
other	29	5	17%

Comparing fluoride levels with well depth, it is clear that the highest fluoride concentrations occur in wells shallower than about 100 feet and that concentrations tend to decrease with well depth (Figure 3.9). However, fluoride levels above the MCL are common in wells 100–200 feet deep. Based on this trend, deepening shallow wells or casing the shallower portions of wells could lead to decreased fluoride concentrations in produced groundwater.

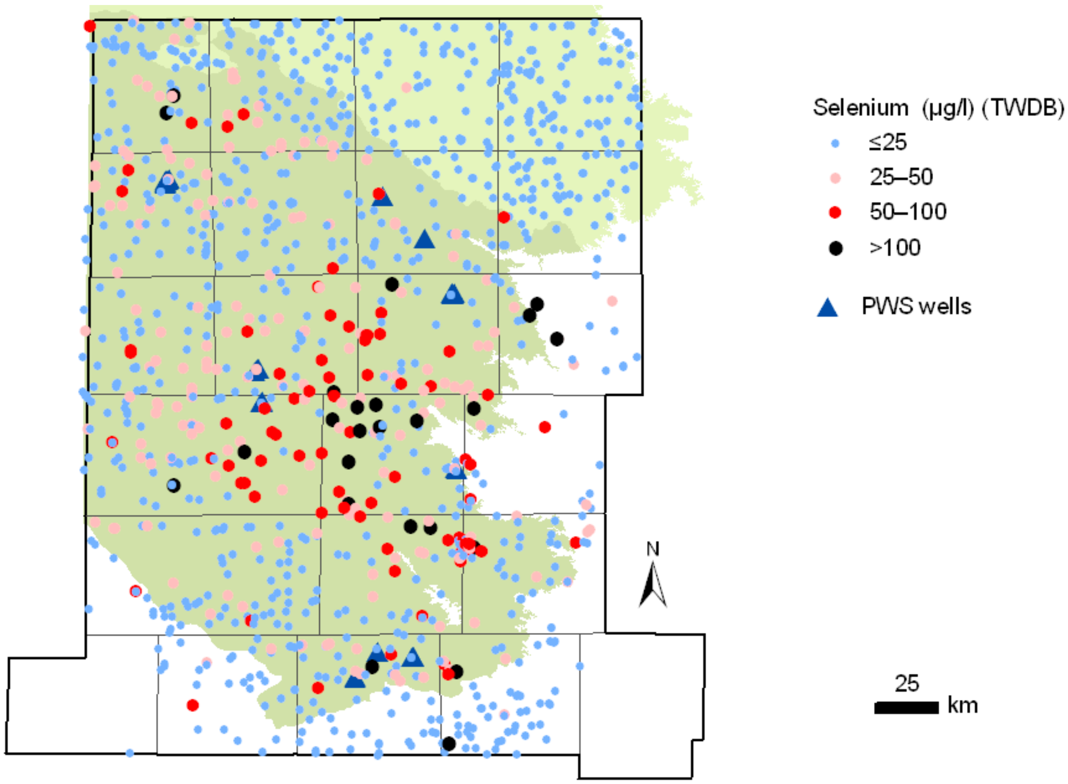
Figure 3.9 Fluoride Concentrations and Well Depths in the Ogallala Aquifer within the Study Area



Selenium

Selenium concentrations in the study area are generally below the MCL (50 µg/L). However, some wells with excess selenium occur in the Dockum and Ogallala-South aquifers, particularly in the eastern part of the study area (Figure 3.10, Table 3.4).

Figure 3.10 Spatial Distribution of Selenium Concentrations



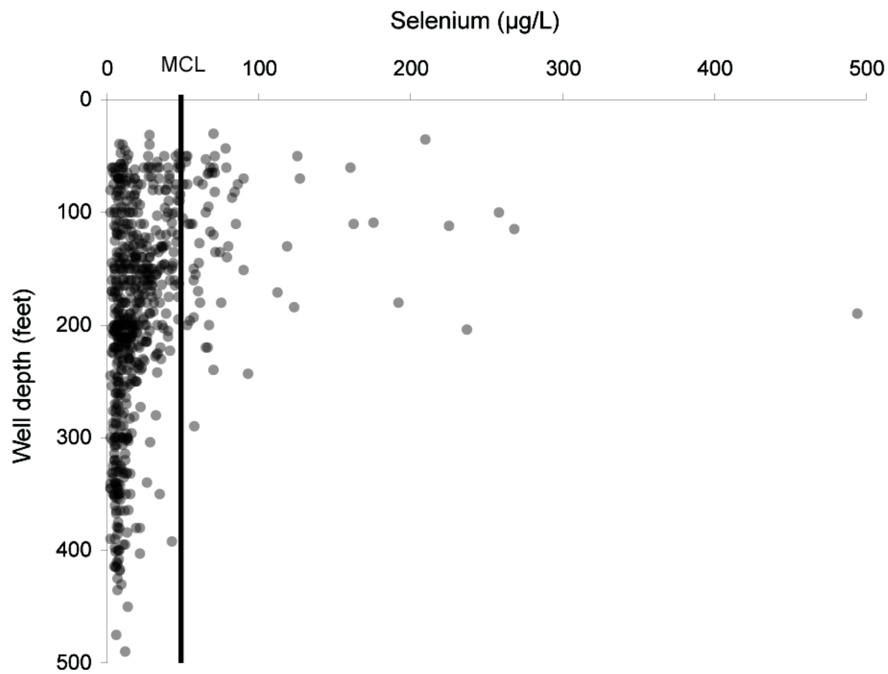
Data presented here are from the TWDB database. The most recent sample for each well is shown. Table 3.4 shows the percentage of wells with selenium concentrations exceeding the selenium MCL (50 µg/L).

Table 3.4 Summary of Wells that Exceed the MCL for Selenium, by Aquifer

Aquifer	Wells with measurements	Wells that exceed 50 µg/L	Percentage of wells that exceed 50 µg/L
Ogallala-North	233	0	0%
Ogallala-South	693	84	12%
Edwards-Trinity (Plateau)	104	1	1%
Edwards-Trinity (High Plains)	16	1	6%
Dockum	74	10	14%
Other	5	1	20%

Selenium shows a trend with well depth similar to that of the other constituents discussed (Figure 3.11). Most wells with selenium concentrations above the MCL are shallower than 200 feet. Thus, deepening a well to more than 200 feet or casing the shallower portion of deeper wells could lead to reduced selenium concentrations.

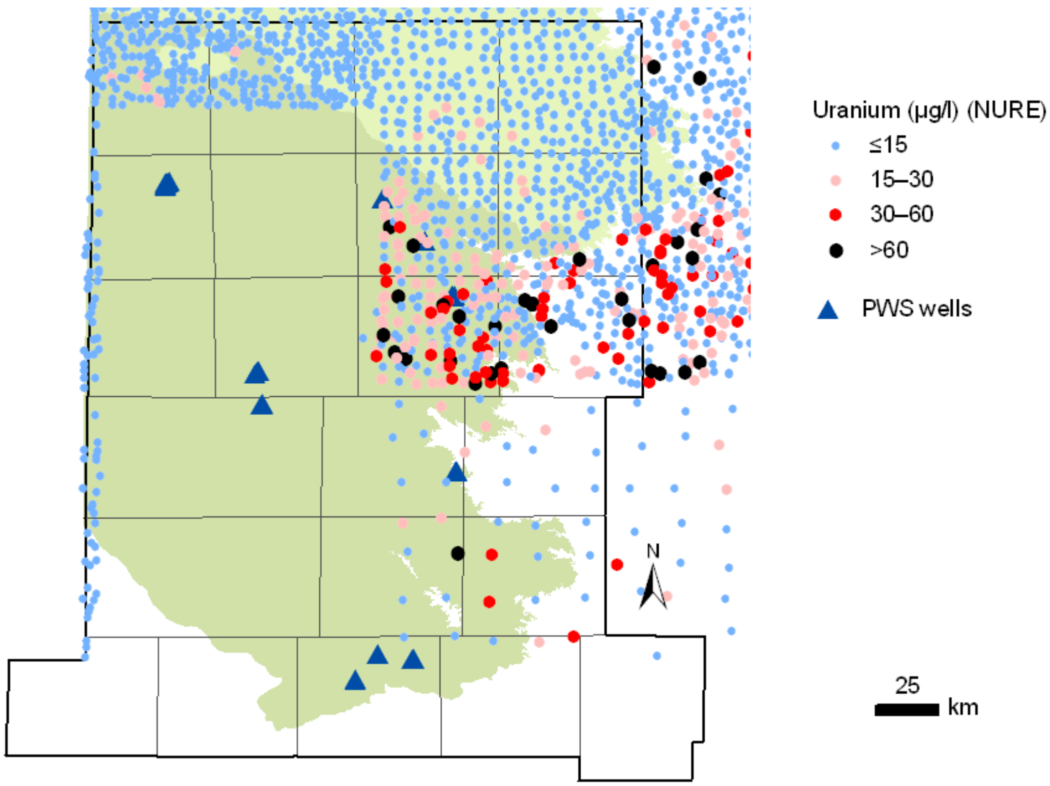
Figure 3.11 Selenium Concentrations and Well Depths in the Ogallala Aquifer within the Study Area



Uranium

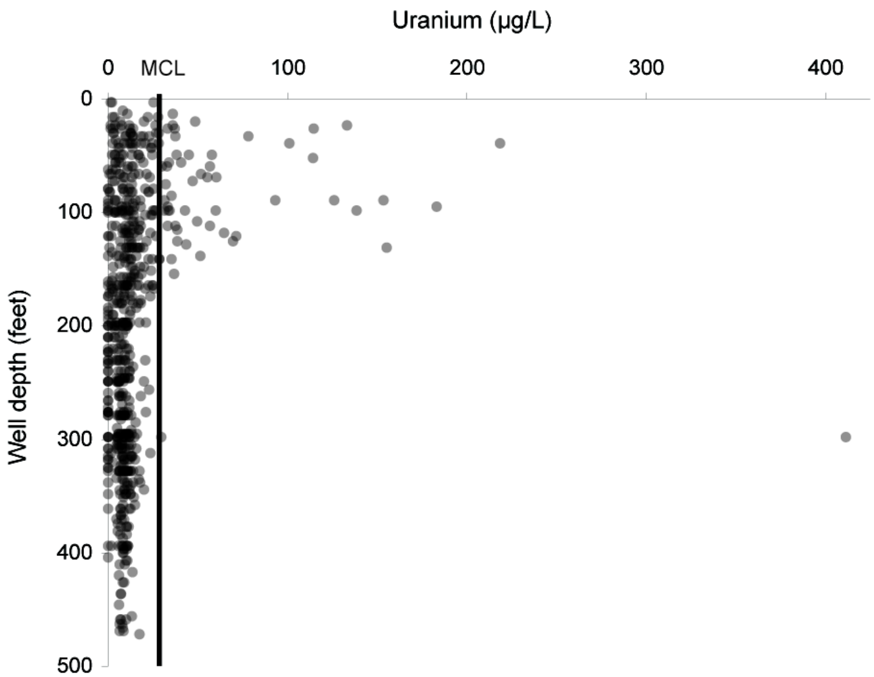
The TWDB rarely tests wells for uranium content in water samples, but the NURE database provides a large dataset of uranium levels in the area. This database only includes wells from part of the study area, as shown in Figure 3.12. Even with this limited distribution of measurements, it is clear that uranium concentrations are much higher in the Ogallala-South aquifer than the Ogallala-North aquifer. However, the NURE database does not include information about which aquifer the sampled wells are from, so a quantitative comparison of uranium levels by aquifer is not available.

Figure 3.12 Spatial Distribution of Uranium Concentrations in the Study Area



A comparison of uranium concentrations and well depths shows that nearly all wells with uranium levels above the MCL are less than about 150 feet deep (Figure 3.13). Therefore, deepening or casing wells to access water from greater depths might reduce uranium levels.

Figure 3.13 Uranium Concentrations and Well Depths in the Study Area



3.1.3 Regional Geology

The major aquifer in the study area is the Ogallala aquifer, which is equivalent to the Ogallala Formation, the predominant geologic unit that makes up the High Plains aquifer. The Ogallala Formation is late Tertiary (Miocene–Pliocene, or about 2–12 million years ago) (Nativ 1988). It consists of coarse fluvial sandstone and conglomerates that were deposited in the paleovalleys of a mid-Tertiary erosional surface and eolian sand deposited in intervening upland areas (Gustavson and Holliday 1985). In the Ogallala-North area, the Ogallala Formation consists largely of sediments within a paleovalley. In this region, the saturated thickness of the aquifer is greater and the water table is deeper. In contrast, the formation is composed of deposition on top of a paleoupland in the Ogallala-South area. Here the formation is thinner, resulting in a smaller saturated thickness and shallower water table. The top of the Ogallala Formation is marked in many places by a resistant calcite layer known as the "caprock caliche."

Within much of the study area, the Ogallala Formation is overlain by Quarternary-age (Pleistocene–Holocene) eolian, fluvial, and lacustrine sediments, collectively called the Blackwater Draw Formation (Holliday 1989). The texture of the formation ranges from sands and gravels along riverbeds to clay-rich sediments in playa floors.

In much of the southern High Plains, the Ogallala Formation lies on top of Lower Cretaceous (Comanchean) strata. The top of the Cretaceous sediments is marked by an uneven erosional surface that represents the end of the Laramide orogeny. Cretaceous strata are absent beneath the thick Ogallala paleovalley fill deposits because they were removed by prior erosion. The Cretaceous sediments were deposited in a subsiding shelf environment and consist of the Trinity Group (including the basal sandy, permeable Antlers Formation); the Fredericksburg Group (limey to shaley formations, including the Walnut, Comanche Peak, and Edwards Formations, as well as the Kiamichi Formation); and the Washita Group (low-permeability, shaley sediments of Duck Creek Formation) (Nativ 1988). The sequence results in two main aquifer units: the Antlers Sandstone (also termed the Trinity or Paluxy sandstone, about 49 feet thick) and the Edwards Limestone (about 98 feet thick). These aquifer units constitute the Edwards-Trinity (High Plains) aquifer (Ashworth and Flores 1991). The limestone decreases in thickness to the northwest and transitions into the Kiamichi and Duck Creek formations.

The Ogallala Formation also overlies the Triassic Dockum Group in much of the southern High Plains. The Dockum Group is generally about 492 feet thick and is exposed along the margins of the High Plains. The uppermost sediments consist of red mudstones that generally form an aquitard. Underlying units (Trujillo Sandstone [Upper Dockum] and Santa Rosa Sandstone [lower Dockum]) form the Dockum aquifer. Water quality in the Dockum is generally poor (Dutton and Simpkins 1986). The sediments of the Dockum were deposited in a continental fluvio-lacustrine environment that included streams, deltas, lakes, and mud flats (McGowen et al. 1977) and included alternating arid and humid climatic conditions. The Triassic rocks reach up to 1,956 feet thick in the Midland Basin.

3.2 DETAILED ASSESSMENT FOR CITY OF WELLMAN PWS

The City of Wellman PWS has five wells, G2230003A–E. Wells G2230003A–E are 150, 150, 150, 135, and 186 feet deep, respectively. Wells G2230003A, G2230003B, G2230003C, and G2230003D are designated as being within the Ogallala aquifer. Well G2230003E is drilled within the Edwards-Trinity (High Plains) aquifer. Water from the supply system is sampled from a single sample tap, so the chemical analyses available represent a mixture of water from all the wells. Past measurements of fluoride concentrations in water from this sample tap are listed in Table 3.5.

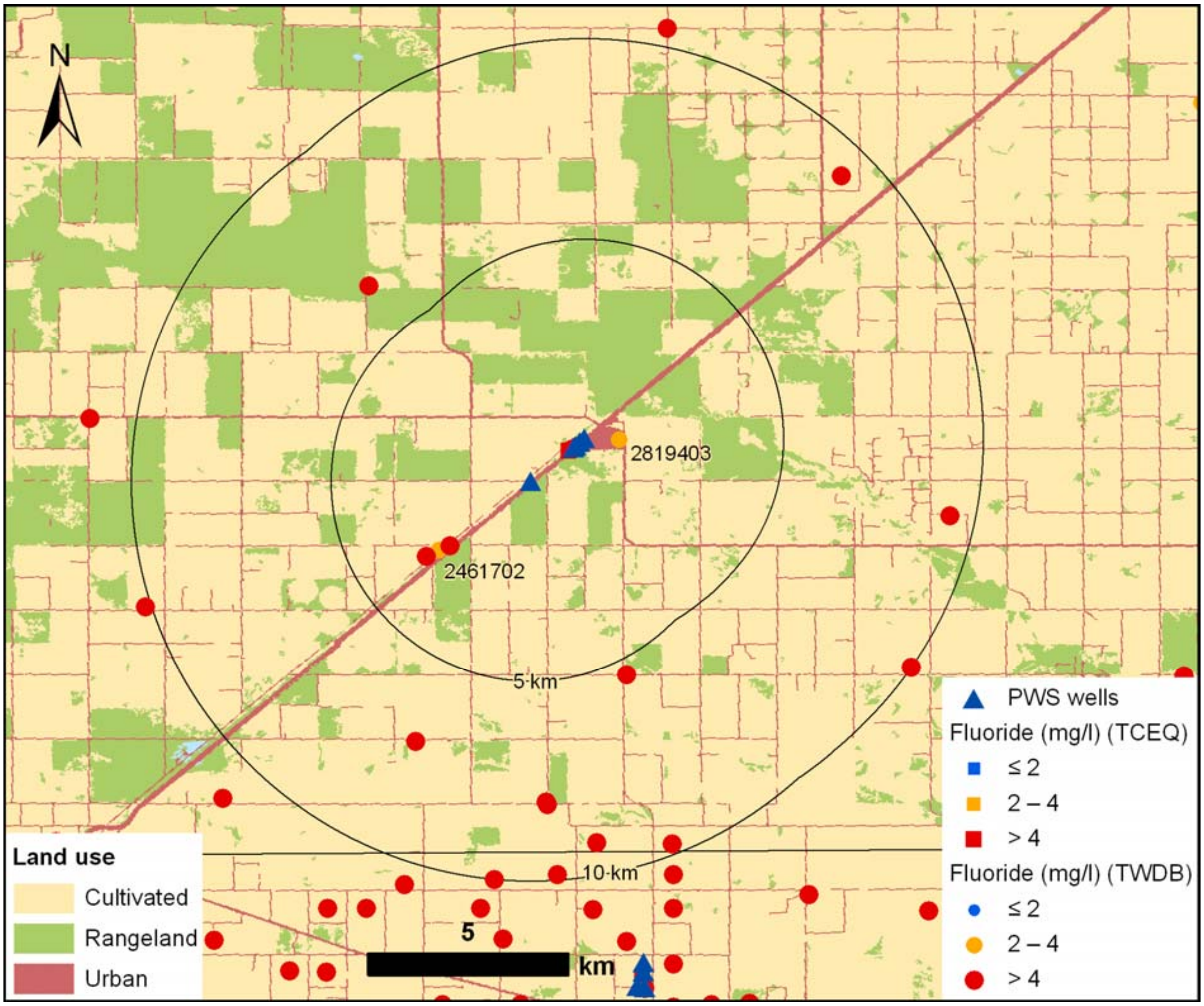
Table 3.5 Fluoride Concentrations in the City of Wellman PWS

Date	Fluoride (mg/L)	Source sampled
4/27/98	5.1	G2230003A–E
1/31/01	5.2	G2230003A–E
2/27/02	5.7	G2230003A–E
2/6/03	5.9	G2230003A–E
4/24/03	5.6	G2230003A–E
8/19/03	6.0	G2230003A–E
12/3/03	6.1	G2230003A–E
2/2/04	0.6	G2230003A–E
4/22/04	5.5	G2230003A–E
9/21/04	5.1	G2230003A–E
11/10/04	5.5	G2230003A–E
1/25/05	5.6	G2230003A–E
6/8/05	5.6	G2230003A–E
8/18/05	5.7	G2230003A–E
11/21/05	4.5	G2230003A–E
2/8/06	5.6	G2230003A–E
6/5/06	5.6	G2230003A–E
8/15/06	6.1	G2230003A–E
11/21/06	5.7	G2230003A–E
2/21/07	5.7	G2230003A–E

Data from TCEQ PWS Database

Historical sampling from 1998 to 2007 shows that the City of Wellman PWS wells consistently exceed the MCL for fluoride (in 19 out of 20 samples). Figure 3.14 shows the distribution of fluoride concentrations measured in nearby wells.

Figure 3.14 Fluoride Concentrations within 5- and 10-km Buffers around the City of Wellman PWS Wells



Data are from the TCEQ and TWDB databases. Two types of samples were included in the analysis. Samples from the TCEQ database (shown as squares on the map) represent the most recent sample taken at a PWS, which can be raw samples from a single well or entry point samples that may combine water from multiple sources. Samples from the TWDB database are taken from single wells (shown as circles in the map). Where more than one measurement has been made in a well, the most recent concentration is shown.

As shown in Figure 3.14, most wells in the vicinity of the City of Wellman PWS wells contain fluoride concentrations above the MCL (4 mg/L). However, two wells, 2461702 and 2819403, do show acceptable fluoride concentrations. More information about these wells is given in Table 3.6. Well 2819403 is about one-half mile away from the PWS wells, and when sampled in 1990 contained low levels of arsenic, nitrate, and selenium, but has not been tested for uranium, and has high TDS concentrations. Well 2461702 is located about a little less than 2 miles from the PWS wells. When last sampled in 1976, it contained exactly 4 mg/L of fluoride and was not tested for arsenic, selenium, or uranium. Both of these wells are currently in use. If considered for a possible alternative supply, they would need to be resampled and tested for all constituents of concern to ensure that they meet water quality requirements.

Table 3.6 Most Recent Concentrations of Select Constituents in Potential Alternative Water Sources

Well	Owner	Depth (ft)	Aquifer	Use	Date	Arsenic (µg/L)	Fluoride (mg/L)	Nitrate as N (mg/L)	Selenium (µg/L)
2461702	J.W. Hawkins	unknown	Ogallala	irrigation	4/4/1976	-	4	3.162	-
2819403	Texaco, Inc.	1390	Dockum	industrial	5/9/1990	<10	2.56	<0.009	<2

3.2.1 Summary of Alternative Groundwater Sources for the City of Wellman PWS

Two nearby wells, described above, might provide an alternative source of water for the City of Wellman PWS. These wells are both currently in use and would need to be resampled to verify that the water currently contains acceptable concentrations of all constituents of concern.

Alternatively, regional analyses indicate that the chances of exceeding the MCLs for fluoride and other constituents of concern decreases in wells deeper than about 250 feet. In addition, as shown in Table 3.6, Well 2819403 is drilled in the Dockum and contains low concentrations of all measured constituents of concern, but has high TDS. Therefore, deepening one or more of the City of Wellman PWS wells might result in lower fluoride levels.

SECTION 4
ANALYSIS OF THE WELLMAN PWS

4.1 DESCRIPTION OF EXISTING SYSTEM

4.1.1 Existing System

The City of Wellman PWS is shown in Figure 4.1. The City of Wellman PWS has 97 water supply connections and serves a population of 225. The water sources for this community water system are five wells, completed in the Ogallala Aquifer, that are approximately 135 feet to 186 feet deep and have a total production capacity of 0.130 mgd. Well #1 (G2230003A), Well #2 (G2230003B), Well #3 (G2230003C), and Well #4 (G2230003D) are all rated at 10 gallons per minute and Well #5 (G2230003E) is rated at 50 gpm.

The wells are all located within 2.5 miles of the City of Wellman. Water from the five wells is discharged into the main supply line. Hydrochloric acid is then injected as a pH adjustment followed by chlorination prior to flowing through two parallel flow ferric oxide media absorption vessels for arsenic removal. The water then flows into the distribution system, and a standpipe (0.068 million gallon capacity) that floats on the system. All wells operate at the same time. The arsenic removal system requires back washing of the media approximately every 30 days. The backwash is approved for irrigation and discharged to the waste water treatment system.

The treatment employed for disinfection is not appropriate or effective for removal of arsenic, selenium, nitrate, and fluoride, so optimization is not expected to be effective for increasing removal of these contaminants. However, there is a potential opportunity for system optimization to reduce arsenic, selenium, nitrate, and fluoride concentrations. The system has more than one well, and since contaminant concentrations can vary significantly between wells, arsenic, selenium, nitrate, and fluoride concentrations should be determined for each well. If one or more wells happens to produce water with acceptable concentrations, as much production as possible should be shifted to that well. It may also be possible to identify contaminant-producing strata through comparison of well logs or through sampling of water produced by various strata intercepted by the well screen.

The City of Wellman PWS recorded arsenic concentrations of 0.0165 mg/L to 0.0436 mg/L between February 2004 and June 2005, which exceeds the MCL of 0.010 mg/L that went into effect on January 23, 2006 (USEPA 2008a; TCEQ 2004). Nevertheless, Wellman has installed a ferric oxide arsenic adsorption system that reduces the arsenic concentration to below the MCL.

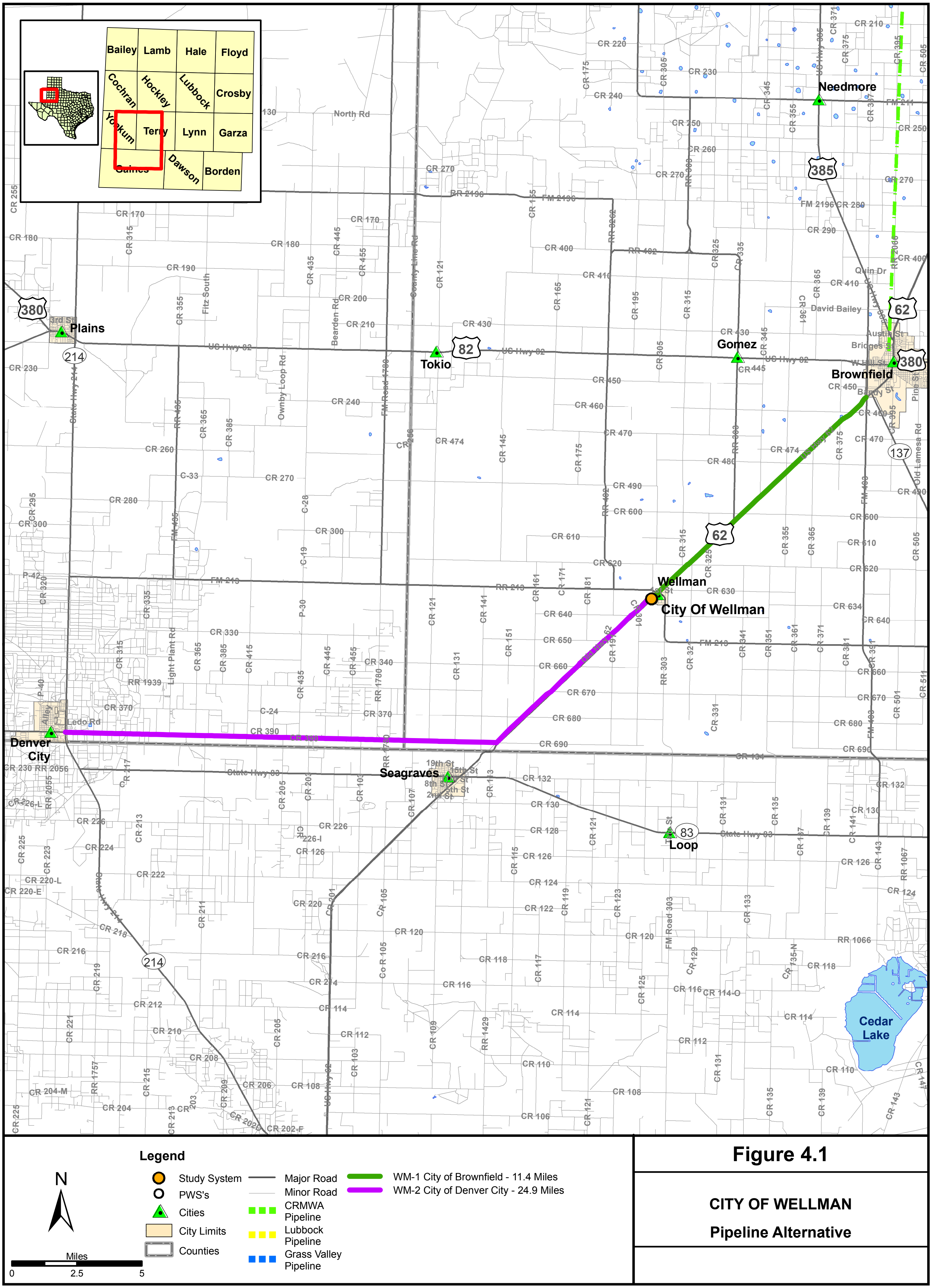


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Figure 4.1

CITY OF WELLMAN

Pipeline Alternative

Fluoride has also been detected in concentrations of 4.0 to 7.3 mg/L between May 1995 and September 2002, exceeding the MCL of 4 mg/L. From April 1998 to January 1999, nitrate values ranged from 4.34 mg/L to 9.06 mg/L, and in February 2008 a nitrate concentration of 12.8 mg/L was detected, exceeding the MCL of 10 mg/L. More testing of nitrate is needed. Selenium concentrations range from 0.0412 to 0.0533 mg/L from April 1998 through February 2004, with the higher results exceeding the MCL of 0.05 mg/L. Therefore, it is likely the City of Wellman PWS would face compliance issues under the water quality standards for these contaminants.

Basic system information is as follows:

- Population served: 225
- Connections: 97
- Average daily flow: 0.03 mgd
- Total production capacity: 0.130 mgd

Basic system raw water quality data are as follows:

- Typical arsenic range: 0.0165 mg/L to 0.0436 mg/L (now below the MCL)
- Typical fluoride range: 4.0 mg/L to 7.3 mg/L
- Typical nitrate range: 4.34 to 9.06 mg/L, with on recent result of 12.8 mg/L
- Typical selenium range: 0.0412 to 0.0533 mg/L
- Typical calcium range: 56.9 mg/L to 77.0 mg/L
- Typical chloride range: 103 mg/L to 136 mg/L
- Typical iron range: <0.01 mg/L to 0.024 mg/L
- Typical magnesium range: 63 mg/L to 122 mg/L
- Typical manganese: <0.008 mg/L
- Typical sodium range: 105 mg/L to 140 mg/L
- Typical sulfate range: 241 to 261 mg/L
- Total hardness as CaCO3 range: 432 to 686 mg/L
- Typical pH: 7.5
- Total alkalinity as CaCO3 range: 240 to 248 mg/L
- Typical bicarbonate range: 293 mg/L to 303 mg/L
- Typical total dissolved solids range: 757 to 823 mg/L

The typical ranges for water quality data listed above are based on a TCEQ database that contains data updated through the beginning of 2005.

4.1.2 Capacity Assessment for City of Wellman Water System

The project team conducted a capacity assessment of the City of Wellman water system on July 15, 2008. Results of this evaluation are separated into four categories: general assessment of capacity, positive aspects of capacity, capacity deficiencies, and capacity concerns. The general assessment of capacity describes the overall impression of FMT capability of the water system. The positive aspects of capacity describe the strengths of the system. These factors can provide the building blocks for the system to improve capacity deficiencies. The capacity deficiencies noted are those aspects that are creating a particular problem for the system related to long-term sustainability. Primarily, these problems are related to the system's ability to meet current or future compliance, ensure proper revenue to pay the expenses of running the system, and ensure proper operation of the system. The last category, capacity concerns, are items that are not causing significant problems for the system at this time. However, the system may want to address them before they become problematic.

Because of the challenges facing very small water systems, it is increasingly important for them to develop the internal capacity to comply with all state and federal requirements for public drinking water systems. For example, it is especially important for very small water systems to develop long-term plans, set aside money in reserve accounts, and track system expenses and revenues because they cannot rely on increased growth and economies of scale to offset their costs. In addition, it is crucial for the owner, manager, and operator of a very small water system to understand the regulations and participate in appropriate trainings. Providing safe drinking water is the responsibility of every public water system, including those very small water systems that face increased challenges with compliance.

The project team interviewed the following individuals.

- Marvin Crutcher, Water Superintendent
- Rosalie Capps, City Secretary

4.1.2.1 General Structure of the Water System

The City of Wellman is located about 6 miles southwest of Brownfield on Highway 62/385. The water system has 97 connections and serves approximately 225 residents. Marvin Crutcher is the water system operator and holds a Level D certification. The city secretary, Rosalie Capps, is responsible for billing and accounting. The water rate is $28 for usage of 0 to 2,999 gallons, $33.25 for usage up to 5,999 gallons, and $38.50 for usage up to 8,999 gallons. Sewer and trash are both flat rates of $45 and $21 per month, respectively. The City well water exceeds the standards for fluoride, selenium, and nitrate. Bottled water is provided upon request for children under the age of 14.

4.1.2.2 General Assessment of Capacity

Based on the team's assessment, this system has a good level of capacity. There are several positive FMT aspects of the water system, but there are also some areas that need improvement. The deficiencies noted could prevent the water system from being able to meet compliance now or in the future and may also impact the water system's long-term sustainability.

4.1.2.3 Positive Aspects of Capacity

In assessing a system's overall capacity, it is important to look at all aspects – positive and negative. It is important for systems to understand those characteristics that are working well, so those activities can be continued or strengthened. In addition, those positive aspects can assist the system in addressing the capacity deficiencies or concerns. The factors particularly important for the City of Wellman are listed below.

- **Participation in USEPA's Arsenic Treatment Technologies Demonstration Program** – Beginning in July 2006 the water system began operating an Adedge adsorption system to treat for arsenic and should now be in compliance with the arsenic standard. The treatment system was turned over to the City in May 2008 and continues to be operated and maintained by the water superintendent.
- **Knowledgeable and Dedicated Water Superintendent** – The Water Superintendent has been with the city for six years. While he only works part-time, he is very dedicated to providing safe drinking water and is extremely knowledgeable, especially about the arsenic treatment system.

4.1.2.4 Capacity Deficiencies

The following capacity deficiency was noted in conducting the assessment and seriously impacts the ability of the water system to comply with current and future regulations and ensure long-term sustainability.

- **Lack of Compliance with Fluoride Standard –** The water system is not in compliance with the standard for fluoride and occasionally not compliant with the selenium and nitrate standard.

4.1.2.5 Potential Capacity Concerns

The following items were concerns regarding capacity, but no specific operational, managerial, or financial problems can be attributed to these items at this time. The system should address the items listed below to further improve FMT capabilities and improve the system's long-term sustainability.

- **Efforts Toward Capital Improvement Planning –** Although the water operator has an idea of future projects for the water system, such as replacing water meters, there is no process or written plan to address long-term water system needs. The lack of a comprehensive long-term written plan could negatively impact the system's ability to develop a budget and associated rate structure to provide sufficient revenue.
- **Lack of Reliable Maps** - The City does not have a set of maps that accurately reflect the components of the water system. In the past, the operator has been unsure of the location of distribution lines and valves. As repairs are made to the water system, the

operator has attempted to document locations on the current map. Without an accurate map, it is more difficult to address emergencies, perform routine maintenance, and track system line breaks over time.

- **Preventative Maintenance** - It does not appear there is a preventative maintenance program. Although the operator does flush the lines regularly, most work on the system seems to be done on a reactive basis instead of a proactive one.
- **Need for additional Staff** - The water operator only works part time for the City and has stated that another operator is needed. The current City Mayor provides some assistance to the operator, but he is not licensed. It is important for the long-term sustainability of the water system, that the City makes an effort to hire an additional water operator.

4.2 ALTERNATIVE WATER SOURCE DEVELOPMENT

4.2.1 Identification of Alternative Existing Public Water Supply Sources

Using data drawn from the TCEQ drinking water and TWDB groundwater well databases, the PWSs surrounding the City of Wellman PWS were reviewed with regard to their reported drinking water quality and production capacity. PWSs that appeared to have water supplies with water quality issues were ruled out from evaluation as alternative sources, while those without identified water quality issues were investigated further. Systems were considered if they were within 30 miles of the study system. A distance of 30 miles was considered to be the upper limit of economic feasibility for constructing a new water line. Table 4.1 is a list of the selected PWSs based on these criteria for large and small PWSs within 30 miles of the City of Wellman. If it was determined these PWSs had excess supply capacity and might be willing to sell the excess, or might be a suitable location for a new groundwater well, the system was taken forward for further consideration and identified with "EVALUATE FURTHER" in the comments column of Table 4.1.

Table 4.1 Selected Public Water Systems within 30 Miles of the City of Wellman

PWS ID	PWS Name	Distance from City of Wellman (miles)	Comments/Other Issues
0830011	LOOP WATER SUPPLY CORP	8.55	Smaller GW system. WQ issues: arsenic, fluoride, and nitrate
0830001	CITY OF SEAGRAVES	10.89	Larger GW system. WQ issues: arsenic and fluoride
2230001	CITY OF BROWNFIELD	12.49	Larger SW/GW system. No WQ issues. **Evaluate Further**
0830019	GAINES COUNTY GOLF COURSE	18.2	Smaller GW system. WQ issues: fluoride, nitrate and sulfate
0830018	GAINES COUNTY PARK	19.09	Smaller GW system. WQ issues: arsenic, fluoride, and sulfate
0580013	WELCH WATER SUPPLY CORP	19.59	Larger GW system. WQ issues: arsenic, fluoride, nitrate and sulfate
2510002	CITY OF PLAINS	23.87	Larger GW system. WQ issues: arsenic, fluoride and sulfate
1100019	OCCIDENTAL PERMIAN LIMITED-SUNLAND	23.94	Smaller Non-residential. GW system. WQ issues: fluoride and sulfate

PWS ID	PWS Name	Distance from City of Wellman (miles)	Comments/Other Issues
2230002	CITY OF MEADOW	24.03	Larger GW system. WQ issues: arsenic, fluoride, gross alpha and selenium
1100017	OCCIDENTAL PERMIAN LTD E SLAUGHTER	24.96	Smaller Non-residential. GW system. WQ issue: arsenic
0830031	AMERADA HESS SEMINOLE GAS PROCESS	27.54	Smaller Non-residential. GW system. WQ issues: arsenic, fluoride and sulfate
2510001	CITY OF DENVER	28.29	Larger GW system. No WQ issues. **Evaluate Further**
1100003	CITY OF SUNDOWN	28.63	Larger GW system. WQ issues: arsenic and fluoride
0830012	CITY OF SEMINOLE	29.23	Larger GW system. WQ issues: arsenic and fluoride
1100039	OXY PERMIAN MALLET PLANT	29.99	Smaller GW system. WQ issues: arsenic and fluoride.
1100004	CITY OF ROPESVILLE	30	Larger GW system. WQ issues: fluoride

WQ = water quality
GW = groundwater

After the PWSs in Table 4.1 with water quality problems were eliminated from further consideration, the remaining PWSs were screened by proximity to City of Wellman and sufficient total production capacity for selling or sharing water. Based on the initial screening summarized in Table 4.1, two alternatives were selected for further evaluation. These alternatives are summarized in Table 4.2. The alternatives are connections to the City of Brownfield and the Denver City. Descriptions of both the City of Brownfield and the Denver City follow Table 4.2.

Table 4.2 Public Water Systems Within the Vicinity of the City of Wellman PWS Selected for Further Evaluation

PWS ID	PWS Name	Population	Connections	Total Production (mgd)	Avg Daily Usage (mgd)	Approx. Dist. from City of Wellman	Comments/Other Issues
2230001	CITY OF BROWNFIELD	9488	3464	6.25	1.265	12.49	Larger SW/GW system. No WQ issues Investigate Further
2510001	DENVER CITY	3985	1800	6.429	0.992	28.29	Larger GW system. No WQ issues Investigate Further

WQ = water quality
GW = groundwater
SW = storm water

4.2.1.1 City of Brownfield

Brownfield is located approximately 12.5 miles northeast from the City of Wellman. Their maximum water production is 6.25 mgd for a population of about 9,488 people or 3,464 connections. Brownfield is one of 11 member cities that receive water through an agreement with the CRMWA. The majority of its water supply is purchased from CRMWA with additional peak capacity provided by a series of wells located within the city limits. According to available information on this PWS, there are no reported exceedances for constituents of concern above the associated MCLs. The city reports no issues with infrastructure. In addition to customers on its own distribution system, Brownfield recently signed a contract to provide water to the City of Meadow with delivery to begin upon completion of storage facilities. The City of Seagraves approached Brownfield for water, but pipeline costs made the project prohibitive. The city does have excess capacity and the city council is willing to entertain discussions on providing water to neighboring communities.

4.2.1.2 Denver City

Denver City is located approximately 28 miles west southwest from the City of Wellman PWS. Its maximum water production is 6.43 mgd for a population of about 3,985 people or 1,800 connections with water provided by two well fields located west of the city. In addition to customers on its own distribution system, Denver City also provides treated water to two subdivisions (for a total of 100 connections) outside the city limits. Although total dissolved solids and chloride concentrations have been somewhat high, there are no reported exceedances for constituents of concern above the associated MCLs. Denver City has an average consumption of 1 mgd, which leaves capacity to provide water to other customers.

A nearby city has unofficially approached Denver City for water. Denver City will be short of water by 2050 according to the regional water plan. The city does own two sections of land with water rights; however, there is uncertainty about water availability because the test well, which produced 600 gpm, was performed more than 20 years ago. The region is experiencing growth due to recent oil production activity.

4.2.1.3 Canadian River Municipal Water Authority

The CRMWA was formed over 50 years ago by a group of Panhandle communities to provide drinking water from Lake Meredith. The CRMWA currently has contracts to provide water to 11 member cities in west Texas, including Amarillo, Borger, Brownfield, Lamesa, Levelland, Lubbock, O’Donnell, Pampa, Plainview, Slaton, and Tahoka. A pipeline ranging in size from 8 feet to 1.5 feet is used to convey raw water approximately 160 miles from Lake Meredith and a well field in Roberts County (40 miles northeast of Lake Meredith) to the Lubbock water treatment plant. Along the pipeline route, four cities (Amarillo, Borger, Pampa, and Plainview) receive their allocated water supply and each of these four cities treats their own water. The rest of the untreated water for the other seven member cities goes to the City of Lubbock water treatment plant. The treated water is pumped into the City of Lubbock distribution system and to the other six member cities. The raw water line flows by gravity from Amarillo to the Lubbock treatment plant. The treated water leaving the City of Lubbock water treatment plant flows by gravity in the east leg pipeline to Lamesa; however, the water in the west leg to Levelland and Brownfield is pumped.

The current volume of water delivered annually by the CRMWA to the member cities is 85,000 acre-feet (35,000 acre-feet from Lake Meredith and 50,000 acre-feet from the well field in Roberts County). The available water volume is set by the CRMWA and may fluctuate during the year, but the volume is based on water levels in the well field and in the lake. The provision for each member city is based on a contracted percentage of the available acre-feet. The City of Lubbock is under contract to receive 41.6 mgd from the CRMWA, and the City of Lubbock water treatment plant treats an additional 5.4 mgd for the other six member cities receiving treated water from the City of Lubbock water treatment plant. When the CRMWA program was established in the 1960s, the system was designed to accommodate the 11 member cities at the time and there were no plans to add additional member cities.

If a member city has excess water, that particular city can decide through its city council how much water it would like to allocate to a non-member PWS. If the non-member city is to receive water directly from a member city's distribution system, then the CRMWA would not be involved. However, if a non-member is requesting to receive the water (essentially a portion of a member city's allocation) via a direct line from the CRMWA line, then the non-member city must get approval from the CRMWA and the 11 member cities for distribution of water to the non-member PWS. The non-member PWS would be responsible for financing the installation of the pipeline to the CRMWA treated water line from Lubbock. The CRMWA would be involved throughout the process of a non-member PWS applying for, securing access to, and eventually receiving water through the CRMWA system.

4.2.2 Potential for New Groundwater Sources

4.2.2.1 Installing New Compliant Wells

Developing new wells or well fields is recommended, provided good quality groundwater available in sufficient quantity can be identified. Since a number of water systems in the area have water quality problems, it should be possible to share in the cost and effort of identifying compliant groundwater and constructing well fields.

Installation of a new well in the vicinity of the system intake point is likely to be an attractive option provided compliant groundwater can be found, since the PWS is already familiar with operation of a water well. As a result, existing nearby wells with good water quality should be investigated. Re-sampling and test pumping would be required to verify and determine the quality and quantity of water at those wells.

The use of existing wells should probably be limited to use as indicators of groundwater quality and availability. If a new groundwater source is to be developed, it is recommended that a new well or wells be installed instead of using existing wells. This would ensure well characteristics are known and meet standards for drinking water wells.

Some of the alternatives suggest new wells be drilled in areas where existing wells have acceptable water quality. In developing the cost estimates, Parsons assumed the aquifer in these areas would produce the required amount of water with only one well. Site investigations and geological research, which are beyond the scope of this study, could indicate whether the aquifer at a particular site and depth would provide the amount of water needed or if more than one well would need to be drilled in separate areas.

4.2.2.2 Results of Groundwater Availability Modeling

In Terry County, groundwater is available from two sources, the relatively shallow Ogallala aquifer, and the underlying Edwards-Trinity (High Plains) aquifer. The Ogallala provides drinking water to most of the communities in the Texas panhandle, as well as irrigation water. The Edwards-Trinity (High Plains) is a lower yield aquifer used almost exclusively as an irrigation water source.

Five wells operated by the City of Wellman PWS are completed in the southern Ogallala Aquifer, at depths ranging from 135 to 186 feet. A search of registered wells was conducted using TCEQ's Public Water Supply database to assess groundwater sources utilized within a 10-mile radius of the PWS. The search indicated that domestic and public supply wells located within a 10 miles from the City of Wellman PWS also withdraw groundwater from the Ogallala; this aquifer is also extensively used in the PWS vicinity as a source of irrigation water. Within the same database search area, several wells completed in the Edwards-Trinity High Plains Aquifer are registered for irrigation and industrial use, but no domestic or public supply wells pump water from this aquifer.

Groundwater Supply

The Ogallala is the largest aquifer in the United States. The aquifer outcrop underlies eastern New Mexico and much of the Texas High Plains region, extending eastward over the entire Terry County. The Ogallala provides significantly more water for users than any other aquifer in the state, and is used primarily for irrigation. The aquifer saturated thickness ranges up to an approximate depth of 600 feet. Supply wells have an average yield of approximately 500 gal/min, but higher yields, up to 2,000 gal/min, are found in previously eroded drainage channels filled with coarse-grained sediments (TWDB 2007).

Water level declines in excess of 300 feet have occurred in several aquifer areas over the last decades. Over a 50-year planning period, the 2007 Texas Water Plan anticipates a water supply depletion of more than 40 percent, from 5,968,260 acre-feet per year (AFY) projected for the year 2010, to 3,534,124 AFY by the year 2060. Nearly 95 percent of the groundwater pumped from the Ogallala Aquifer is used for irrigated agriculture.

Groundwater Availability

Regional groundwater withdrawal in the Texas High Plains region is extensive and likely to remain near current levels over the next decades. The 2007 State Water Plan indicates that in Terry County, without implementation of additional water management strategies, the increasing water demand will exceed projected water supply estimates. For the 50-year planning period ending in 2060, the additional water need will be 90,605 AFY by the year 2060. Nearly all the deficit would be associated with a large increase in irrigation water use, with municipal and other uses accounting for only 457 AFY.

A GAM developed for the Ogallala aquifer simulated historical conditions and provided long-term groundwater projections (Blandford et al., 2003). Predictive simulations using the

GAM model indicated that, if estimated future withdrawals are realized, aquifer water levels could decline to a point at which significant regions currently practicing irrigated agriculture could be essentially dewatered by 2050. The 2007 State Water Plan, however, indicates that the rate of decline has slowed relative to previous decades, and water levels have risen in a few areas.

The GAM model predicted the most critical conditions for Cochran, Hockley, Lubbock, Yoakum, Terry, and Gaines Counties where the simulated drawdown could exceed 100 feet. For Terry County, the simulated drawdown by the year 2050 would be within a typical 50 to 100 feet range (Blandford et al., 2003). The Ogallala Aquifer GAM was not run for the PWS. Water use by the system would represent a minor addition to regional withdrawal conditions, making potential changes in aquifer levels beyond the spatial resolution of the regional GAM model.

4.2.3 Potential for New Surface Water Sources

There is a minimum potential for development of new surface water sources for the City of Wellman PWS because water availability is very limited over the entire river basin, at the county level, and within the site vicinity.

The PWS is located in the upper reach of the Colorado Basin, within a relatively arid region of Texas that has a low surface water yield. The Texas State Water Plan, updated in 2007 by the TWDB, estimates that the average yield over the entire basin is 1.2 inches per year. Surface water rights are assigned primarily to municipal use and irrigation (66% and 25%, respectively). Over a 50-year planning period, the plan anticipates that availability will steadily decrease as a result of an increasing water demand. A projected 2010 surface water supply value of 1,110,000 AFY for the Colorado Basin is expected to decrease over 10 percent by the year 2060. This decrease takes into account the implementation of various long-term water management strategies proposed in the State Water Plan.

In Terry County, where the PWS is located, nearly all of the water supply is used for irrigation, largely supported by groundwater from the Ogallala Aquifer. The 2007 State Water Plan indicates that, without implementation of additional water management strategies, the increasing water demand in the county will exceed projected water supply estimates. For the 50-year planning period ending in 2060, the additional water need will be 90,605 AFY by the year 2060. Nearly all the deficit would be associated with a large increase in irrigation water use, with municipal and other uses accounting for only 457 AFY.

The TWDB developed a surface water availability model for the Colorado Basin as a tool to determine, at a regional level, the maximum amount of water available during the drought of record over the simulation period, regardless of whether the supply is physically or legally available. For the PWS vicinity, simulation data indicate that there is a minimum availability of surface water for new uses. Surface water availability maps were developed by TCEQ for the Colorado Basin, illustrating percent of months of flow per year. Availability maps indicate that in the site vicinity, and over all of Terry County, unappropriated flows for new applications are typically available 25 to 50 percent of the time. This availability is inadequate for development of new municipal water supplies as a 100 percent year-round availability is required by TCEQ for a new surface water source permit applications.

4.2.4 Options for Detailed Consideration

The initial review of alternative sources of water results in the following options for more-detailed consideration:

1. Brownfield. Potable water would be purchased from the City of Brownfield. A pipeline would be constructed to convey water from Brownfield to Wellman (Alternative WM-1).

2. Denver City. Potable water would be purchased from the Denver City. A pipeline would be constructed to convey water from the Denver City to Wellman (Alternative WM-2).

3. New Wells at 10, 5, and 1 mile. Installing a new well within 10, 5, or 1 mile of Wellman may produce compliant water in place of the water produced by the existing active wells (Alternatives WM-3, WM-4, and WM-5).

4.3 TREATMENT OPTIONS

4.3.1 Centralized Treatment Systems

Centralized treatment of the well water is identified as a potential option. Both RO and EDR could be potentially applicable. The central RO treatment alternative is Alternative WM-6, and the central EDR treatment alternative is Alternative WM-7.

4.3.2 Point-of-Use Systems

POU treatment using RO technology is valid for arsenic, fluoride, selenium, and nitrate removal. The POU treatment alternative is WM-8.

4.3.3 Point-of-Entry Systems

POE treatment using RO technology is valid for arsenic fluoride, selenium, and nitrate removal. The POE treatment alternative is WM-9.

4.4 BOTTLED WATER

Providing bottled water is considered an interim measure to be used until a compliance alternative is implemented. Even though the community is small and people know each other; it would be reasonable to require a quarterly communication advising customers of the need to take advantage of the bottled water program. An alternative to providing delivered bottled water is to provide a central, publicly accessible dispenser for treated drinking water. Alternatives addressing bottled water are WM-10, WM-11, and WM-12.

4.5 ALTERNATIVE DEVELOPMENT AND ANALYSIS

A number of potential alternatives for compliance with the MCL for arsenic, fluoride, selenium, and nitrate have been identified. Each of the potential alternatives is described in the following subsections. It should be noted that the cost information given is the capital cost and change in O&M costs associated with implementing the particular alternative. Appendix C contains cost estimates for the compliance alternatives. These compliance alternatives represent a range of possibilities, and a number of them are likely not feasible. However, all have been presented to provide a complete picture of the range of alternatives considered. It is anticipated that a PWS will be able to use the information contained herein to select the most attractive alternative(s) for more detailed evaluation and possible subsequent implementation.

4.5.1 Alternative WM-1: Purchase Potable Water from the City of Brownfield

This alternative involves purchasing compliant water from Brownfield, which will be used to supply Wellman. The Brownfield currently has sufficient excess capacity for this alternative to be feasible. It is assumed that City of Wellman would obtain all its water from the City of Brownfield.

This alternative would require construction of a pipeline, pump station, and a 5,000-gallon feed tank at a point adjacent to a City of Brownfield water main, and would require constructing a pipeline to a new 10,000-gallon storage tank and service pumps located at the City of Wellman PWS. The required pipeline would be 4-inches in diameter, approximately 11.4 miles long, and follow Highway 62 north.

By definition this alternative involves regionalization, since City of Wellman would be obtaining drinking water from an existing larger supplier. Also, other PWSs near City of Wellman are in need of compliant drinking water and could share in implementation of this alternative.

The estimated capital cost for this alternative includes constructing the pipeline, storage tank, pump stations and feed tanks, buildings, and distribution pumps. The estimated O&M cost for this alternative includes the purchase price for the water minus the cost related to current operation of the City of Wellman's wells, plus maintenance cost for the pipeline, and power and O&M labor and materials for the pump stations. The estimated capital cost for this alternative is $1.74 million with an estimated annual O&M cost of $52,900. If the purchased water was used for blending rather than for the full water supply, the annual O&M cost for this alternative could be reduced because of reduced pumping costs and reduced water purchase costs. However, additional costs would be incurred for equipment to ensure proper blending, and additional monitoring to ensure the finished water is compliant.

The reliability of adequate amounts of compliant water under this alternative should be good. The City of Brownfield provides treated surface water on a large scale, facilitating adequate O&M resources. From the perspective of the City of Wellman PWS, this alternative would be characterized as easy to operate and repair, since O&M and repair of pipelines and pumps are well understood. If the decision were made to perform blending then the operational complexity would increase.

The feasibility of this alternative is dependent on an agreement being reached with the City of Brownfield to purchase treated drinking water.

4.5.2 Alternative WM-2: Purchase Treated Water from Denver City

This alternative involves purchasing compliant water from Denver City, which will be used to supply the City of Wellman PWS. Denver City currently has sufficient excess capacity for this alternative to be feasible. It is assumed that City of Wellman would obtain all its water from Denver City.

This alternative would require constructing a pipeline, pump station, and 5000-gallon feed tank. The pipeline would begin at a Denver City water main to a new 10,000-gallon storage tank service pump station located at the City of Wellman. The required pipeline would be 4 inches in diameter, approximately 24.9 miles long, and follow Highway 62 south to County Road 690 west.

By definition this alternative involves regionalization, since City of Wellman would be obtaining drinking water from an existing larger supplier. Also, other PWSs near City of Wellman are in need of compliant drinking water and could share in implementation of this alternative.

The estimated capital cost for this alternative includes constructing the pipeline, storage tank, building, and distribution pumps. The estimated O&M cost for this alternative includes the purchase price for the water minus the cost related to current operation of the City of Wellman's wells, plus maintenance cost for the pipeline, and power and O&M labor and materials for the pump station. The estimated capital cost for this alternative is $3.49 million with an estimated annual O&M cost of $50,700. If the purchased water was used for blending rather than for the full water supply, the annual O&M cost for this alternative could be reduced because of reduced pumping costs and reduced water purchase costs. However, additional costs would be incurred for equipment to ensure proper blending, and additional monitoring to ensure the finished water is compliant.

The reliability of adequate amounts of compliant water under this alternative should be good. The Denver City provides treated surface water on a large scale, facilitating adequate O&M resources. From the perspective of the City of Wellman, this alternative would be characterized as easy to operate and repair, since O&M and repair of pipelines and pumps are well understood. If the decision were made to perform blending then the operational complexity would increase.

The feasibility of this alternative is dependent on an agreement being reached with Denver City to purchase treated drinking water. There are several small PWSs relatively close to the City of Wellman PWS that have water quality problems that would be good candidates for sharing the cost for obtaining water from Denver City. The cost to the City of Wellman for this alternative could be reduced if the other PWSs would be willing to share the costs. The analysis for a shared solution is presented in Appendix F. This analysis shows that the City of Wellman could expect to save between $1.46 million to $3.04 million if they were to implement a shared solution like this, which would be a savings between 42 to 87 percent.

4.5.3 Alternative WM-3: New Well at 10 miles

This alternative consists of installing one new well within 10 miles of the City of Wellman that would produce compliant water in place of the water produced by the existing wells. At this level of study, it is not possible to positively identify existing wells or the location where new wells could be installed.

This alternative would require constructing one new 300-foot well, a new pump station with a 5,000-gallon feed tank near the new well and a pipeline from the new well/feed tank to a new 10,000-gallon storage tank with two service pumps installed near the existing intake point for the City of Wellman. The pump station and feed tank would be necessary to overcome pipe friction and changes in land elevation. For this alternative, the pipeline is assumed to be approximately 10 miles long, and would be a 4-inches in diameter and discharge to the new 10,000-gallon storage tank at the City of Wellman. The pump station would include a feed tank, two transfer pumps, including one standby, and would be housed in a building. The new storage tank would include two service pumps, including one standby. The service pumps would be housed in a building.

Depending on well location and capacity, this alternative could present some options for a more regional solution. It may be possible to share water and costs with another nearby system.

The estimated capital cost for this alternative includes installing the well, constructing the pipeline, the pump station and feed tank, the storage tank, service pumps and pump house. The estimated O&M cost for this alternative includes O&M for the pipeline and pump stations. The estimated capital cost for this alternative is $1.61 million, and the estimated annual O&M cost for this alternative is $39,800.

The reliability of adequate amounts of compliant water under this alternative should be good, since water wells, pump stations and pipelines are commonly employed. From the perspective of the City of Wellman, this alternative would be similar to operate as the existing system. City of Wellman personnel have experience with O&M of wells, pipelines, and pump stations.

The feasibility of this alternative is dependent on the ability to find an adequate existing well or success in installing a well that produces an adequate supply of compliant water. It is likely that an alternate groundwater source would not be found on land owned by City of Wellman, so landowner cooperation would likely be required.

4.5.4 Alternative WM-4: New Well at 5 miles

This alternative consists of installing one new well within 5 miles of the City of Wellman that would produce compliant water in place of the water produced by the existing wells. At this level of study, it is not possible to positively identify an existing well or the location where new wells could be installed.

This alternative would require constructing one new 300-foot well, a new pump station with a 5,000 gallon feed tank near the new well, and a pipeline from the new well/feed tank to a new 10,000-gallon storage tank with two service pumps installed near the existing intake point for the City of Wellman. The pump station and feed tank would be necessary to overcome pipe friction and changes in land elevation. For this alternative, the pipeline is assumed to be 4-inches in diameter, approximately 5 miles long, and would discharge to a new storage tank at the City of Wellman. The pump station near the well would include two transfer pumps, including one standby, and would be housed in a building. The new storage tank would include two service pumps, including one standby. The service pumps would be housed in a building.

Depending on well location and capacity, this alternative could present some options for a more regional solution. It may be possible to share water and costs with another nearby system.

The estimated capital cost for this alternative includes installing the well, and constructing the pipeline and pump station. The estimated O&M cost for this alternative includes O&M for the pipeline and pump station. The estimated capital cost for this alternative is $991,800, and the estimated annual O&M cost for this alternative is $38,200.

The reliability of adequate amounts of compliant water under this alternative should be good, since water wells, pump stations and pipelines are commonly employed. From the perspective of the Wellman PWS, this alternative would be similar to operate as the existing system. City of Wellman personnel have experience with O&M of wells, pipelines and pump stations.

The feasibility of this alternative is dependent on the ability to find an adequate existing well or success in installing a well that produces an adequate supply of compliant water. It is likely an alternate groundwater source would not be found on land owned by City of Wellman, so landowner cooperation would likely be required.

4.5.5 Alternative WM-5: New Well at 1 mile

This alternative consists of installing one new well within 1 mile of the Wellman PWS that would produce compliant water in place of the water produced by the existing wells. At this level of study, it is not possible to positively identify an existing well or the location where a new well could be installed.

This alternative would require constructing one new 300-foot well and a pipeline from the new well to a new 10,000-gallon storage tank with two service pumps installed within a pump house near the existing intake point for the City of Wellman system. Since the new well is relatively close, a pump station would not be necessary. For this alternative, the pipeline is assumed to be 4 inches in diameter, approximately 1 mile long, and would discharge to a new storage tank at the Wellman PWS. The new storage tank would include two service pumps, including one standby. The service pumps would be housed in a building.

Depending on well location and capacity, this alternative could present some options for a more regional solution. It may be possible to share water and costs with another nearby system.

The estimated capital cost for this alternative includes installing the well, and constructing the pipeline. The estimated O&M cost for this alternative includes O&M for the pipeline. The estimated capital cost for this alternative is $318,800, and the estimated annual O&M cost savings for this alternative is $13,000.

The reliability of adequate amounts of compliant water under this alternative should be good, since water wells and pipelines are commonly employed. From the perspective of the City of Wellman, this alternative would be similar to operate as the existing system. City of Wellman personnel have experience with O&M of wells, pipelines and pump stations.

The feasibility of this alternative is dependent on the ability to find adequate existing wells or success in installing wells that produces an adequate supply of compliant water. It is possible an alternate groundwater source would not be found on land owned by City of Wellman, so landowner cooperation may be required

4.5.6 Alternative WM-6: Central RO Treatment

This system would continue to pump water from the existing wells, and would treat the water through an RO system prior to distribution. RO treatment is applicable for removal of nitrate, selenium, and fluoride, and would also remove arsenic. If an RO unit is installed, the existing arsenic treatment unit could be taken out of service. For this option, 100 percent of the raw water would be treated to obtain compliant water. The RO process concentrates impurities in the reject stream that would be discharged to the City of Wellman sewer system. It is estimated the RO reject generation would be approximately 13,000 gallons per day (gpd) when the system is operated at an average daily flow rate of 0.03 mgd.

This alternative consists of constructing the RO treatment plant near the existing wells. The plant is composed of a 750 square foot building with a paved driveway; a skid with the pre-constructed RO plant and a connection to the sewer for discharge of reject water. The treated water would be chlorinated and stored in the new permeate tank prior to being pumped into the distribution system. The entire facility is fenced.

The estimated capital cost for this alternative is $596,200, and the estimated annual O&M cost is $81,800.

The reliability of adequate amount of compliant water under this alternative is good, since RO treatment is a common and well-understood treatment technology. However, O&M efforts required for the central RO treatment plant may be significant, and O&M personnel would require training with RO. The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.7 Alternative WM-7: Central EDR Treatment

The system would continue to pump water from the existing wells, and would treat the water through an EDR system prior to distribution. EDR treatment is applicable for removal of nitrate, selenium, and fluoride, and would also remove arsenic. If an EDR unit is installed, the existing arsenic treatment unit could be taken out of service. For this option the EDR would treat the full flow without bypass as the EDR operation can be tailored for desired removal efficiency. It is estimated the EDR reject generation would be approximately 9,600 gpd when the system is operated at an average daily flow rate of 0.03 mgd.

This alternative consists of constructing the EDR treatment plant near the existing well. The plant is composed of a 625 square foot building with a paved driveway; a skid with the pre-constructed EDR system; and a connection to the sewer for discharge reject water. The treated water would be chlorinated and stored in the existing water storage tank prior to being pumped into the distribution system. The entire facility is fenced.

The estimated capital cost for this alternative is $649,800 and the estimated annual O&M cost is $80,000.

The reliability of adequate amounts of compliant water under this alternative is good, since EDR treatment is a common and well-understood treatment technology. However, O&M efforts required for the central EDR treatment plant may be significant, and O&M personnel would require training with EDR. The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.8 Alternative WM-8: Point-of-Use Treatment

This alternative consists of the continued operation of the City of Wellman well field, plus treatment of water to be used for drinking or food preparation at the point of use to remove arsenic, fluoride, nitrate, and selenium. The purchase, installation, and maintenance of POU treatment systems to be installed "under the sink" would be necessary for this alternative. Blending is not an option in this case.

This alternative would require installing the POU treatment units in residences and other buildings that provide drinking or cooking water. City of Wellman staff would be responsible for purchase and maintenance of the treatment units, including membrane and filter replacement, periodic sampling, and necessary repairs. In houses, the most convenient point for installation of the treatment units is typically under the kitchen sink, with a separate tap installed for dispensing treated water. Installation of the treatment units in kitchens will require the entry of City of Wellman or contract personnel into the houses of customers. As a result, cooperation of customers would be important for success implementing this alternative. The treatment units could be installed for access without house entry, but that would complicate the installation and increase costs.

Treatment processes would involve RO. Treatment processes produce a reject waste stream. The reject waste streams result in a slight increase in the overall volume of water used. POU systems have the advantage that only a minimum volume of water is treated (only that for human consumption). This minimizes the size of the treatment units, the increase in water required, and the waste for disposal. For this alternative, it is assumed the increase in water consumption is insignificant in terms of supply cost, and that the reject waste stream can be discharged to the house septic or sewer system.

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the POU treatment systems. The estimated O&M cost for this alternative includes the purchase and replacement of filters and membranes, as well as periodic sampling and record keeping as required by the Texas Administrative Code (TAC) (Title 30, Part I, Chapter 290, Subchapter F, Rule 290.106). The estimated capital cost for this alternative is $123,200, and the estimated annual O&M cost for this alternative is $81,000. For the cost estimate, it is assumed that one POU treatment unit will be required for each of the 97 connections in the City of Wellman system. It should be noted that the POU treatment units would need to be more complex than units typically found in commercial retail outlets in order to meet regulatory requirements, making purchase and installation more expensive. Additionally, capital cost would increase if POU treatment units are placed at other taps within a home, such as refrigerator water dispensers, ice makers, and bathroom sinks. In school settings, all taps where children and faculty receive water may need POU treatment units or clearly mark those taps suitable for human consumption. Additional considerations may be necessary for preschools or other establishments where individuals cannot read.

The reliability of adequate amounts of compliant water under this alternative is fair, since it relies on the active cooperation of the customers for system installation, use, and maintenance, and only provides compliant water to single tap within a house. Additionally, the O&M efforts (including monitoring of the devices to ensure adequate performance) required for the POU systems will be significant, and the current personnel are inexperienced in this type of work. From the perspective of the City of Wellman PWS, this alternative would be characterized as more difficult to operate owing to the in-home requirements and the large number of individual units.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.9 Alternative WM-9: Point-of-Entry Treatment

This alternative consists of the continued operation of the City of Wellman well field, plus treatment of water as it enters residences to remove arsenic, fluoride, nitrate, and selenium.

The purchase, installation, and maintenance of the treatment systems at the point of entry to a household would be necessary for this alternative. Blending is not an option in this case.

This alternative would require the installation of the POE treatment units at houses and other buildings that provide drinking or cooking water. Every building connected to the system must have a POE device installed, maintained, and adequately monitored. TCEQ must be assured the system has 100 percent participation of all property and or building owners. A way to achieve 100 percent participation is through a public announcement and education program. Example public programs are provided in the document "*Point-of-Use or Point-of-Entry" Treatment Options for Small Drinking Water Systems*" published by USEPA. The property owner's responsibilities for the POE device must also be contained in the title to the property and "run with the land" so subsequent property owners understand their responsibilities (USEPA 2006).

City of Wellman would be responsible for purchase, operation, and maintenance of the treatment units, including membrane and filter replacement, periodic sampling, and necessary repairs. It may also be desirable to modify piping so water for non-consumptive uses can be withdrawn upstream of the treatment unit. The POE treatment units would be installed outside the residences, so entry would not be necessary for O&M. Some cooperation from customers would be necessary for installation and maintenance of the treatment systems.

POE treatment for arsenic, fluoride, nitrate, and selenium would involve RO. Treatment processes produce a reject stream that requires disposal. The reject water stream results in a slight increase in overall volume of water used. POE systems treat a greater volume of water than POU systems. For this alternative, it is assumed the increase in water consumption is insignificant in terms of supply cost, and that the backwash reject waste stream can be discharged to the house septic or sewer system.

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the POE treatment systems. The estimated O&M cost for this alternative includes the purchase and replacement of filters and membranes, as well as periodic sampling and record keeping. The estimated capital cost for this alternative is $1.48 million, and the estimated annual O&M cost for this alternative is $208,100. For the cost estimate, it is assumed that one POE treatment unit will be required for each of the 97 existing connections to the City of Wellman system.

The reliability of adequate amounts of compliant water under this alternative are fair, but better than POU systems since it relies less on the active cooperation of the customers for system installation, use, and maintenance, and compliant water is supplied to all taps within a house. Additionally, the O&M efforts required for the POE systems will be significant, and the current personnel are inexperienced in this type of work. From the perspective of the City of Wellman PWS, this alternative would be characterized as more difficult to operate owing to the on-property requirements and the large number of individual units.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.10 Alternative WM-10: Public Dispenser for Treated Drinking Water

This alternative consists of the continued operation of the City of Wellman wells, plus dispensing treated water for drinking and cooking at a publicly accessible location. Implementing this alternative would require purchasing and installing a treatment unit where customers would be able to come and fill their own containers. This alternative also includes notifying customers of the importance of obtaining drinking water from the dispenser. In this way, only a relatively small volume of water requires treatment, but customers would be required to pick up and deliver their own water. Blending is not an option in this case. It should be noted that this alternative would be considered an interim measure until a compliance alternative is implemented.

City of Wellman personnel would be responsible for maintenance of the treatment unit, including media or membrane replacement, periodic sampling, and necessary repairs. The spent media or membranes will require disposal. This alternative relies on a great deal of cooperation and action from the customers in order to be effective.

This alternative does not present options for a regional solution.

The estimated capital cost for this alternative includes purchasing and installing the treatment system to be used for the drinking water dispenser. The estimated O&M cost for this alternative includes purchasing and replacing filters and media or membranes, as well as periodic sampling and record keeping. The estimated capital cost for this alternative is $17,800, and the estimated annual O&M cost for this alternative is $34,600.

The reliability of adequate amounts of compliant water under this alternative is fair, because of the large amount of effort required from the customers and the associated inconvenience. City of Wellman PWS has not provided this type of service in the past. From the City of Wellman's perspective this alternative would be characterized as relatively easy to operate, since these types of treatment units are highly automated, and there is only one unit.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.11 Alternative WM-11: 100 Percent Bottled Water Delivery

This alternative consists of the continued operation of the City of Wellman wells, but compliant drinking water will be delivered to customers in containers. This alternative involves setting up and operating a bottled water delivery program to serve all customers in the system. It is expected that City of Wellman would find it most convenient and economical to contract a bottled water service. The bottle delivery program would have to be flexible enough to allow the delivery of smaller containers should customers be incapable of lifting and manipulating 5-gallon bottles. Blending is not an option in this case. It should be noted that this alternative would be considered an interim measure until a compliance alternative is implemented.

This alternative does not involve capital cost for construction, but would require some initial costs for system setup, and then ongoing costs to have the bottled water furnished. It is assumed for this alternative that bottled water is provided to 100 percent of the City of Wellman PWS customers.

This alternative does not present options for a regional solution.

The estimated initial capital cost is for setting up the program. The estimated O&M cost for this alternative includes program administration and purchase of the bottled water. The estimated capital cost for this alternative is $27,000, and the estimated annual O&M cost for this alternative is $128,800. For the cost estimate, it is assumed that each person requires one gallon of bottled water per day.

The reliability of adequate amounts of compliant water under this alternative is fair, since it relies on the active cooperation of customers to order and utilize the water. Management and administration of the bottled water delivery program will require attention from City of Wellman.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.12 Alternative WM-12: Public Dispenser for Trucked Drinking Water

This alternative consists of continued operation of the City of Wellman wells, plus dispensing compliant water for drinking and cooking at a publicly accessible location. The compliant water would be purchased from the City of Lubbock, and delivered by truck to a tank at a central location where customers would be able to fill their own containers. This alternative also includes notifying customers of the importance of obtaining drinking water from the dispenser. In this way, only a relatively small volume of water requires treatment, but customers are required to pick up and deliver their own water. Blending is not an option in this case. It should be noted that this alternative would be considered an interim measure until a compliance alternative is implemented.

The City of Wellman would purchase a truck suitable for hauling potable water, and install a storage tank. It is assumed the storage tank would be filled once a week, and that the chlorine residual would be tested for each truckload. The truck would have to meet requirements for potable water, and each load would be treated with bleach. This alternative relies on a great deal of cooperation and action from the customers for it to be effective.

This alternative presents limited options for a regional solution if two or more systems share the purchase and operation of the water truck.

The estimated capital cost for this alternative includes purchasing a water truck and construction of the storage tank to be used for the drinking water dispenser. The estimated O&M cost for this alternative includes O&M for the truck, maintenance for the tank, water quality testing, record keeping, and water purchase, The estimated capital cost for this alternative is $127,700, and the estimated annual O&M cost for this alternative is $33,100.

The reliability of adequate amounts of compliant water under this alternative is fair because of the large amount of effort required from the customers and the associated inconvenience. Current personnel have not provided this type of service in the past. From the perspective of the City of Wellman, this alternative would be characterized as relatively easy to operate, but the water hauling and storage would have to be done with care to ensure sanitary conditions.

The feasibility of this alternative is not dependent on the cooperation, willingness, or capability of other water supply entities.

4.5.13 Summary of Alternatives

Table 4.3 provides a summary of the key features of each alternative for the City of Wellman PWS.

4.6 DEVELOPMENT AND EVALUATION OF A REGIONAL SOLUTION

A concept for a regional solution to provide compliant drinking water to PWSs near Lubbock and surrounding counties was developed and evaluated to investigate whether a large-scale regional approach might be more cost-effective than each PWS seeking its own solution. The development and evaluation of the Lubbock Area Regional Solutions is described in Appendix E. It was found that a regional solution to serving non-compliant PWSs in the Lubbock area presents a potentially viable solution to an existing problem. A regional system could be implemented within a cost-per-connection range of $61/month ($738/year) to $173/month ($2,079/year), with the actual cost depending on the source and costs of capital funds needed to build a regional system.

1 **Table 4.3 Summary of Compliance Alternatives for City of Wellman PWS**

Alt No.	Alternative Description	Major Components	Capital Cost[1]	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
WM-1	Purchase Water from City of Brownfield	- 1 new pump station / feed tank - storage tank - 11.4-mile pipeline	$1,740,000	$52,900	$204,600	Good	N	Agreement must be successfully negotiated with City of Brownfield. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
WM-2	Purchase Water from Denver City	- 1 new pump stations/ feed tank - storage tank - 24.9-mile pipeline	$3,494,300	$50,700	$355,400	Good	N	Agreement must be successfully negotiated with Denver City. Blending may be possible. Costs could possibly be shared with small systems along pipeline route.
WM-3	Install new compliant well within 10 Miles	- New well - New pump station / feed tank - storage tank - 10-mile pipeline	$1,614,800	$39,800	$180,500	Good	N	May be difficult to find well with good water quality and pipeline easements must be obtained. Costs could possibly be shared with small systems along pipeline route.
WM-4	Install new compliant well within 5 Miles	- New well - Pump station / feed tank - storage tank - 5-mile pipeline	$991,800	$38,200	$124,700	Good	N	May be difficult to find well with good water quality and pipeline easements must be obtained. Costs could possibly be shared with small systems along pipeline route.
WM-5	Install new compliant well within 1 Mile	- New well - storage tank - 1-mile pipeline	$318,800	$13,000	$40,800	Good	N	May be difficult to find well with good water quality and pipeline easements must be obtained.
WM-6	Continue operation of City of Wellman well field with central RO treatment	- Central RO treatment plant	$596,200	$81,800	$133,800	Good	T	Costs could possibly be shared with nearby small systems.
WM-7	Continue operation of City of Wellman well field with central EDR treatment	-Central EDR treatment plant	$649,800	$80,000	$136,700	Good	T	Costs could possibly be shared with nearby small systems.
WM-8	Continue operation of City of Wellman well field, and POU treatment	- POU treatment units.	$123,200	$81,000	$91,700	Fair	T, M	Only one compliant tap in home. Cooperation of residents required for installation, maintenance, and testing.
WM-9	Continue operation of City of Wellman well field, and POE treatment	- POE treatment units.	$1,476,500	$208,100	$336,800	Fair (*better than POU*)	T, M	All home taps compliant and less resident cooperation required.
WM-10	Continue operation of City of Wellman well field, but furnish public dispenser for treated drinking water	- Water treatment and dispenser unit	$17,800	$34,600	$36,200	Fair/interim measure	T	Does not provide compliant water to all taps, and requires a lot of effort by customers.

Alt No.	Alternative Description	Major Components	Capital Cost[1]	Annual O&M Cost	Total Annualized Cost	Reliability	System Impact	Remarks
WM-11	Continue operation of City of Wellman well field, but furnish bottled drinking water for all customers	- Set up bottled water system	$27,000	$128,800	$131,200	Fair/interim measure	M	Does not provide compliant water to all taps, and requires customers to order and use. Management of program may be significant.
WM-12	Continue operation of City of Wellman well field, but furnish public dispenser for trucked drinking water	- Construct storage tank and dispenser - Purchase potable water truck	$127,700	$33,100	$44,300	Fair/interim measure	M	Does not provide compliant water to all taps, and requires a lot of effort by customers.

Notes: *N – No significant increase required in technical or management capability*
T – Implementation of alternative will require increase in technical capability
M – Implementation of alternative will require increase in management capability
1 – See cost breakdown in Appendix C
2 – 20-year return period and 6 percent interest

4.7 COST OF SERVICE AND FUNDING ANALYSIS

To evaluate the financial impact of implementing the compliance alternatives, a 30-year financial planning model was developed. This model can be found in Appendix D. The financial model is based on estimated cash flows, with and without implementation of the compliance alternatives. Data for such models are typically derived from established budgets, audited financial reports, published water tariffs, and consumption data. The City of Wellman operates a PWS with 97 connections serving a population of 225. Information that was available to complete the financial analysis included 2007 revenues and expenses, 2007 water usage records for the City of Wellman, and current water rates for City of Wellman.

This analysis will need to be performed in a more detailed fashion and applied to alternatives deemed attractive and worthy of more detailed evaluation. A more detailed analysis should include additional factors such as:

- Cost escalation,
- Price elasticity effects where increased rates may result in lower water consumption,
- Costs for other system upgrades and rehabilitation needed to maintain compliant operation.

4.7.1 Financial Plan Development

According to the City's financial statements for FY2007, a total of 10.95 million gallons of water were sold in fiscal year 2007, generating an annual operating income of $45,030. Expenses for the City of Wellman PWS were derived from the 2006-2007 Statement of Activities for year ended March 31, 2007.

4.7.2 Current Financial Condition

4.7.2.1 Cash Flow Needs

Based on the 2007 water system revenues, the current average annual water bill for the City of Wellman customers is estimated at $464 or about 1.7 percent of the City of Wellman median household income of $27,614, as given in the 2000 Census.

A review of the actual revenues and the actual operating expenses for the City of Wellman PWS suggest that the water rates are adequate to sustain operations. However, City of Wellman PWS may need to raise rates in the future to service the debt associated with any capital improvements for the various alternatives that may be implemented to address compliance issues.

4.7.2.2 Ratio Analysis

Current Ratio

The Current Ratio is a measure of liquidity. It is defined as the ratio of Current Assets to current Liabilities. Current liabilities are defined as all debt due within 1 year. There are no current liabilities related to the water system for the City of Wellman PWS.

Debt to Net Worth Ratio

A Debt to Net Worth ratio is another measure of financial liquidity and stability. Ratios less than 1.25 are indicative of financial stability, with lower ratios indicating greater financial stability and better credit risks for future borrowings. There is no debt related to water system for the City of Wellman PWS.

Operating Ratio = 1.3

The Operating Ratio is a financial term defined as a company's revenues divided by the operating expenses. An operating ratio of 1.0 means that a utility is collecting just enough money to meet expenses. In general, an operating ratio of 1.25 or higher is desirable. An operating ratio of 1.3 indicates that the water revenues are sufficient to fund current water system operations.

4.7.3 Financial Plan Results

Each of the compliance alternatives for the City of Wellman was evaluated using the financial model to determine the overall increase in water rates that would be necessary to pay for the improvements. Each alternative was examined under the various funding options described in Section 2.4.

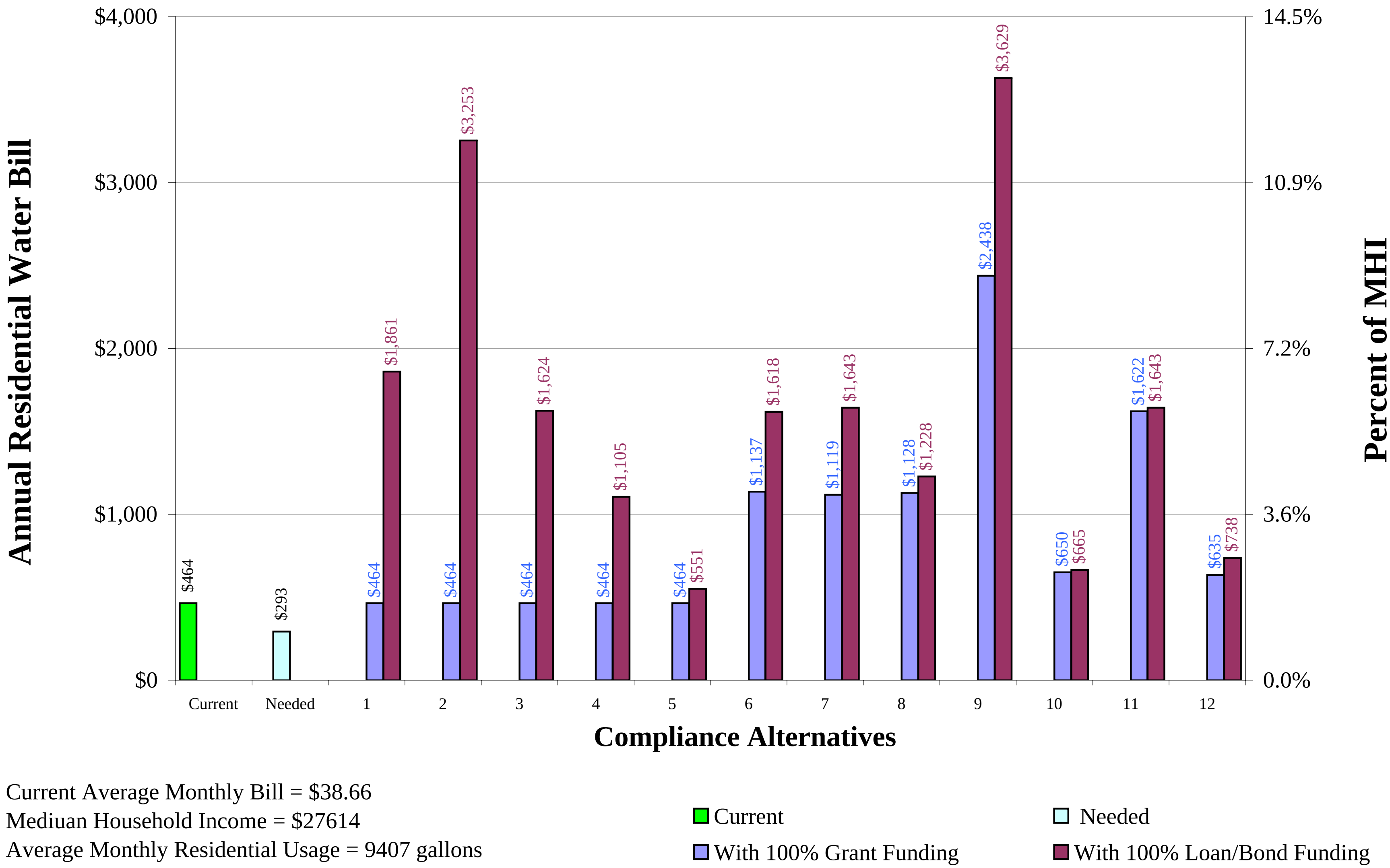
Results of the financial impact analysis are provided in Table 4.4 and Figure 4.2. Table 4.4 and Figure 4.2 present rate impacts assuming that revenues match expenses, without funding reserve accounts, and that operations and implementation of compliance alternatives are funded with revenue and are not paid for from reserve accounts. Figure 4.2 provides a bar chart that, in terms of the yearly billing to an average customer, shows the following:

- Current annual average bill,
- Projected annual average bill including rate increase, if needed, to match existing expenditures, and
- Projected annual bill including rate increases needed to fund implementation of a compliance alternative (this does not include funding for reserve accounts).

City of Wellman
Table 4.4 Financial Impact on Households

Alternative	Description		All Revenue	100% Grant	75% Grant	50% Grant	SRF	Bond
1	Purchase Water from City of Brownfield	Maximum % of MHI	66.0%	1.7%	2.9%	4.2%	4.9%	6.7%
		Percentage Rate Increase Compared to Current	3830%	0%	74%	150%	192%	301%
		Average Annual Water Bill	$18,232	$464	$808	$1,159	$1,354	$1,861
2	Purchase Water from Denver City	Maximum % of MHI	131.5%	1.7%	4.1%	6.7%	8.1%	11.8%
		Percentage Rate Increase Compared to Current	7728%	0%	146%	297%	382%	601%
		Average Annual Water Bill	$36,318	$464	$1,139	$1,844	$2,236	$3,253
3	New Well at 10 Miles	Maximum % of MHI	61.4%	1.7%	2.3%	3.5%	4.2%	5.9%
		Percentage Rate Increase Compared to Current	3552%	0%	40%	110%	149%	250%
		Average Annual Water Bill	$16,941	$464	$647	$973	$1,154	$1,624
4	New Well at 5 Miles	Maximum % of MHI	38.1%	1.7%	1.8%	2.6%	3.0%	4.0%
		Percentage Rate Increase Compared to Current	2167%	0%	9%	52%	76%	138%
		Average Annual Water Bill	$10,518	$464	$505	$705	$817	$1,105
5	New Well at 1 Mile	Maximum % of MHI	13.0%	1.7%	1.7%	1.7%	1.7%	2.0%
		Percentage Rate Increase Compared to Current	672%	0%	0%	0%	0%	19%
		Average Annual Water Bill	$3,580	$464	$464	$464	$464	$551
6	Central Treatment - RO	Maximum % of MHI	23.3%	4.1%	4.6%	5.0%	5.2%	5.9%
		Percentage Rate Increase Compared to Current	1288%	145%	171%	197%	211%	249%
		Average Annual Water Bill	$6,439	$1,137	$1,257	$1,377	$1,444	$1,618
7	Central Treatment - EDR	Maximum % of MHI	25.3%	4.1%	4.5%	5.0%	5.3%	5.9%
		Percentage Rate Increase Compared to Current	1407%	141%	169%	198%	213%	254%
		Average Annual Water Bill	$6,992	$1,119	$1,250	$1,381	$1,454	$1,643
8	Point-of-Use Treatment	Maximum % of MHI	5.7%	4.1%	4.2%	4.3%	4.3%	4.4%
		Percentage Rate Increase Compared to Current	237%	143%	149%	154%	157%	165%
		Average Annual Water Bill	$1,564	$1,128	$1,153	$1,178	$1,192	$1,228
9	Point-of-Entry Treatment	Maximum % of MHI	56.2%	8.8%	9.9%	11.0%	11.6%	13.1%
		Percentage Rate Increase Compared to Current	3244%	426%	490%	554%	590%	682%
		Average Annual Water Bill	$15,515	$2,438	$2,736	$3,034	$3,199	$3,629
10	Public Dispenser for Treated Drinking Water	Maximum % of MHI	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%
		Percentage Rate Increase Compared to Current	40%	40%	41%	42%	42%	43%
		Average Annual Water Bill	$650	$650	$654	$657	$659	$665
11	Supply Bottled Water to 100% of Population	Maximum % of MHI	5.9%	5.9%	5.9%	5.9%	5.9%	6.0%
		Percentage Rate Increase Compared to Current	250%	250%	251%	252%	253%	254%
		Average Annual Water Bill	$1,622	$1,622	$1,627	$1,633	$1,636	$1,643
12	Central Trucked Drinking Water	Maximum % of MHI	5.8%	2.3%	2.4%	2.5%	2.5%	2.7%
		Percentage Rate Increase Compared to Current	247%	37%	42%	48%	51%	59%
		Average Annual Water Bill	$1,610	$635	$661	$686	$701	$738

Figure 4.2
Alternative Cost Summary: City of Wellman



Current Average Monthly Bill = $38.66
Mediuan Household Income = $27614
Average Monthly Residential Usage = 9407 gallons

The two bars shown for each compliance alternative represent the rate changes necessary for revenues to match total expenditures assuming 100 percent grant funding and 100 percent loan/bond funding. Most funding options will fall between 100 percent grant and 100 percent loan/bond funding, with the exception of 100 percent revenue financing. Establishing or increasing reserve accounts would require an increase in rates. If existing reserves are insufficient to fund a compliance alternative, rates would need to be raised before implementing the compliance alternative. This would allow for accumulation of sufficient reserves to avoid larger but temporary rate increases during the years the compliance alternative was being implemented.

4.7.4 Evaluation of Potential Funding Options

There are a variety of funding programs available to entities as described in Section 2.4. The City of Wellman PWS is most likely to obtain funding from programs administered by the TWDB, ORCA, and Rural Development. This report contains information that would be used for an application for funding. Information such as financial analyses, water supply assessment, and records demonstrating health concerns, failing infrastructure, and financial need, may be required by these agencies. This section describes the candidate funding agencies and their appropriate programs as well as information and steps needed to begin the application process.

This report should serve to document the existing water quality issues, infrastructure need and costs, and water system information needed to begin the application process. Although this report is at the conceptual level, it demonstrates that significant funding will be needed to meet Safe Drinking Water Standards. The information provided in this report may serve as the needed documentation to justify a project that may only be possible with significant financial assistance.

4.7.4.1 TWDB Funding Options

The programs offered by the TWDB include the Drinking Water State Revolving Fund (DWSRF), Rural Water Assistance Fund (RWAF), State Loan Program (Development Fund II), and Economically Distressed Areas Program (EDAP).

Drinking Water State Revolving Fund

The DWSRF offers net long-term interest lending rates below the rate the borrower would receive on the open market for a period of 20 years. Because the City of Wellman PWS is a “disadvantaged community,” it can receive a 30-year loan term. A cost-recovery loan origination charge is imposed to cover the administrative costs of operating the DWSRF, but an additional interest rate subsidy is offered to offset the charge. The terms of the loan typically require a revenue or tax pledge. Depending on how the origination charge is handled, interest rates can be as low as 0.95 percent below market rates with the possibility of additional federal subsidies for total interest rates 1.95 percent below market rates. Disadvantaged communities may obtain loans at interest rates between 0 percent and 1 percent.

The loan application process has several steps: pre-application, application and commitment, loan closing, funding and construction monitoring, and any other special requirements. In the pre-application phase, prospective loan applicants are asked to submit a brief DWSRF Information Form to the TWDB that describes the applicant's existing water facilities, additional facility needs and the nature of projects being considered for meeting those needs, project cost estimates, and "disadvantaged community" status. The TCEQ assigns a priority rating that includes an applicant's readiness to proceed. TWDB staff notify prospective applicants of their priority rating and encourage them to schedule a pre-planning conference for guidance in preparing the engineering, planning, environmental, financial, and water conservation portions of the DWSRF application.

Additional information can be found online at the TWDB website under the Assistance tab, Financial Assistance section, Public Works Infrastructure Construction subsection, and under the links "Clean Water State Revolving Fund Loan Program."

State Loan Program (Development Fund II)

The State Loan Program is a diverse lending program directly from state funding sources. As it does not receive federal subsidies, it is more streamlined. The loans can incorporate more than one project under the umbrella of one loan. Political subdivision of the state are eligible for tax exempt rates. Projects can include purchase of water rights, treatment plants, storage and pumping facilities, transmission lines, well development, and acquisitions.

The loan requires that the applicant pledge revenue or taxes. The maximum financing life is 50 years. The average financing period is 20 to 23 years. The lending rate scale varies according to several factors, but is set by the TWDB based on cost of funds to the board, risk factors of managing the board loan portfolio, and market rate scales. The TWDB seeks to make reasonable loans with minimal risk to the state. The TWDB post rates for comparison for applicants and in August 2008, the TWDB showed their rates for a 22-year, taxable loan at 5.5 percent where the market was at 7.84 percent.

The TWDB staff can discuss the terms of the loan and assist applicants during preparation of the application, and a preapplication conference is encouraged. The application materials must include an engineering feasibility report, environmental information, rates and customer base, operating budgets, financial statements, and project information. The TWDB considers the needs of the area; benefits of the project; the relationship of the project to the overall state water needs and the State Water Plan; and the availability of all sources of revenue to the rural utility for the ultimate repayment of the loan. The board considers applications monthly.

Additional information can be found online at the TWDB website under the Assistance tab, Financial Assistance section, Public Works Infrastructure Construction subsection, and under the link "Water and Wastewater Loan Program."

Economically Distressed Areas Program

The EDAP Program was designed to assist areas along the U.S./Mexico border in areas that were economically distressed. In 2008, this program was extended to apply to the entire state so long as requirements are met. This program provides financial assistance through the provision of grants and loans to communities where present facilities are inadequate to meet resident's minimal needs. Eligible communities are those that have median household income less than 75 percent of the state household income. Non-profit water supply corporations can apply, but they must be capable of maintaining and operating the completed system, and hold or be in the process of obtaining a Certificate of Convenience and Necessity. The county where the project is located must adopt model rules for the regulation of subdivisions prior to application for financial assistance. If the applicant is a city, the city must also adopt Model Subdivision Rules of TWDB (31 TAC Chapter 364). The program funds design, construction, improvements, and acquisition, and includes measures to prevent future substandard development. The TWDB works with the applicant to find ways to leverage other state and federal financial resources.

The loan requires that the applicant pledge revenue or taxes. The maximum financing life is 50 years. The average financing period is 20 to 23 years. The lending rate scale varies according to several factors but is set by the TWDB based on cost of funds to the board, risk factors of managing the board loan portfolio, and market rate scales. The TWDB seeks to make reasonable loans with minimal loss to the state. The TWDB posts rates for comparison for applicants and in August 2008 the TWDB showed its rates for a 22-year, tax exempt loan at 5.11 percent where the market was at 5.60 percent. Most projects have a financial package with the majority of the project financed with grants. Many have received 100 percent grants.

The first step in the application process is to meet with TWDB staff to discuss the terms of the loan and assist applicants during preparation of the application. Major components of the application materials must include an engineering feasibility report, environmental information, rates and customer base, operating budgets, financial statements, community information, project information, and other legal information.

Additional information can be found online at the TWDB website under the Assistance tab, Financial Assistance section, Public Works Infrastructure Construction subsection, and under the link "Economically Distressed Area Program."

4.7.4.2 ORCA Funding Options

Created in 2001, ORCA seeks to strengthen rural communities and assist them with community and economic development and healthcare by providing a variety of rural programs, services, and activities. Of their many programs and funds, the most appropriate programs related to drinking water are the Community Development (CD) Fund, and Texas Small Towns Environment Program (STEP). These programs offer attractive funding packages to help make improvements to potable water systems to mitigate potential health concerns.

Community Development Fund

The CD Fund is a competitive grant program for water system improvements as well as other utility services (wastewater, drainage improvements, and housing activities). Funds are distributed between 24 state planning regions where funds are allocated to address each region's utility priorities. Funds can be used for various types of public works projects, including water system improvements. Cities with a population of less than 50,000 that are not eligible for direct CDBG funding from the U.S. Department of Housing and Urban Development are eligible. Funds are awarded on a competitive basis decided twice a year by regional review committees using a defined scoring system (past performance with CDBG is a factor). Awards are no less then $75,000 and cannot exceed $800,000. More information can be found at the Office of Community Affairs website under Community Development Fund.

Texas Small Towns Environment Program

Under special occasions some communities are invited to participate in grant programs when self-help is a feasible method for completing a water project, the community is committed to self-help, and the community has the capacity to complete the project. The purpose is to significantly reduce the cost of the project by using the communities' own human, material, and financial capital. Projects typically are repair, rehabilitation, improvements, service connections, and yard services. Reasonable associated administration and engineering cost can be funded. A letter of interest is first submitted, and after CDBG staff determine eligibility, an application may be submitted. Awards are only given twice per year on a priority basis so long as the project can be fully funded ($350,000 maximum award). Ranking criteria are project impact, local effort, past performance, percent of savings, and benefit to low to medium-income persons.

4.7.4.3 Rural Development

The RUS agency of Rural Development established a Revolving Fund Program (RFP) administered by the staff of the Water and Environment Program (WEP) to assist communities with water and wastewater systems. The purpose is to fund technical assistance and projects to help communities bring safe drinking water and sanitary, environmentally sound, waste disposal facilities to rural Americans in greatest need. WEP provides loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas and cities and towns with a population of 10,000 or less. Recipients must be public entities such as municipalities, counties, special purpose districts, Indian tribes, and corporations not operated for profit. Projects include all forms of infrastructure improvement, acquisition of land and water rights, and design fees. Rural Development attempts to provide some level of assistance to all communities that apply. Funds are provided on a first come, first serve basis; however, staff do evaluate need and assign priorities as funds are limited. Grant/loan mixes vary on a case by case basis and some communities may have to wait though several funding cycles until funds become available.

Water and Wastewater Disposal Program

The major components of the RFP are loan, loan guarantees, and grant funding for water and waste disposal systems. Entities must demonstrate that they cannot obtain reasonable loans at market rates, but have the capacity to repay loans, pledge security, and operate the facilities. Grants can be up to 75 percent of the project costs, and loan guarantees can be up to 90 percent of eligible loss. Loans are not to exceed a 40-year repayment period, require tax or revenue pledges, and are offered at three rates:

- Poverty Rate - The lowest rate is the poverty interest rate of 4.5 percent. Loans must be used to upgrade or construct new facilities to meet health standards, and the MHI in the service area must be below the poverty line for a family of four or below 80 percent of the statewide MHI for non-metropolitan communities.
- Market Rate – Where the MHI in the service exceeds the state MHI, the rate is based on the average of the "Bond Buyer" 11-Bond Index over a four week period.
- Intermediate Rate – the average of the Poverty Rate and the Market Rate, but not to exceed seven percent.

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APPENDIX A
PWS INTERVIEW FORM

CAPACITY DEVELOPMENT ASSESSMENT FORM

*Prepared By*___________________________________ *Date*___________________________

Section 1. Public Water System Information

1. PWS ID # [ ] 2. Water System Name [ ]

3. County [ ]

4. Owner [ ] Address [ ]
   Tele. [ ] E-mail [ ]
   Fax [ ] Message [ ]

5. Admin [ ] Address [ ]
   Tele. [ ] E-mail [ ]
   Fax [ ] Message [ ]

6. Operator [ ] Address [ ]
   Tele. [ ] E-mail [ ]
   Fax [ ] Message [ ]

7. Population Served [ ] 8. No. of Service Connections [ ]

9. Ownership Type [ ] 10. Metered (Yes or No) [ ]

11. Source Type [ ]

12. Total PWS Annual Water Used [ ]

13. Number of Water Quality Violations (Prior 36 months)

    Total Coliform [ ] Chemical/Radiological [ ]

    Monitoring (CCR, Public Notification, etc.) [ ] Treatment Technique, D/DBP [ ]

A. Basic Information

1. Name of Water System:

2. Name of Person Interviewed:

3. Position:

4. Number of years at job:

5. Number of years experience with drinking water systems:

6. Percent of time (day or week) on drinking water system activities, with current position (how much time is dedicated exclusively to the water system, not wastewater, solid waste or other activities):

7. Certified Water Operator (Yes or No):

   If Yes,
   7a. Certification Level (water):

   7b. How long have you been certified?

8. Describe your water system related duties on a typical day.

B. Organization and Structure

1. Describe the organizational structure of the Utility. Please provide an organizational chart. (Looking to find out the governance structure (who reports to whom), whether or not there is a utility board, if the water system answers to public works or city council, etc.)

2. If not already covered in Question 1, to whom do you report?

3. Do all of the positions have a written job description?

    3a. If yes, is it available to employees?

    3b. May we see a copy?

C. Personnel

1. What is the current staffing level (include all personnel who spend more than 10% of their time working on the water system)?

2. Are there any vacant positions? How long have the positions been vacant?

3. In your opinion, is the current staffing level adequate? If not adequate, what are the issues or staffing needs (how many and what positions)?

4. What is the rate of employee turnover for management and operators? What are the major issues involved in the turnover (e.g., operator pay, working conditions, hours)?

5. Is the system staffed 24 hours a day? How is this handled (on-site or on-call)? Is there an alarm system to call an operator if an emergency occurs after hours?

D. Communication

1. Does the utility have a mission statement? If yes, what is it?

2. Does the utility have water quality goals? What are they?

3. How are your work priorities set?

4. How are work tasks delegated to staff?

5. Does the utility have regular staff meetings? How often? Who attends?

6. Are there separate management meetings? If so, describe.

7. Do management personnel ever visit the treatment facility? If yes, how often?

8. Is there effective communication between utility management and state regulators (e.g., NMED)?

9. Describe communication between utility and customers.

E. Planning and Funding

1. Describe the rate structure for the utility.

2. Is there a written rate structure, such as a rate ordinance? May we see it?

   2a. What is the average rate for 6,000 gallons of water?

3. How often are the rates reviewed?

4. What process is used to set or revise the rates?

5. In general, how often are the new rates set?

6. Is there an operating budget for the water utility? Is it separate from other activities, such as wastewater, other utilities, or general city funds?

7. Who develops the budget, how is it developed and how often is a new budget created or the old budget updated?

8. How is the budget approved or adopted?

9. In the last 5 years, how many budget shortfalls have there been (i.e., didn't collect enough money to cover expenses)? What caused the shortfall (e.g., unpaid bills, an emergency repair, weather conditions)?

    9a. How are budget shortfalls handled?

10. In the last 5 years how many years have there been budget surpluses (i.e., collected revenues exceeded expenses?

    10a. How are budget surpluses handled (i.e., what is done with the money)?

11. Does the utility have a line-item in the budget for emergencies or some kind of emergency reserve account?

12. How do you plan and pay for short-term system needs?

13. How do you plan and pay for long- term system needs?

14. How are major water system capital improvements funded? Does the utility have a written capital improvements plan?

15. How is the facility planning for future growth (either new hook-ups or expansion into new areas)?

16. Does the utility have and maintain an annual financial report? Is it presented to policy makers?

17. Has an independent financial audit been conducted of the utility finances? If so, how often? When was the last one?

18. Will the system consider any type of regionalization with any other PWS, such as system interconnection, purchasing water, sharing operator, emergency water connection, sharing bookkeeper/billing or other?

F. Policies, Procedures, and Programs

1. Are there written operational procedures? Do the employees use them?

2. Who in the utility department has spending authorization? What is the process for obtaining needed equipment or supplies, including who approves expenditures?

3. Does the utility have a source water protection program? What are the major components of the program?

4. Are managers and operators familiar with current SDWA regulations?

5. How do the managers and operators hear about new or proposed regulations, such as arsenic, DBP, Groundwater Rule? Are there any new regulations that will be of particular concern to the utility?

6. What are the typical customer complaints that the utility receives?

7. Approximately how many complaints are there per month?

8. How are customer complaints handled? Are they recorded?

9. (If not specifically addressed in Question 7) If the complaint is of a water quality nature, how are these types of complaints handled?

10. Does the utility maintain an updated list of critical customers?

11. Is there a cross-connection control plan for the utility? Is it written? Who enforces the plan's requirements?

12. Does the utility have a written water conservation plan?

13. Has there been a water audit of the system? If yes, what were the results?

14. (If not specifically answered in 11 above) What is the estimated percentage for loss to leakage for the system?

15. Are you, or is the utility itself, a member of any trade organizations, such as AWWA or Rural Water Association? Are you an active member (i.e., attend regular meetings or participate in a leadership role)? Do you find this membership helpful? If yes, in what ways does it help you?

G. Operations and Maintenance

1. How is decision-making authority split between operations and management for the following items:

    a. Process Control

    b. Purchases of supplies or small equipment

    c. Compliance sampling/reporting

    d. Staff scheduling

2. Describe your utility's preventative maintenance program.

3. Do the operators have the ability to make changes or modify the preventative maintenance program?

4. How does management prioritize the repair or replacement of utility assets? Do the operators play a role in this prioritization process?

5. Does the utility keep an inventory of spare parts?

6. Where does staff have to go to buy supplies/minor equipment? How often?

    6a. How do you handle supplies that are critical, but not in close proximity (for example if chlorine is not available in the immediate area or if the components for a critical pump are not in the area)

7. Describe the system's disinfection process. Have you had any problems in the last few years with the disinfection system?

    7a. Who has the ability to adjust the disinfection process?

8. How often is the disinfectant residual checked and where is it checked?

    8a. Is there an official policy on checking residuals or is it up to the operators?

9. Does the utility have an O & M manual? Does the staff use it?

10. Are the operators trained on safety issues? How are they trained and how often?

11. Describe how on-going training is handled for operators and other staff. How do you hear about appropriate trainings? Who suggests the trainings – the managers or the operators? How often do operators, managers, or other staff go to training? Who are the typical trainers used and where are the trainings usually held?

12. In your opinion is the level of your on-going training adequate?

13. In your opinion is the level of on-going training for other staff members, particularly the operators, adequate?

14. Does the facility have mapping of the water utility components? Is it used on any routine basis by the operators or management? If so, how is it used? If not, what is the process used for locating utility components?

15. In the last sanitary survey, were any deficiencies noted? If yes, were they corrected?

16. How often are storage tanks inspected? Who does the inspection?

    16a. Have you experienced any problems with the storage tanks?

H. SDWA Compliance

1. Has the system had any violations (monitoring or MCL) in the past 3 years? If so, describe.

2. How were the violations handled?

3. Does the system properly publish public notifications when notified of a violation?

4. Is the system currently in violation of any SDWA or state regulatory requirements, including failure to pay fees, fines, or other administrative type requirements?

5. Does the utility prepare and distribute a Consumer Confidence Report (CCR)? Is it done every year? What type of response does the utility get to the CCR from customers?

I. Emergency Planning

1. Does the system have a written emergency plan to handle emergencies such as water outages, weather issues, loss of power, loss of major equipment, etc?

2. When was the last time the plan was updated?

3. Do all employees know where the plan is? Do they follow it?

4. Describe the last emergency the facility faced and how it was handled.

Attachment A

A. Technical Capacity Assessment Questions

1. Based on available information of water rights on record and water pumped has the system exceeded its water rights in the past year? YES ☐ NO ☐

   In any of the past 5 years? YES ☐ NO ☐ How many times? _____

2. Does the system have the proper level of certified operator? *(Use questions a – c to answer.)*
   YES ☐ NO ☐

   a. What is the Classification Level of the system by NMED? _____

   b. Does the system have one or more certified operator(s)? [20 NMAC 7.4.20]

   YES ☐ NO ☐

   c. If YES, provide the number of operators at each New Mexico Certification Level. [20 NMAC 7.4.12]

   _____NM Small System _____Class 2

   _____NM Small System Advanced _____Class 3

   _____Class 1 _____Class 4

3. Did the system correct any sanitary deficiency noted on the most recent sanitary survey within 6 months of receiving that information? [20 NMAC 7.20.504]

   YES ☐ NO ☐ No Deficiencies ☐

   What was the type of deficiency? *(Check all that are applicable.)*

   Source ☐ Storage ☐

   Treatment ☐ Distribution ☐

   Other _____

   From the system's perspective, were there any other deficiencies that were not noted on the sanitary survey? Please describe.

4. Will the system's current treatment process meet known future regulations?

   Radionuclides YES ☐ NO ☐ Doesn't Apply ☐

   Arsenic YES ☐ NO ☐ Doesn't Apply ☐

   Stage 1 Disinfectants and Disinfection By-Product (DBP)

   YES ☐ NO ☐ Doesn't Apply ☐

   Surface Water Treatment Rule YES ☐ NO ☐ Doesn't Apply ☐

5. Does the system have a current site plan/map? [20 NMAC 7.10.302 A.1.]

   YES ☐ NO ☐

6. Has the system had a water supply outage in the prior 24 months?

YES ☐ NO ☐

What were the causes of the outage(s)? *(Include number of outages for each cause.)*

Drought _____ Limited Supply _____

System Failure _____ Other _____

7. Has the system ever had a water audit or a leak evaluation?

YES ☐ NO ☐ Don't Know ☐

If YES, please complete the following table.

Type of Investigation	Date Done	Water Loss (%)	What approach or technology was used to complete the investigation?	Was any follow-up done? If so, describe

8. Have all drinking water projects received NMED review and approval? [20 NMAC 7.10.201]

YES ☐ NO ☐

If NO, what types of projects have not received NMED review and approval.

Source ☐ Storage ☐

Treatment ☐ Distribution ☐

Other ☐ _____

9. What are the typical customer complaints that the utility receives?

10. Approximately how many complaints are there per month? _____

11. How are customer complaints handled? Are they recorded?

12. What is the age and composition of the distribution system? ***(Collect this information from the Sanitary Survey)***

Pipe Material	Approximate Age	Percentage of the system	Comments
			Sanitary Survey Distribution System Records Attached

13. Are there any dead end lines in the system?

YES ☐ NO ☐

14. Does the system have a flushing program?

YES ☐ NO ☐

If YES, please describe.

15. Are there any pressure problems within the system?

YES ☐ NO ☐

If YES, please describe.

16. Does the system disinfect the finished water?

YES ☐ NO ☐

If yes, which disinfectant product is used? ______

Interviewer Comments on Technical Capacity:

B. Managerial Capacity Assessment Questions

17. Has the system completed a 5-year Infrastructure Capital Improvement Plan (ICIP) plan?

YES ☐ NO ☐

If YES, has the plan been submitted to Local Government Division?

YES ☐ NO ☐

18. Does the system have written operating procedures?

YES ☐ NO ☐

19. Does the system have written job descriptions for all staff?

YES ☐ NO ☐

20. Does the system have:

A preventative maintenance plan?
YES ☐ NO ☐
A source water protection plan?
YES ☐ NO ☐ N/A ☐
An emergency plan?
YES ☐ NO ☐
A cross-connection control program?
YES ☐ NO ☐
An emergency source?
YES ☐ NO ☐
System security measures?
YES ☐ NO ☐

21. Does the system report and maintain records in accordance with the drinking water regulations concerning:

Water quality violations
YES ☐ NO ☐

Public notification
YES ☐ NO ☐

Sampling exemptions
YES ☐ NO ☐

22. Please describe how the above records are maintained:

23. Describe the management structure for the water system, including board and operations staff. Please include examples of duties, if possible.

24. Please describe type and quantity of training or continuing education for staff identified above.

25. Describe last major project undertaken by the water system, including the following: project in detail, positive aspects, negative aspects, the way in which the project was funded, any necessary rate increases, the public response to the project, whether the project is complete or not, and any other pertinent information.

26. Does the system have any debt? YES ☐ NO ☐

If yes, is the system current with all debt payments?
YES ☐ NO ☐

If no, describe the applicable funding agency and the default.

27. Is the system currently contemplating or actively seeking funding for any project?
YES ☐ NO ☐

If yes, from which agency and how much?

Describe the project?

Is the system receiving assistance from any agency or organization in its efforts?

28. Will the system consider any type of regionalization with other PWS? *(Check YES if the system has already regionalized.)*

YES ☐ NO ☐

If YES, what type of regionalization has been implemented/considered/discussed? *(Check all that apply.)*

- System interconnection ☐
- Sharing operator ☐
- Sharing bookkeeper ☐
- Purchasing water ☐
- Emergency water connection ☐
- Other: _____

29. Does the system have any of the following? *(Check all that apply.)*

Water Conservation Policy/Ordinance	☐	Current Drought Plan	☐
Water Use Restrictions	☐	Water Supply Emergency Plan	☐

Interviewer Comments on Managerial Capacity:

C. Financial Capacity Assessment

30. Does the system have a budget?

YES ☐ NO ☐

If YES, what type of budget?

Operating Budget ☐

Capital Budget ☐

31. Have the system revenues covered expenses and debt service for the past 5 years?

YES ☐ NO ☐

If NO, how many years has the system had a shortfall? _____

32. Does the system have a written/adopted rate structure?

YES ☐ NO ☐

33. What was the date of the last rate increase? _____

34. Are rates reviewed annually?

YES ☐ NO ☐

IF YES, what was the date of the last review? _____

35. Did the rate review show that the rates covered the following expenses? *(Check all that apply.)*

Operation & Maintenance ☐

Infrastructure Repair & replacement ☐

Staffing ☐

Emergency/Reserve fund ☐

Debt payment ☐

36. Is the rate collection above 90% of the customers?

YES ☐ NO ☐

37. Is there a cut-off policy for customers who are in arrears with their bill or for illegal connections?

YES ☐ NO ☐

If yes, is this policy implemented?

38. What is the residential water rate for 6,000 gallons of usage in one month. _____

39. In the past 12 months, how many customers have had accounts frozen or dropped for non-payment? _____

[Convert to % of active connections

Less than 1% ☐ 1% - 3% ☐ 4% - 5% ☐ 6% - 10% ☐

11% - 20% ☐ 21% - 50% ☐ Greater than 50% ☐]

40. The following questions refer to the process of obtaining needed equipment and supplies.

a. Can the water system operator buy or obtain supplies or equipment when they are needed?

YES ☐ NO ☐

b. Is the process simple or burdensome to the employees?

c. Can supplies or equipment be obtained quickly during an emergency?

YES ☐ NO ☐

d. Has the water system operator ever experienced a situation in which he/she couldn't purchase the needed supplies?

YES ☐ NO ☐

e. Does the system maintain some type of spare parts inventory?

YES ☐ NO ☐

If yes, please describe.

41. Has the system ever had a financial audit?

YES ☐ NO ☐

If YES, what is the date of the most recent audit? ______

42. Has the system ever had its electricity or phone turned off due to non-payment? Please describe.

Interviewer Comments on Financial Assessment:

43. What do you think the system capabilities are now and what are the issues you feel your system will be facing in the future? In addition, are there any specific needs, such as types of training that you would like to see addressed by NMED or its contractors?

APPENDIX B
COST BASIS

This section presents the basis for unit costs used to develop the conceptual cost estimates for the compliance alternatives. Cost estimates are conceptual in nature (+50%/-30%), and are intended to make comparisons between compliance options and to provide a preliminary indication of possible rate impacts. Consequently, these costs are pre-planning level and should not be viewed as final estimated costs for alternative implementation. Capital cost includes an allowance for engineering and construction management. It is assumed that adequate electrical power is available near the site. The cost estimates specifically do not include costs for the following:

- Obtaining land or easements.
- Surveying.
- Mobilization/demobilization for construction.
- Insurance and bonds

In general, unit costs are based on recent construction bids for similar work in the area; when possible, consultations with vendors or other suppliers; published construction and O&M cost data; and USEPA cost guidance. Unit costs used for the cost estimates are summarized in Table B.1.

Unit costs for pipeline components are based on 2008 RS Means Site Work & Landscape Cost Data. The number of borings and encasements and open cuts and encasements is estimated by counting the road, highway, railroad, stream, and river crossings for a conceptual routing of the pipeline. The number of air release valves is estimated by examining the land surface profile along the conceptual pipeline route. It is assumed that gate valves and flush valves would be installed, on average, every 5,000 feet along the pipeline. Pipeline cost estimates are based on the use of C-900 PVC pipe. Other pipe materials could be considered for more detailed development of attractive alternatives.

Pump station unit costs are based on experience with similar installations. The cost estimate for the pump stations include two pumps, station piping and valves, station electrical and instrumentation, minor site improvement, installation of a concrete pad, fence and building, and tools. The number of pump stations is based on calculations of pressure losses in the proposed pipeline for each alternative. Back-flow prevention is required in cases where pressure losses are negligible, and pump stations are not needed. Construction cost of a storage tank is based on consultations with vendors and 2008 RS Means Site Work & Landscape Cost Data.

Labor costs are estimated based on 2008 RS Means Site Work & Landscape Cost Data specific to the Lubbock County region.

Electrical power cost is estimated to be $0.04 per kWH, as supplied by Xcel Energy. The annual cost for power to a pump station is calculated based on the pumping head and volume, and includes 11,800 kWH for pump building heating, cooling, and lighting, as recommended in USEPA publication, *Standardized Costs for Water Supply Distribution Systems* (1992).

In addition to the cost of electricity, pump stations have other maintenance costs. These costs cover: materials for minor repairs to keep the pumps operating; purchase of a maintenance vehicle, fuel costs, and vehicle maintenance costs; utilities; office supplies, small tools and equipment; and miscellaneous materials such as safety, clothing, chemicals, and paint. The non-power O&M costs are estimated based on the USEPA publication, *Standardized Costs for Water Supply Distribution Systems* (1992), which provides cost curves for O&M components. Costs from the 1992 report are adjusted to 2008 dollars based on the ENR construction cost index.

Pipeline maintenance costs include routine cleaning and flushing, as well as minor repairs to lines. The unit rate for pipeline maintenance is calculated based on the USEPA technical report, *Innovative and Alternate Technology Assessment Manual MCD 53* (1978). Costs from the 1978 report are adjusted to 2008 dollars based on the ENR construction cost index.

Storage tank maintenance costs include cleaning and renewal of interior lining and exterior coating. Unit costs for storage tank O&M are based on USEPA publication *Standardized Costs for Water Supply Distribution Systems* (1992). Costs from the 1992 report are adjusted to 2008 dollars based on the ENR construction cost index.

The purchase price for point-of-use (POU) water treatment units is based on vendor price lists for treatment units, plus installation. O&M costs for POU treatment units are also based on vendor price lists. It is assumed that a yearly water sample would be analyzed for the contaminant of concern.

The purchase price for point-of-entry (POE) water treatment units is based on vendor price lists for treatment units, plus an allowance for installation, including a concrete pad and shed, piping modifications, and electrical connection. O&M costs for POE treatment units are also based on vendor price lists. It is assumed that a yearly water sample would be analyzed for the contaminant of concern.

Central treatment plant costs include pricing for buildings, utilities, and site work. Costs are based on pricing given in the various R.S. Means Construction Cost Data References, as well as prices obtained from similar work on other projects. Pricing for treatment equipment was obtained from vendors.

Well installation costs are based on 2008 RS Means Site Work & Landscape Cost Data. Well installation costs include drilling, a well pump, electrical and instrumentation installation, well finishing, piping, and water quality testing. O&M costs for water wells include power, materials, and labor. It is assumed that new wells located more than 1 mile from the intake point of an existing system would require a storage tank and pump station.

Purchase price for the treatment unit dispenser is based on vendor price lists, plus an allowance for installation at a centralized public location. The O&M costs are also based on vendor price lists. It is assumed that weekly water samples would be analyzed for the contaminant of concern.

Costs for bottled water delivery alternatives are based on consultation with vendors that deliver residential bottled water. The cost estimate includes an initial allowance for set-up of the program, and a yearly allowance for program administration.

The cost estimate for a public dispenser for trucked water includes the purchase price for a water truck and construction of a storage tank. Annual costs include labor for purchasing the water, picking up and delivering the water, truck maintenance, and water sampling and testing. It is assumed the water truck would be required to make one trip each week, and that chlorine residual would be determined for each truck load.

Table B.1
Summary of General Data
City Of Wellman
2230003
General PWS Information

Service Population	225	**Number of Connections**	97
Total PWS Daily Water Usage	0.03 (mgd)	**Source**	Site visit list

Unit Cost Data

General Items	**Unit**	**Unit Cost**
Treated water purchase cost	See alternative	
Water purchase cost (trucked)	$/1,000 gals	$ 2.30
Contingency	20%	n/a
Engineering & Constr. Management	25%	n/a
Procurement/admin (POU/POE)	20%	n/a
Pipeline Unit Costs	**Unit**	**Unit Cost**
PVC water line, Class 200, 04"	LF	$ 12
Bore and encasement, 10"	LF	$ 240
Open cut and encasement, 10"	LF	$ 130
Gate valve and box, 04"	EA	$ 710
Air valve	EA	$ 2,050
Flush valve	EA	$ 1,025
Metal detectable tape	LF	$ 2.00
Bore and encasement, length	Feet	200
Open cut and encasement, length	Feet	50
Pump Station Unit Costs	**Unit**	**Unit Cost**
Pump	EA	$ 8,000
Pump Station Piping, 04"	EA	$ 550
Gate valve, 04"	EA	$ 710
Check valve, 04"	EA	$ 755
Electrical/Instrumentation	EA	$ 10,250
Site work	EA	$ 2,560
Building pad	EA	$ 5,125
Pump Building	EA	$ 10,250
Fence	EA	$ 6,150
Tools	EA	$ 1,025
5,000 gal feed tank	EA	$ 10,000
Backflow preventer, 4"	EA	$ 2,295
Backflow Testing/Certification	EA	$ 105
Well Installation Unit Costs	**Unit**	**Unit Cost**
Well installation	See alternative	
Water quality testing	EA	$ 1,280
5HP Well Pump	EA	$ 2,750
Well electrical/instrumentation	EA	$ 5,635
Well cover and base	EA	$ 3,075
Piping	EA	$ 3,075
10,000 gal ground storage tank	EA	$ 15,000
Electrical Power	$/kWH	$ 0.038
Building Power	kWH	11,800
Labor	$/hr	$ 60
Materials	EA	$ 1,540
Transmission main O&M	$/mile	$ 275
Tank O&M	EA	$ 1,025
POU/POE Unit Costs		
POU treatment unit purchase	EA	$ 615
POU treatment unit installation	EA	$ 155
POE treatment unit purchase	EA	$ 5,125
POE - pad and shed, per unit	EA	$ 2,050
POE - piping connection, per unit	EA	$ 1,025
POE - electrical hook-up, per unit	EA	$ 1,025
POU Treatment O&M, per unit	$/year	$ 230
POE Treatment O&M, per unit	$/year	$ 1,540
Treatment analysis	$/year	$ 205
POU/POE labor support	$/hr	$ 40
Dispenser/Bottled Water Unit Costs		
POE-Treatment unit purchase	EA	$ 7,175
POE-Treatment unit installation	EA	$ 5,125
Treatment unit O&M	EA	$ 2,050
Administrative labor	hr	$ 45
Bottled water cost (inc. delivery)	gallon	$ 1.25
Water use, per capita per day	gpcd	1.0
Bottled water program materials	EA	$ 5,125
5,000 gal ground storage tank	EA	$ 10,000
Site improvements	EA	$ 3,075
Potable water truck	EA	$ 75,000
Water analysis, per sample	EA	$ 205
Potable water truck O&M costs	$/mile	$ 3.00

Central Treatment Unit Costs	**Unit**	**Unit Cost**
General		
Site preparation	acre	$ 4,000
Slab	CY	$ 1,000
Building	SF	$ 60
Building electrical	SF	$ 8.00
Building plumbing	SF	$ 8.00
Heating and ventilation	SF	$ 7.00
Fence	LF	$ 15
Paving	SF	$ 2.00
General O&M		
Building power	kwh/yr	$ 0.038
Equipment power	kwh/yr	$ 0.038
Labor, O&M	hr	$ 40
Analyses	test	$ 200
Reject Pond		
Reject pond, excavation	CYD	$ 3
Reject pond, compacted fill	CYD	$ 7
Reject pond, lining	SF	$ 1.50
Reject pond, vegetation	SY	$ 1.50
Reject pond, access road	LF	$ 30
Reject water haulage truck	EA	$ 100,000
Reverse Osmosis		
Electrical	JOB	$ 40,000
Piping	JOB	$ 20,000
RO package plant	UNIT	$ 152,000
Transfer pumps (5 hp)	EA	$ 5,000
Permeate tank	gal	$ 3
RO materials and chemicals	kgal	$ 0.75
RO chemicals	year	$ 2,000
Backwash disposal mileage cost	miles	$ 1.50
Backwash disposal fee	1,000 gal/yr	$ 5.00
EDR		
Electrical	JOB	$ 50,000
Piping	JOB	$ 20,000
Product storage tank	gal	$ 3.00
EDR package plant	UNIT	$ 197,000
EDR materials- maintenance	kgal	$ 0.58
EDR chemicals	kgal	$ 0.40
Backwash disposal mileage cost	miles	$ 1.50
Backwash disposal fee	1,000 gal/yr	$ 5.00
Transfer pumps (5 hp)	EA	$ 5,000

APPENDIX C
COMPLIANCE ALTERNATIVE CONCEPTUAL COST ESTIMATES

This appendix presents the conceptual cost estimates developed for the compliance alternatives. The conceptual cost estimates are given in Tables C.1 through C.12. The cost estimates are conceptual in nature (+50%/-30%), and are intended for making comparisons between compliance options and to provide a preliminary indication of possible water rate impacts. Consequently, these costs are pre-planning level and should not be viewed as final estimated costs for alternative implementation.

Table C.1

PWS Name *City Of Wellman*
Alternative Name *Purchase Water from City of Brownfield*
Alternative Number *WM-1*

Distance from Alternative to PWS (along pipe)		11.4	miles
Total PWS annual water usage		10.950	MG
Treated water purchase cost	$	2.30	per 1,000 gals
Pump Stations needed w/ 1 feed tank each		1	
On site storage tanks / pump sets needed		1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	2	n/a	n/a	n/a
Number of Crossings, open cut	11	n/a	n/a	n/a
PVC water line, Class 200, 04"	60,097	LF	$ 12	$ 721,164
Bore and encasement, 10"	400	LF	$ 240	$ 96,000
Open cut and encasement, 10"	550	LF	$ 130	$ 71,500
Gate valve and box, 04"	12	EA	$ 710	$ 8,534
Air valve	16	EA	$ 2,050	$ 32,800
Flush valve	12	EA	$ 1,025	$ 12,320
Metal detectable tape	60,097	LF	$ 2	$ 120,194
Subtotal				**$ 1,062,512**
Pump Station(s) Installation				
Pump	4	EA	$ 8,000	$ 32,000
Pump Station Piping, 04"	2	EA	$ 550	$ 1,100
Gate valve, 04"	8	EA	$ 710	$ 5,680
Check valve, 04"	4	EA	$ 755	$ 3,020
Electrical/Instrumentation	2	EA	$ 10,250	$ 20,500
Site work	2	EA	$ 2,560	$ 5,120
Building pad	2	EA	$ 5,125	$ 10,250
Pump Building	2	EA	$ 10,250	$ 20,500
Fence	2	EA	$ 6,150	$ 12,300
Tools	2	EA	$ 1,025	$ 2,050
5,000 gal feed tank	1	EA	$ 10,000	$ 10,000
10,000 gal ground storage tank	1	EA	$ 15,000	$ 15,000
Backflow Preventor	-	EA	$ 2,295	$ -
Subtotal				**$ 137,520**
Subtotal of Component Costs				**$ 1,200,032**
Contingency	20%			$ 240,006
Design & Constr Management	25%			$ 300,008
TOTAL CAPITAL COSTS				**$ 1,740,046**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	11.4	mile	$ 275	$ 3,130
Subtotal				**$ 3,130**
Water Purchase Cost				
From PWS	10,950	1,000 gal	$ 2.30	$ 25,185
Subtotal				**$ 25,185**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.038	$ 897
Pump Power	17,296	kWH	$ 0.038	$ 657
Materials	2	EA	$ 1,540	$ 3,080
Labor	730	Hrs	$ 60.00	$ 43,800
Tank O&M	1	EA	$ 1,025	$ 1,025
Backflow Test/Cert	-	EA	$ 105	$ -
Subtotal				**$ 49,459**
O&M Credit for Existing Well Closure				
Pump power	4,157	kWH	$ 0.038	$ (158)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (24,838)**
TOTAL ANNUAL O&M COSTS				**$ 52,936**

Table C.2

PWS Name	***City Of Wellman***
Alternative Name	***Purchase Water from Denver City***
Alternative Number	***WM-2***

Distance from Alternative to PWS (along pipe)		24.9	miles
Total PWS annual water usage		10.950	MG
Treated water purchase cost	$	1.75	per 1,000 gals
Pump Stations needed w/ 1 feed tank each		1	
On site storage tanks / pump sets needed		1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	2	n/a	n/a	n/a
Number of Crossings, open cut	30	n/a	n/a	n/a
PVC water line, Class 200, 04"	131,245	LF	$ 12	$ 1,574,940
Bore and encasement, 10"	400	LF	$ 240	$ 96,000
Open cut and encasement, 10"	1,500	LF	$ 130	$ 195,000
Gate valve and box, 04"	26	EA	$ 710	$ 18,637
Air valve	48	EA	$ 2,050	$ 98,400
Flush valve	26	EA	$ 1,025	$ 26,905
Metal detectable tape	131,245	LF	$ 2	$ 262,490
Subtotal				**$ 2,272,372**
Pump Station(s) Installation				
Pump	4	EA	$ 8,000	$ 32,000
Pump Station Piping, 04"	2	EA	$ 550	$ 1,100
Gate valve, 04"	8	EA	$ 710	$ 5,680
Check valve, 04"	4	EA	$ 755	$ 3,020
Electrical/Instrumentation	2	EA	$ 10,250	$ 20,500
Site work	2	EA	$ 2,560	$ 5,120
Building pad	2	EA	$ 5,125	$ 10,250
Pump Building	2	EA	$ 10,250	$ 20,500
Fence	2	EA	$ 6,150	$ 12,300
Tools	2	EA	$ 1,025	$ 2,050
5,000 gal feed tank	1	EA	$ 10,000	$ 10,000
10,000 gal ground storage tank	1	EA	$ 15,000	$ 15,000
Backflow Preventor	-	EA	$ 2,295	$ -
Subtotal				**$ 137,520**
Subtotal of Component Costs				**$ 2,409,892**
Contingency	20%			$ 481,978
Design & Constr Management	25%			$ 602,473
TOTAL CAPITAL COSTS				**$ 3,494,343**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	24.9	mile	$ 275	$ 6,836
Subtotal				**$ 6,836**
Water Purchase Cost				
From PWS	10,950	1,000 gal	$ 1.75	$ 19,163
Subtotal				**$ 19,163**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.038	$ 897
Pump Power	20,409	kWH	$ 0.038	$ 776
Materials	2	EA	$ 1,540	$ 3,080
Labor	730	Hrs	$ 60.00	$ 43,800
Tank O&M	1	EA	$ 1,025	$ 1,025
Backflow Test/Cert	0	EA	$ 105	$ -
Subtotal				**$ 49,577**
O&M Credit for Existing Well Closure				
Pump power	4,157	kWH	$ 0.038	$ (158)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (24,838)**
TOTAL ANNUAL O&M COSTS				**$ 50,738**

Table C.3

PWS Name *City Of Wellman*
Alternative Name *New Well at 10 Miles*
Alternative Number *WM-3*

Distance from PWS to new well location	10.0	miles
Estimated well depth	300	feet
Number of wells required	1	
Well installation cost (location specific)	$150.5	per foot
Pump Stations needed w/ 1 feed tank each	1	
On site storage tanks / pump sets needed	1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	1	n/a	n/a	n/a
Number of Crossings, open cut	11	n/a	n/a	n/a
PVC water line, Class 200, 04"	52,800	LF	$ 12	$ 633,600
Bore and encasement, 10"	200	LF	$ 240	$ 48,000
Open cut and encasement, 10"	550	LF	$ 130	$ 71,500
Gate valve and box, 04"	11	EA	$ 710	$ 7,498
Air valve	18	EA	$ 2,050	$ 36,900
Flush valve	11	EA	$ 1,025	$ 10,824
Metal detectable tape	52,800	LF	$ 2	$ 105,600
Subtotal				**$ 913,922**
Pump Station(s) Installation				
Pump	4	EA	$ 8,000	$ 32,000
Pump Station Piping, 04"	2	EA	$ 550	$ 1,100
Gate valve, 04"	8	EA	$ 710	$ 5,680
Check valve, 04"	4	EA	$ 755	$ 3,020
Electrical/Instrumentation	2	EA	$ 10,250	$ 20,500
Site work	2	EA	$ 2,560	$ 5,120
Building pad	2	EA	$ 5,125	$ 10,250
Pump Building	2	EA	$ 10,250	$ 20,500
Fence	2	EA	$ 6,150	$ 12,300
Tools	2	EA	$ 1,025	$ 2,050
5,000 gal feed tank	1	EA	$ 10,000	$ 10,000
10,000 gal ground storage tank	1	EA	$ 15,000	$ 15,000
Subtotal				**$ 137,520**
Well Installation				
Well installation	300	LF	$ 150.5	$ 45,150
Water quality testing	2	EA	$ 1,280	$ 2,560
Well pump	1	EA	$ 2,750	$ 2,750
Well electrical/instrumentation	1	EA	$ 5,635	$ 5,635
Well cover and base	1	EA	$ 3,075	$ 3,075
Piping	1	EA	$ 3,075	$ 3,075
Subtotal				**$ 62,245**
Subtotal of Component Costs				**$ 1,113,687**
Contingency	20%			$ 222,737
Design & Constr Management	25%			$ 278,422
TOTAL CAPITAL COSTS				**$ 1,614,846**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	10.0	mile	$ 275	$ 2,750
Subtotal				**$ 2,750**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.038	$ 897
Pump Power	10,405	kWH	$ 0.038	$ 395
Materials	2	EA	$ 1,540	$ 3,080
Labor	730	Hrs	$ 60.00	$ 43,800
Tank O&M	1	EA	$ 1,025	$ 1,025
Subtotal				**$ 49,197**
Well O&M				
Pump power	8,089	kWH	$ 0.038	$ 307
Well O&M matl	1	EA	$ 1,540	$ 1,540
Well O&M labor	180	Hrs	$ 60	$ 10,800
Subtotal				**$ 12,647**
O&M Credit for Existing Well Closure				
Pump power	4,157	kWH	$ 0.038	$ (158)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (24,838)**
TOTAL ANNUAL O&M COSTS				**$ 39,757**

Table C.4

PWS Name *City Of Wellman*
Alternative Name *New Well at 5 Miles*
Alternative Number *WM-4*

Distance from PWS to new well location	5.0	miles
Estimated well depth	300	feet
Number of wells required	1	
Well installation cost (location specific)	$ 150.5	per foot
Pump Stations needed w/ 1 feed tank each	1	
On site storage tanks / pump sets needed	1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	1	n/a	n/a	n/a
Number of Crossings, open cut	6	n/a	n/a	n/a
PVC water line, Class 200, 04"	26,400	LF	$ 12	$ 316,800
Bore and encasement, 10"	200	LF	$ 240	$ 48,000
Open cut and encasement, 10"	300	LF	$ 130	$ 39,000
Gate valve and box, 04"	5	EA	$ 710	$ 3,749
Air valve	9	EA	$ 2,050	$ 18,450
Flush valve	5	EA	$ 1,025	$ 5,412
Metal detectable tape	26,400	LF	$ 2	$ 52,800
Subtotal				**$ 484,211**
Pump Station(s) Installation				
Pump	4	EA	$ 8,000	$ 32,000
Pump Station Piping, 04"	2	EA	$ 550	$ 1,100
Gate valve, 04"	8	EA	$ 710	$ 5,680
Check valve, 04"	4	EA	$ 755	$ 3,020
Electrical/Instrumentation	2	EA	$ 10,250	$ 20,500
Site work	2	EA	$ 2,560	$ 5,120
Building pad	2	EA	$ 5,125	$ 10,250
Pump Building	2	EA	$ 10,250	$ 20,500
Fence	2	EA	$ 6,150	$ 12,300
Tools	2	EA	$ 1,025	$ 2,050
5,000 gal feed tank	1	EA	$ 10,000	$ 10,000
10,000 gal ground storage tank	1	EA	$ 15,000	$ 15,000
Subtotal				**$ 137,520**
Well Installation				
Well installation	300	LF	$ 150.5	$ 45,150
Water quality testing	2	EA	$ 1,280	$ 2,560
Well pump	1	EA	$ 2,750	$ 2,750
Well electrical/instrumentation	1	EA	$ 5,635	$ 5,635
Well cover and base	1	EA	$ 3,075	$ 3,075
Piping	1	EA	$ 3,075	$ 3,075
Subtotal				**$ 62,245**
Subtotal of Component Costs				**$ 683,976**
Contingency	20%			$ 136,795
Design & Constr Management	25%			$ 170,994
TOTAL CAPITAL COSTS				**$ 991,765**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline O&M				
Pipeline O&M	5.0	mile	$ 275	$ 1,375
Subtotal				**$ 1,375**
Pump Station(s) O&M				
Building Power	23,600	kWH	$ 0.038	$ 897
Pump Power	5,202	kWH	$ 0.038	$ 198
Materials	2	EA	$ 1,540	$ 3,080
Labor	730	Hrs	$ 60.00	$ 43,800
Tank O&M	1	EA	$ 1,025	$ 1,025
Subtotal				**$ 48,999**
Well O&M				
Pump power	8,089	kWH	$ 0.038	$ 307
Well O&M matl	1	EA	$ 1,540	$ 1,540
Well O&M labor	180	Hrs	$ 60	$ 10,800
Subtotal				**$ 12,647**
O&M Credit for Existing Well Closure				
Pump power	4,157	kWH	$ 0.038	$ (158)
Well O&M matl	2	EA	$ 1,540	$ (3,080)
Well O&M labor	360	Hrs	$ 60	$ (21,600)
Subtotal				**$ (24,838)**
TOTAL ANNUAL O&M COSTS				**$ 38,184**

Table C.5

PWS Name ***City Of Wellman***
Alternative Name ***New Well at 1 Mile***
Alternative Number ***WM-5***

Distance from PWS to new well location		1.0	miles
Estimated well depth		300	feet
Number of wells required		1	
Well installation cost (location specific)	$	150.5	per foot
Pump Stations needed w/ 1 feed tank each		0	
On site storage tanks / pump sets needed		1	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost		Total Cost	
Pipeline Construction						
Number of Crossings, bore	-	n/a	n/a		n/a	
Number of Crossings, open cut	1	n/a	n/a		n/a	
PVC water line, Class 200, 04"	5,280	LF	$	12	$	63,360
Bore and encasement, 10"	-	LF	$	240	$	-
Open cut and encasement, 10"	50	LF	$	130	$	6,500
Gate valve and box, 04"	1	EA	$	710	$	750
Air valve	2	EA	$	2,050	$	4,100
Flush valve	1	EA	$	1,025	$	1,082
Metal detectable tape	5,280	LF	$	2	$	10,560
Subtotal					**$**	**86,352**
Pump Station(s) Installation						
Pump	2	EA	$	8,000	$	16,000
Pump Station Piping, 04"	1	EA	$	550	$	550
Gate valve, 04"	4	EA	$	710	$	2,840
Check valve, 04"	2	EA	$	755	$	1,510
Electrical/Instrumentation	1	EA	$	10,250	$	10,250
Site work	1	EA	$	2,560	$	2,560
Building pad	1	EA	$	5,125	$	5,125
Pump Building	1	EA	$	10,250	$	10,250
Fence	1	EA	$	6,150	$	6,150
Tools	1	EA	$	1,025	$	1,025
5,000 gal feed tank	-	EA	$	10,000	$	-
10,000 gal ground storage tank	1	EA	$	15,000	$	15,000
Subtotal					**$**	**71,260**
Well Installation						
Well installation	300	LF	$	150.5	$	45,150
Water quality testing	2	EA	$	1,280	$	2,560
Well pump	1	EA	$	2,750	$	2,750
Well electrical/instrumentation	1	EA	$	5,635	$	5,635
Well cover and base	1	EA	$	3,075	$	3,075
Piping	1	EA	$	3,075	$	3,075
Subtotal					**$**	**62,245**
Subtotal of Component Costs					**$**	**219,857**
Contingency	20%				$	43,971
Design & Constr Management	25%				$	54,964
TOTAL CAPITAL COSTS					**$**	**318,793**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost		Total Cost	
Pipeline O&M						
Pipeline O&M	1.0	mile	$	275	$	275
Subtotal					**$**	**275**
Pump Station(s) O&M						
Building Power	11,800	kWH	$	0.038	$	448
Pump Power	-	kWH	$	0.038	$	-
Materials	1	EA	$	1,540	$	1,540
Labor	365	Hrs	$	60.00	$	21,900
Tank O&M	1	EA	$	1,025	$	1,025
Subtotal					**$**	**24,913**
Well O&M						
Pump power	8,089	kWH	$	0.038	$	307
Well O&M matl	1	EA	$	1,540	$	1,540
Well O&M labor	180	Hrs	$	60	$	10,800
Subtotal					**$**	**12,647**
O&M Credit for Existing Well Closure						
Pump power	4,157	kWH	$	0.038	$	(158)
Well O&M matl	2	EA	$	1,540	$	(3,080)
Well O&M labor	360	Hrs	$	60	$	(21,600)
Subtotal					**$**	**(24,838)**
TOTAL ANNUAL O&M COSTS					**$**	**12,998**

Table C.6

PWS Name *City Of Wellman*
Alternative Name *Central Treatment - Reverse Osmosis*
Alternative Number *WM-6*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit Purchase/Installation				
Site preparation	0.60	acre	$ 4,000	$ 2,400
Slab	38	CY	$ 1,000	$ 37,500
Building	750	SF	$ 60	$ 45,000
Building electrical	750	SF	$ 8	$ 6,000
Building plumbing	750	SF	$ 8	$ 6,000
Heating and ventilation	750	SF	$ 7	$ 5,250
Fence	500	LF	$ 15	$ 7,500
Paving	3,500	SF	$ 2	$ 7,000
Electrical	1	JOB	$ 40,000	$ 40,000
Piping	1	JOB	$ 20,000	$ 20,000
Reverse osmosis package including:				
High pressure pumps - 20 hp				
Cartridge filters and vessels				
RO membranes and vessels				
Control system				
Chemical feed systems				
Freight cost				
Vendor start-up services	1	UNIT	$ 152,000	$ 152,000
Transfer pumps	4	EA	$ 5,000	$ 20,000
Permeate tank	5,000	gal	$ 3	$ 15,000
Feed Tank	7,500	gal	$ 3	$ 22,500
Brine Pipeline to Sewer	1	EA	$ 25,000	$ 25,000
Subtotal of Design/Construction Costs				**$ 411,150**
Contingency	20%			$ 82,230
Design & Constr Management	25%			$ 102,788
TOTAL CAPITAL COSTS				**$ 596,168**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit O&M				
Building Power	7,000	kwh/yr	$ 0.038	$ 266
Equipment power	84,000	kwh/yr	$ 0.038	$ 3,192
Labor	1,000	hrs/yr	$ 40.00	$ 40,000
RO materials and Chemicals	13,900	kgal	$ 0.75	$ 10,425
Analyses	24	test	$ 200	$ 4,800
Subtotal				**$ 58,683**
Backwash Disposal				
Backwash disposal fee	4,625	kgal/yr	$ 5.00	$ 23,126
Subtotal				**$ 23,126**
TOTAL ANNUAL O&M COSTS				**$ 81,809**

Table C.7

PWS Name *City Of Wellman*
Alternative Name *Central Treatment - Electro-dialysis Reversal*
Alternative Number *WM-7*

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Reverse Osmosis Unit Purchase/Installation				
Site preparation	0.50	acre	$ 4,000	$ 2,000
Slab	31	CY	$ 1,000	$ 31,250
Building	625	SF	$ 60	$ 37,500
Building electrical	625	SF	$ 8	$ 5,000
Building plumbing	625	SF	$ 8	$ 5,000
Heating and ventilation	625	SF	$ 7	$ 4,375
Fence	500	LF	$ 15	$ 7,500
Paving	3,000	SF	$ 2	$ 6,000
Electrical	1	JOB	$ 50,000	$ 50,000
Piping	1	JOB	$ 20,000	$ 20,000
EDR package including:				
Feed and concentrate pumps				
Cartridge filters and vessels				
EDR membrane stacks				
Electrical module				
Chemical feed systems				
Freight cost				
Vendor start-up services	1	UNIT	$ 197,000	$ 197,000
Transfer pumps	4	EA	$ 5,000	$ 20,000
Permeate tank	5,000	gal	$ 3.00	$ 15,000
Feed Tank	7,500	gal	$ 3.00	$ 22,500
Brine Pipeline to Sewer	1	EA	$ 25,000	$ 25,000
Subtotal of Design/Construction Costs				**$ 448,125**
Contingency	20%			$ 89,625
Design & Constr Management	25%			$ 112,031
TOTAL CAPITAL COSTS				**$ 649,781**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
EDR Unit O&M				
Building Power	5,500	kwh/yr	$ 0.038	$ 209
Equipment power	107,000	kwh/yr	$ 0.038	$ 4,066
Labor	1,000	hrs/yr	$ 40.00	$ 40,000
Materials - maintenance	13,900	kgal	$ 0.58	$ 8,062
Chemicals	13,900	kgal	$ 0.40	$ 5,560
Analyses	24	test	$ 200	$ 4,800
Subtotal				**$ 62,697**
Backwash Disposal				
Backwash disposal fee	3,469	kgal/yr	$ 5.00	$ 17,345
Subtotal				**$ 17,345**
TOTAL ANNUAL O&M COSTS				**$ 80,042**

Table C.8

PWS Name *City Of Wellman*
Alternative Name *Point-of-Use Treatment*
Alternative Number *WM-8*

Number of Connections for POU Unit Installation 97 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
POU-Treatment - Purchase/Installation				
POU treatment unit purchase	97	EA	$ 615	$ 59,655
POU treatment unit installation	97	EA	$ 155	$ 15,035
Subtotal				**$ 74,690**
Subtotal of Component Costs				**$ 74,690**
Contingency	20%			$ 14,938
Design & Constr Management	25%			$ 18,673
Procurement & Administration	20%			$ 14,938
TOTAL CAPITAL COSTS				**$ 123,239**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
O&M				
POU materials, per unit	97	EA	$ 230	$ 22,310
Contaminant analysis, 1/yr per unit	97	EA	$ 205	$ 19,885
Program labor, 10 hrs/unit	970	hrs	$ 40	$ 38,800
Subtotal				**$ 80,995**
TOTAL ANNUAL O&M COSTS				**$ 80,995**

Table C.9

PWS Name — ***City Of Wellman***
Alternative Name — ***Point-of-Entry Treatment***
Alternative Number — ***WM-9***

Number of Connections for POE Unit Installation 97 connections

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
POE-Treatment - Purchase/Installat				
POE treatment unit purchase	97	EA	$ 5,125	$ 497,125
Pad and shed, per unit	97	EA	$ 2,050	$ 198,850
Piping connection, per unit	97	EA	$ 1,025	$ 99,425
Electrical hook-up, per unit	97	EA	$ 1,025	$ 99,425
Subtotal				**$ 894,825**
Subtotal of Component Costs				**$ 894,825**
Contingency	20%			$ 178,965
Design & Constr Management	25%			$ 223,706
Procurement & Administration	20%			$ 178,965
TOTAL CAPITAL COSTS				**$ 1,476,461**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
O&M				
POE materials, per unit	97	EA	$ 1,540	$ 149,380
Contaminant analysis, 1/yr per unit	97	EA	$ 205	$ 19,885
Program labor, 10 hrs/unit	970	hrs	$ 40	$ 38,800
Subtotal				**$ 208,065**
TOTAL ANNUAL O&M COSTS				**$ 208,065**

Table C.10

PWS Name ***City Of Wellman***
Alternative Name ***Public Dispenser for Treated Drinking Water***
Alternative Number ***WM-10***

Number of Treatment Units Recommended 1

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Public Dispenser Unit Installation				
POE-Treatment unit(s)	1	EA	$ 7,175	$ 7,175
Unit installation costs	1	EA	$ 5,125	$ 5,125
Subtotal				**$ 12,300**
Subtotal of Component Costs				**$ 12,300**
Contingency	20%			$ 2,460
Design & Constr Management	25%			$ 3,075
TOTAL CAPITAL COSTS				**17,835**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Treatment unit O&M, 1 per unit	1	EA	$ 2,050	$ 2,050
Contaminant analysis, 1/wk per ur	52	EA	$ 205	$ 10,660
Sampling/reporting, 1 hr/day	365	HRS	$ 60	$ 21,900
Subtotal				**$ 34,610**
TOTAL ANNUAL O&M COSTS				**$ 34,610**

Table C.11

PWS Name *City Of Wellman*
Alternative Name *Supply Bottled Water to 100% of Population*
Alternative Number *WM-11*

Service Population	225	
Percentage of population requiring supply	100%	
Water consumption per person	1.00	gpcd
Calculated annual potable water needs	82,125	gallons

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Implementation				
Initial program set-up	500	hours	$ 45	$ 22,500
Subtotal				**$ 22,500**
Subtotal of Component Costs				**$ 22,500**
Contingency	20%			$ 4,500
TOTAL CAPITAL COSTS				**$ 27,000**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Water purchase costs	82,125	gals	$ 1.25	$ 102,656
Program admin, 9 hrs/wk	468	hours	$ 45	$ 21,060
Program materials	1	EA	$ 5,125	$ 5,125
Subtotal				**$ 128,841**
TOTAL ANNUAL O&M COSTS				**$ 128,841**

Table C.12

PWS Name	***City Of Wellman***
Alternative Name	***Central Trucked Drinking Water***
Alternative Number	***WM-12***

Service Population	225	
Percentage of population requiring supply	100%	
Water consumption per person	1.00	gpcd
Calculated annual potable water needs	82,125	gallons
Travel distance to compliant water source	11	miles

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Storage Tank Installation				
5,000 gal ground storage tank	1	EA	$ 10,000	$ 10,000
Site improvements	1	EA	$ 3,075	$ 3,075
Potable water truck	1	EA	$ 75,000	$ 75,000
Subtotal				**$ 88,075**
Subtotal of Component Costs				**$ 88,075**
Contingency	20%			$ 17,615
Design & Constr Management	25%			$ 22,019
TOTAL CAPITAL COSTS				**$ 127,709**

Annual Operations and Maintenance Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Program Operation				
Water delivery labor, 4 hrs/wk	208	hrs	$ 60	$ 12,480
Truck operation, 1 round trip/wk	1,186	miles	$ 3.00	$ 3,557
Water purchase	82	1,000 gals	$ 2.30	$ 189
Water testing, 1 test/wk	52	EA	$ 205	$ 10,660
Sampling/reporting, 2 hrs/wk	104	hrs	$ 60	$ 6,240
Subtotal				**$ 33,126**
TOTAL ANNUAL O&M COSTS				**$ 33,126**

APPENDIX D
EXAMPLE FINANCIAL MODEL

City of Wellman

Number of Alternatives 12 Selected from Results Sheet

Input Fields are Indicated by:

General Inputs		
Implementation Year	2009	
Months of Working Capital	0	
Depreciation	$ -	
Percent of Depreciation for Replacement Fund	0%	
Allow Negative Cash Balance (yes or no)	No	
Median Household Income	$ 27,614	City of Wellman
Median HH Income -- Texas	$ 39,927	
Grant Funded Percentage	0%	Selected from Results
Capital Funded from Revenues	$ -	

	Base Year Growth/Escalation	2007
Accounts & Consumption		
Metered Residential Accounts		
Number of Accounts	0.0%	97
Number of Bills Per Year		12
Annual Billed Consumption		10,950,000
Consumption per Account Per Pay Period	0.0%	9,407
Consumption Allowance in Rates		-
Total Allowance		-
Net Consumption Billed		10,950,000
Percentage Collected		100.0%
Unmetered Residential Accounts		
Number of Accounts	0.0%	0
Number of Bills Per Year		12
Percentage Collected		100.0%
Metered Non-Residential Accounts		
Number of Accounts	0.0%	0
Number of Bills Per Year		12
Non-Residential Consumption		-
Consumption per Account	0.0%	-
Consumption Allowance in Rates		-
Total Allowance		-
Net Consumption Billed		-
Percentage Collected		0.0%
Unmetered Non-Residential Accounts		
Number of Accounts	0.0%	0
Number of Bills Per Year		12
Percentage Collected		100.0%
Water Purchase & Production		
Water Purchased (gallons)	0.0%	-
Average Cost Per Unit Purchased	0.0%	$ -
Bulk Water Purchases	0.0%	$ -
Water Production	0.0%	10,950,000
Unaccounted for Water		-
Percentage Unaccounted for Water		0.0%

City of Wellman

Number of Alternatives	12	Selected from Results Sheet
Input Fields are Indicated by:		

Residential Rate Structure	Allowance within Tier	
	-	
Estimated Average Water Rate ($/1000gallons)		$ 4.11
Non-Residential Rate Structure		
	-	
Estimated Average Water Rate ($/1000gallons)		$ 4.11
INITIAL YEAR EXPENDITURES	Inflation	Initial Year
Operating Expenditures:		
Salaries & Benefits	0.0%	-
Contract Labor	0.0%	-
Water Purchases	0.0%	-
Chemicals, Treatment	0.0%	-
Utilities	0.0%	-
Repairs, Maintenance, Supplies	0.0%	-
Repairs	0.0%	-
Maintenance	0.0%	-
Supplies	0.0%	-
Administrative Expenses	0.0%	
Accounting and Legal Fees	0.0%	-
Insurance	0.0%	-
Automotive and Travel	0.0%	-
Professional and Directors Fees	0.0%	-
Bad Debts	0.0%	-
Garbage Pick-up	0.0%	-
Miscellaneous	0.0%	-
Other 3	0.0%	34,586
Other 4	0.0%	-
Incremental O&M for Alternative	0.0%	-
Total Operating Expenses		34,586
Non-Operating Income/Expenditures		
Interest Income	0.0%	-
Other Income	0.0%	6,124
Other Expense	0.0%	-
Transfers In (Out)	0.0%	-
Net Non-Operating		6,124

Esisting Debt Service		
Bonds Payable, Less Current Maturities		$ -
Bonds Payable, Current		$ -
Interest Expense		$ -

Debt Service for City of Wellman
Alternative Number = 12
Funding Source = Loan/Bond

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Existing Debt Service	$ -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal Payments		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest Payment	0.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term	25																															
Revenue Bonds		-	-	127,709	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%	-	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	127,709	125,381	122,914	120,298	117,526	114,587	111,472	108,171	104,671	100,960	97,028	92,859	88,441	83,757	78,792	73,529	67,951	62,037	55,769	49,125	42,083	34,617	26,704	18,316	9,425	0	0	0	0
Principal		-	-	2,328	2,467	2,615	2,772	2,939	3,115	3,302	3,500	3,710	3,933	4,169	4,419	4,684	4,965	5,263	5,579	5,913	6,268	6,644	7,043	7,465	7,913	8,388	8,891	9,425	-	-	-	-
Interest	6.00%	-	-	7,663	7,523	7,375	7,218	7,052	6,875	6,688	6,490	6,280	6,058	5,822	5,572	5,306	5,025	4,728	4,412	4,077	3,722	3,346	2,948	2,525	2,077	1,602	1,099	0	0	0	0	0
Total Debt Service		-	-	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,425	0	0	0	0
New Balance		-	-	125,381	122,914	120,298	117,526	114,587	111,472	108,171	104,671	100,960	97,028	92,859	88,441	83,757	78,792	73,529	67,951	62,037	55,769	49,125	42,083	34,617	26,704	18,316	9,425	0	0	0	0	0
Term	20																															
State Revolving Fund		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%	-	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	0.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term	10																															
Bank/Interfund Loan				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%	-	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	8.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term	25																															
RUS Loan			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forgiveness	0.00%		-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Principal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest	5.00%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New Balance		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cashflow Projections for City of Wellman
Alternative Number = 12
Funding Source = Loan/Bond

Estimated At Sept. 30 of Each Year

	Growth/ Escalation	2007 0	2008 1	2009 2	2010 3	2011 4	2012 5	2013 6	2014 7	2015 8	2016 9	2017 10	2018 11	2019 12	2020 13	2021 14	2022 15
CASH FLOW PROJECTIONS																	
Beginning Unrestricted Cash Balance		$ -	16,541	16,541	6,551	0	0	0	0	0	0	0	0	0	0	0	0
RECEIPTS																	
Operating Revenues																	
Water Base Rate-- Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 1 -- Res	100,000	45,003	45,003	45,003	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578
Water: Tier 2 -- Res	100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 3 -- Res	200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 4 -- Res	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unmetered Residential		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Base Rate - Non Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 1 -- NR	100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 2 -- NR	100,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 3 -- NR	200,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 4 -- NR	300,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unmetered Non Residential		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sewer Sales		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Operating Revenues		$ 45,003	$ 45,003	$ 45,003	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578
Capital Receipts																	
Grants Received		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SRF Proceeds		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank/Interfund Loan Proceeds		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUS Loan Proceeds		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bond Proceeds		-	-	127,709	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Receipts		-	-	127,709	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Receipts		45,003	45,003	172,712	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578
EXPENDITURES																	
Operating Expenditures:																	
Salaries & Benefits	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contract Labor	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Purchases	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemicals, Treatment	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Utilities	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repairs, Maintenance, Supplies	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repairs	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Supplies	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Administrative Expenses	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Accounting and Legal Fees	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Insurance	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Automotive and Travel	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Professional and Directors Fees	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bad Debts	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Garbage Pick-up	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 3	0.0%	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586
Other 4	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incremental O&M for Alternative	0.0%	-	-	-	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126
Total Operating Expenses		34,586	34,586	34,586	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712
Non-Operating Income/Expenditures																	
Interest Income	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Income	0.0%	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124
Other Expense	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transfers In (Out)	0.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Non-Operating		6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124
Debt Service																	
Existing		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed:																	
Revenue Bonds		-	-	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990
State Revolving Fund		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank Loan		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUS Loan		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service		-	-	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990
Capital Expenditures	$ 127,709																
Funded From Revenues/Reserves	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded From Grants	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded From SRF Loans		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from Bank/Interfund Loans		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from RUS Loan		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from Bonds		-	-	127,709	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Expenditures		-	-	127,709	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Expenditures		28,462	28,462	166,161	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578
What Water Rev Needs to be		(28,462)	(28,462)	(38,452)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)
Water Rate Increase		0.00%	0.00%	0.00%	59.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Net Cash Flow		16,541	16,541	6,551	0	0	0	0	0	0	0	0	0	0	0	0	0
Reserves:																	
Working Capital (Months O&M)	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Replacement Reserve		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Required Reserves		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average Annual Water Bill	$ 738	$ 464	$ 464	$ 464	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738
Median Household Income		$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614
Maximum % of MHI	2.7%	1.7%	1.7%	1.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%
Percentage Rate Increase Compared to Current	59.1%		0.0%	0.0%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%

	2023 16	2024 17	2025 18	2026 19	2027 20	2028 21	2029 22	2030 23	2031 24	2032 25	2033 26	2034 27	2035 28	2036 29	2037 30
CASH FLOW PROJECTIONS															
Beginning Unrestricted Cash Balance	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RECEIPTS															
Operating Revenues															
Water Base Rate-- Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 1 -- Res	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,013	61,588	61,588	61,588	61,588
Water: Tier 2 -- Res	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 3 -- Res	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 4 -- Res	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unmetered Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Base Rate - Non Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 1 -- NR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 2 -- NR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 3 -- NR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water: Tier 4 -- NR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unmetered Non Residential	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sewer Sales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Operating Revenues	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,578	$ 71,013	$ 61,588	$ 61,588	$ 61,588	$ 61,588
Capital Receipts															
Grants Received	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SRF Proceeds	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank/Interfund Loan Proceeds	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUS Loan Proceeds	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bond Proceeds	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Receipts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Receipts	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,013	61,588	61,588	61,588	61,588
EXPENDITURES															
Operating Expenditures:															
Salaries & Benefits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contract Labor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Purchases	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemicals, Treatment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Utilities	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repairs, Maintenance, Supplies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Repairs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Supplies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Administrative Expenses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Accounting and Legal Fees	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Insurance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Automotive and Travel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Professional and Directors Fees	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bad Debts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Garbage Pick-up	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other 3	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586	34,586
Other 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incremental O&M for Alternative	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126	33,126
Total Operating Expenses	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712	67,712
Non-Operating Income/Expenditures															
Interest Income	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Income	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124
Other Expense	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transfers In (Out)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Non-Operating	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124	6,124
Debt Service															
Existing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proposed:															
Revenue Bonds	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,425	0	0	0	0
State Revolving Fund	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank Loan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUS Loan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Debt Service	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,990	9,425	0	0	0	0
Capital Expenditures															
Funded From Revenues/Reserves	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded From Grants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded From SRF Loans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from Bank/Interfund Loans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from RUS Loan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Funded from Bonds	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capital Expenditures	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Expenditures	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,578	71,013	61,588	61,588	61,588	61,588
What Water Rev Needs to be	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,578)	(71,013)	(61,588)	(61,588)	(61,588)	(61,588)
Water Rate Increase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	-0.79%	-13.27%	0.00%	0.00%	0.00%
Net Cash Flow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reserves:															
Working Capital (Months O&M)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Replacement Reserve	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Required Reserves	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average Annual Water Bill	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 738	$ 732	$ 635	$ 635	$ 635	$ 635
Median Household Income	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614	$ 27,614
Maximum % of MHI	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.3%	2.3%	2.3%	2.3%
Percentage Rate Increase Compared to Current	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	59.1%	57.8%	36.9%	36.9%	36.9%	36.9%

APPENDIX E
CONCEPTUAL ANALYSIS OF INCREASING COMPLIANT DRINKING WATER

E.1 Introduction

E.1.1 Overview of Drinking Water Quality in Region

There are many PWSs in the Lubbock area that do not have compliant drinking water due to elevated concentrations of naturally occurring contaminants in the area groundwater. Largely, this is a result of the generally poor water quality associated with the Ogallala-South Formation that is the water source for most of these systems (see Chapter 3 of the report to which this is appended). The common groundwater contaminants in the Ogallala-South Formation include arsenic, selenium, fluoride, nitrate, and uranium.

According to the TCEQ Water Utility Database, there are nearly 24,000 people in the Lubbock area who are served by active residential PWSs that do not currently have compliant drinking water. The majority of this population can be found in the area just outside the City of Lubbock, and also to the south of the city. The total area population with noncompliant drinking water is likely greater than 24,000, since only populations served by active PWSs are included in this estimate. There is additional populations that currently obtain drinking water from private wells or are served by PWSs that have too few connections to be considered active PWSs in the TCEQ Water Utility Database. Additionally, while the issue of noncompliant drinking water affects these area residents directly, the lack of good quality drinking water may restrict growth in the entire Lubbock area.

This appendix presents a conceptual analysis of a possible regional solution to the drinking water compliance issue in the Lubbock area. The purpose of this analysis is to investigate whether a large-scale regional approach to provide compliant drinking water might be more cost-effective than each PWS seeking its own solution. The objective of the analysis is to provide an indication of whether there is sufficient potential benefit to a regional approach to warrant further study. The conceptual analysis presented here is based on a single scenario and does not attempt to evaluate or rank a range of different solutions. For purposes of this report, this single scenario is referred to as the Lubbock Area Regional Solution (LARS).

To improve readability, the tables and figures for this appendix appear in Section E.6.

E.1.2 Evaluation of PWS Drinking Water Quality

Drinking water quality for the PWSs in the eight counties included in and around Lubbock was evaluated using TCEQ PWS drinking water quality data to identify PWSs that had potential water quality compliance issues. There are a number of PWSs that do not serve residential populations, such as restaurants, businesses, *etc*. Since this analysis is focused on residential systems, these commercial systems were excluded from the analysis. Additionally, systems listed as "inactive" were also excluded because it was not easy to determine whether they were listed as inactive because of small size, or are truly inactive.

Once the active residential PWSs were identified, they were screened for the common contaminants in the area: arsenic, selenium, fluoride, nitrate, and uranium. Systems with concentrations of the identified contaminants greater than MCLs were deemed to have noncompliant water. It is important to note that this screening was not an official compliance determination, and a system's compliance status determined from the screening may not coincide with a system's actual compliance status. Discrepancies may result from the data available not being current, the use of simplified algorithms to give an indication of compliance, *etc*.

The PWSs identified with potential water quality compliance issues are shown in Table E.1, along with numbers of connections, the population served, and average daily consumption. For the LARS, the area has been divided into three separate subareas named LARS–Lubbock, LARS-Lamesa, and LARS-Brownfield. The PWSs, population, connections, and average daily consumptions for these subareas are shown in Tables E.2, E.3, and E.4. These systems are also shown in Figure E.1. As can be seen on the figure, these systems are generally located near Lubbock and south of Lubbock.

E.1.3 Existing Drinking Water Supplies and Infrastructure

PWSs in the area typically obtain drinking water from wells, purchase water from the City of Lubbock, or obtain water from the Canadian River Municipal Water Authority (CRMWA), either as one of the 11 member cities or as customers of a member city. The City of Lubbock is a member city of the CRMWA and has the largest water system in the area. As well as getting water from the CRMWA, Lubbock obtains water from its own well field in Bailey County. The CRMWA provides surface water and groundwater via a pipeline from the north to a water treatment plant located at and operated by Lubbock, from which point the treated water is distributed via transmission mains to the seven member cities west and south of Lubbock. There are existing CRMWA pipelines that extend to the southeast and west and southwest from Lubbock. The approximate location and extent of these lines are shown in Figure E.1.

The CRMWA production is fully committed to the 11 member cities. In addition, the transmission mains from Lubbock to the other seven member cities are at capacity during the summer months. Therefore, the LARS scenario proposed here uses new wells for the water source and if existing pipeline infrastructure is used for water transmission, allowances are made to account for any pipeline capacity used.

E.2 Description of the LARS

Since existing water supplies and infrastructure do not have sufficient capacity available, and the existing infrastructure does not cover the entire area projected to be served by the LARS, the LARS needs to provide both a water source and a means of conveyance. To accomplish this, the LARS includes several groundwater treatment plants located near clusters of PWSs with water quality problems. The locations of these treatment plants include one near the existing water treatment plant in Lubbock, one at Lamesa, and one at Brownfield (Figure E.2).

In addition to the groundwater treatment plants, new well fields would also be required to feed the groundwater treatment plants. The assumed water quality used to design each groundwater treatment plant is based on water quality data for PWSs near the proposed plant location. Groundwater treatment will be achieved using RO technology because, of the two technologies best suited for treating contaminants generally found in the water of the Ogallala-South aquifer (RO and EDR), RO is typically the most economical option.

The plant at Lubbock would tie into the Lubbock distribution system. The water would be passed through the Lubbock distribution system, and pipelines would be run from the Lubbock distribution system to the noncompliant PWSs around Lubbock. The location of the treatment plant, required new pipelines, and potential customers for the Lubbock component of the LARS are shown on Figure E.3.

The plant at Lamesa could tie into the Lubbock distribution system at Lamesa or could be independent. If tied into the Lamesa system, it could supplement Lamesa's system to allow the non-compliant PWSs upstream of Lamesa to withdraw water without impacting existing customers between Lamesa and Lubbock. If not tied in, the system could serve PWSs outside the Lamesa area. The location of the treatment plant, required new pipelines, and potential customers for the Lamesa component of the LARS are shown on Figure E.4.

The plant at Brownfield could tie into the Brownfield distribution system at Brownfield or could be independent. If tied into the Brownfield system, it could supplement Lubbock's system to allow the non-compliant PWSs upstream of Brownfield to withdraw water without impacting existing customers between Brownfield and Lubbock. If not tied in, the system could serve PWSs outside the Brownfield area. The location of the treatment plant, required new pipelines, and potential customers for the Brownfield component of the LARS are shown on Figure E.5.

Pipelines could be built to connect the CRMWA lines to the other noncompliant PWSs. In this way, the Lamesa and Brownfield groundwater treatment plants could provide enough drinking water to meet the demands of the systems at the ends of the CRMWA lines to offset water that would be taken out by noncompliant PWSs along the existing CRMWA lines. Connecting pipelines for the groundwater treatment plants and noncompliant PWSs to the existing City of Lubbock and CRMWA pipe systems reduces the need for added infrastructure to implement the regional solution, and would provide operational flexibility.

E.3 Estimated Costs

Costs to implement the LARS were estimated. This includes costs for new wells, pipelines, pump stations, and treatment plants. A conceptual design was developed for the main infrastructure components, and was used as the basis for estimating capital and O&M costs. The estimated capital and O&M costs for the major infrastructure components are summarized in Table E.5. The annualized costs of these components are also shown in

Table E.5, using a 6 percent discount rate and a 20-year period. Details of the capital costs for the three subareas are included in Tables E.6, E.7, and E.8.

Table E.9 presents an estimate of the cost of service to the LARS customers. If the customers were to bear the total capital and operating costs of the systems for their subarea or the system as a whole, the approximate monthly cost per connection would be as follows:

LARS-Lubbock:	$97/month	$1,163/year	3% of MHI
LARS-Lamesa:	$233/month	$2,794/year	7% of MHI
LARS-Brownfield:	$190/month	$2,281/year	6% of MHI
Combined:	$173/month	$2,079/year	5% of MHI

If the systems would be able to get 100 percent grant funding for the capital costs of constructing the system, the approximate monthly cost per connection would be as follows:

LARS-Lubbock:	$43/month	$519/year	1% of MHI
LARS-Lamesa:	$61/month	$732/year	2% of MHI
LARS-Brownfield:	$80/month	$962/year	3% of MHI
Combined:	$61/month	$738/year	2% of MHI

This then forms the approximate range of the cost of service for the customers (per connection) of a regional solution.

Increasing the coverage of the regional solution to include populations served by inactive PWSs or those that have private wells could have the effect of reducing treatment costs on a per gallon basis, but increasing the cost for distribution piping. Likewise, other sources of water with associated quality aspects would affect the cost, including surface water sources, better groundwater sources, and the use of reclaimed water, either for supplemental potable or non-potable uses. A more detailed assessment would be required to determine whether the overall effect would be an increase or decrease on the cost to the customers.

E.4 Conclusion

A regional solution to serving non-compliant PWSs in the Lubbock area presents a potentially viable solution to an existing problem. If suitable groundwater can be found, a regional system could be implemented within a cost per connection range of $61/month to $173/month, with the actual cost depending on the source and costs of capital funds needed to build a regional system.

A Community Development Block Grant is one possible source of funding the capital costs for the regional solution. Community Development Block Grants are discussed further in Attachment E1.

E.5 Tables and Figures

Table E.1
Active Residential Public Water Systems with Potential Water Quality Problems
Lubbock Area Regional Solution

PWS ID #	PWS Name	Population	Connections	Avg. Daily Consumption (mgd)	County
0170010	BORDEN COUNTY WATER SYSTEM	150	98	0.012	BORDEN
0580011	CITY OF ACKERLY	230	126	0.004	DAWSON
0580013	WELCH WATER SUPPLY CORP	354	115	0.035	DAWSON
0580025	KLONDIKE ISD	207	11	0.025	DAWSON
0830001	SEAGRAVES CITY OF	2396	931	0.344	GAINES
0830011	LOOP WATER SUPPLY CORP	300	113	0.040	GAINES
0830012	SEMINOLE CITY OF	5916	2540	1.410	GAINES
0850002	SOUTHLAND ISD	190	4	0.019	GARZA
1100004	ROPESVILLE CITY OF	517	196	0.094	HOCKLEY
1100010	SMYER CITY OF	480	180	0.051	HOCKLEY
1100011	WHITHARRAL WATER SUPPLY CORP	275	82	0.043	HOCKLEY
1100030	OPDYKE WEST WATER SUPPLY	140	63	0.018	HOCKLEY
1520005	WOLFFORTH CITY OF	3000	1150	0.439	LUBBOCK
1520009	BIG Q MOBILE HOME ESTATES	200	70	0.013	LUBBOCK
1520025	BUSTERS MOBILE HOME PARK	20	8	0.002	LUBBOCK
1520026	FAMILY COMMUNITY CENTER MHP	88	40	0.011	LUBBOCK
1520027	WAGON WHEEL MOBILE VILLAGE HOME PR	30	21	0.003	LUBBOCK
1520036	GREEN MOBILE HOME PARK	50	28	0.004	LUBBOCK
1520039	PECAN GROVE MOBILE HOME PARK	100	50	0.008	LUBBOCK
1520062	PLOTT ACRES	201	63	0.019	LUBBOCK
1520067	114TH STREET MOBILE HOME PARK	96	43	0.009	LUBBOCK
1520080	FRANKLIN WATER SERVICE COMPANY	152	64	0.011	LUBBOCK
1520094	TOWN NORTH VILLAGE WATER SYSTEM	330	117	0.031	LUBBOCK
1520106	COX ADDITION WATER SYSTEM	133	40	0.014	LUBBOCK
1520122	LUBBOCK COOPER ISD	1900	14	0.190	LUBBOCK
1520123	ROOSEVELT ISD	1600	11	0.048	LUBBOCK
1520149	WHORTON MOBILE HOME PARK	75	26	0.008	LUBBOCK
1520152	TOWN NORTH ESTATES	227	67	0.015	LUBBOCK
1520154	CHARLIE BROWNS LEARNING CENTER	47	3	0.005	LUBBOCK
1520155	COUNTRY SQUIRE MHP 2	75	16	0.008	LUBBOCK
1520156	ELM GROVE MOBILE HOME PARK	24	20	0.002	LUBBOCK
1520158	MILLER MOBILE HOME PARK	60	33	0.005	LUBBOCK
1520185	LUBBOCK RV PARK	133	100	0.009	LUBBOCK
1520188	CASEY ESTATES WATER	312	104	0.026	LUBBOCK
1520192	TERRELLS MOBILE HOME PARK	50	22	0.005	LUBBOCK
1520198	VALLEY ESTATES	70	36	0.007	LUBBOCK
1520199	WOLFFORTH PLACE	411	137	0.041	LUBBOCK
1520211	TEXIN ENTERPRISES	26	7	0.008	LUBBOCK
1520217	SOUTHWEST GARDEN WATER	375	125	0.028	LUBBOCK
1520223	PAUL COBB WATER SYSTEM	11	10	0.003	LUBBOCK
1520225	FAY BEN MOBILE HOME PARK	90	44	0.007	LUBBOCK
1520241	MANAGED CARE CENTER	40	5	0.003	LUBBOCK
1520247	COUNTRY VIEW MHP	76	23	0.004	LUBBOCK
1530001	ODONNELL CITY OF	1011	364	0.257	LYNN
1530003	WILSON CITY OF	532	212	0.050	LYNN
1530004	NEW HOME CITY OF	375	180	0.044	LYNN
1530005	GRASSLAND WATER SUPPLY CORP	85	27	0.008	LYNN
2230002	MEADOW CITY OF	547	230	0.138	TERRY
2230003	WELLMAN PUBLIC WATER SYSTEM	225	97	0.010	TERRY
	TOTALS	**23,932**	**8,066**	**3.586**	

Table E.2
Public Water Systems associated with LARS-Lubbock Treatment Plant

PWS ID #	PWS Name	Population	Connections	Avg. Daily Consumption (mgd)	County
0850002	SOUTHLAND ISD	190	4	0.019	GARZA
1100010	SMYER CITY OF	480	180	0.051	HOCKLEY
1100011	WHITHARRAL WATER SUPPLY CORP	275	82	0.043	HOCKLEY
1100030	OPDYKE WEST WATER SUPPLY	140	63	0.018	HOCKLEY
1520005	WOLFFORTH CITY OF	3000	1150	0.439	LUBBOCK
1520009	BIG Q MOBILE HOME ESTATES	200	70	0.013	LUBBOCK
1520025	BUSTERS MOBILE HOME PARK	20	8	0.002	LUBBOCK
1520026	FAMILY COMMUNITY CENTER MHP	88	40	0.011	LUBBOCK
1520027	WAGON WHEEL MOBILE VILLAGE HOME PR	30	21	0.003	LUBBOCK
1520036	GREEN MOBILE HOME PARK	50	28	0.004	LUBBOCK
1520039	PECAN GROVE MOBILE HOME PARK	100	50	0.008	LUBBOCK
1520062	PLOTT ACRES	201	63	0.019	LUBBOCK
1520067	114TH STREET MOBILE HOME PARK	96	43	0.009	LUBBOCK
1520080	FRANKLIN WATER SERVICE COMPANY	152	64	0.011	LUBBOCK
1520094	TOWN NORTH VILLAGE WATER SYSTEM	330	117	0.031	LUBBOCK
1520106	COX ADDITION WATER SYSTEM	133	40	0.014	LUBBOCK
1520122	LUBBOCK COOPER ISD	1900	14	0.190	LUBBOCK
1520123	ROOSEVELT ISD	1600	11	0.048	LUBBOCK
1520149	WHORTON MOBILE HOME PARK	75	26	0.008	LUBBOCK
1520152	TOWN NORTH ESTATES	227	67	0.015	LUBBOCK
1520154	CHARLIE BROWNS LEARNING CENTER	47	3	0.005	LUBBOCK
1520155	COUNTRY SQUIRE MHP 2	75	16	0.008	LUBBOCK
1520156	ELM GROVE MOBILE HOME PARK	24	20	0.002	LUBBOCK
1520158	MILLER MOBILE HOME PARK	60	33	0.005	LUBBOCK
1520185	LUBBOCK RV PARK	133	100	0.009	LUBBOCK
1520188	CASEY ESTATES WATER	312	104	0.026	LUBBOCK
1520192	TERRELLS MOBILE HOME PARK	50	22	0.005	LUBBOCK
1520198	VALLEY ESTATES	70	36	0.007	LUBBOCK
1520199	WOLFFORTH PLACE	411	137	0.041	LUBBOCK
1520211	TEXIN ENTERPRISES	26	7	0.008	LUBBOCK
1520217	SOUTHWEST GARDEN WATER	375	125	0.028	LUBBOCK
1520223	PAUL COBB WATER SYSTEM	11	10	0.003	LUBBOCK
1520225	FAY BEN MOBILE HOME PARK	90	44	0.007	LUBBOCK
1520241	MANAGED CARE CENTER	40	5	0.003	LUBBOCK
1520247	COUNTRY VIEW MHP	76	23	0.004	LUBBOCK
1530003	WILSON CITY OF	532	212	0.050	LYNN
1530004	NEW HOME CITY OF	375	180	0.044	LYNN
	TOTALS	**11,994**	**3,218**	**1.209**	

Table E.3
Public Water Systems associated with LARS-Lamesa Treatment Plant

PWS ID #	PWS Name	Population	Connections	Avg. Daily Consumption (mgd)	County
0170010	BORDEN COUNTY WATER SYSTEM	150	98	0.012	BORDEN
0580011	CITY OF ACKERLY	230	126	0.004	DAWSON
0580013	WELCH WATER SUPPLY CORP	354	115	0.035	DAWSON
0580025	KLONDIKE ISD	207	11	0.025	DAWSON
1530001	ODONNELL CITY OF	1011	364	0.257	LYNN
1530005	GRASSLAND WATER SUPPLY CORP	85	27	0.008	LYNN
	TOTALS	**2,037**	**741**	**0.341**	

Table E.4
Public Water Systems associated with LARS-Brownfield Treatment Plant

PWS ID #	PWS Name	Population	Connections	Avg. Daily Consumption (mgd)	County
0830001	SEAGRAVES CITY OF	2396	931	0.344	GAINES
0830011	LOOP WATER SUPPLY CORP	300	113	0.040	GAINES
0830012	SEMINOLE CITY OF	5916	2540	1.410	GAINES
1100004	ROPESVILLE CITY OF	517	196	0.094	HOCKLEY
2230002	MEADOW CITY OF	547	230	0.138	TERRY
2230003	WELLMAN PUBLIC WATER SYSTEM	225	97	0.010	TERRY
	TOTALS	**9,901**	**4,107**	**2.036**	

Table E.5
Summary of Cost Components
Lubbock Area Regional Solution (LARS)

Cost Item	Capital	O&M	Annualized 20yr, 6%
LARS - Lamesa			
Wells	$ 783,000	$ 96,638	$ 164,904
Treatment Plant	$ 3,126,200	$ 318,331	$ 590,887
Pipeline and Pump Stations	$ 13,615,339	$ 127,211	$ 1,314,258
Subtotal	**$ 17,524,539**	**$ 542,180**	**$ 2,070,049**
LARS - Brownfield			
Wells	$ 4,698,000	$ 579,281	$ 988,874
Treatment Plant	$ 14,227,400	$ 1,677,715	$ 2,918,125
Pipeline and Pump Stations	$ 43,189,155	$ 1,694,814	$ 5,460,241
Subtotal	**$ 62,114,555**	**$ 3,951,810**	**$ 9,367,240**
LARS - Lubbock			
Wells	$ 2,740,500	$ 339,603	$ 578,533
Treatment Plant	$ 7,252,900	$ 871,540	$ 1,503,881
Pipeline and Pump Stations	$ 13,778,461	$ 460,173	$ 1,661,442
Subtotal	**$ 23,771,861**	**$ 1,671,317**	**$ 3,743,856**
TOTAL	**$ 103,410,955**	**$ 6,165,307**	**$ 15,181,146**

Table E.6
Lubbock Area Regional Solution - Treatment Plant at Lubbock
Summary of Cost Components

Item	Quantity	Unit	Capital	O&M
Wells				
New wells	28	EA	$ 1,890,000	$ 339,603
Contingency	20%		$ 378,000	
Design & Constr Management	25%		$ 472,500	
Subtotal			**$ 2,740,500**	**$ 339,603**
Treatment				
RO Treatment Plant	1	EA	$ 5,002,000	$ 871,540
Contingency	20%		$ 1,000,400	
Design & Constr Management	25%		$ 1,250,500	
Subtotal			**$ 7,252,900**	**$ 871,540**
Pipeline				
4" Pipeline w/complete installation	49.07	Miles	$ 5,916,959	$ 12,385
6" Pipeline w/complete installation	3.66	Miles	$ 622,107	$ 856
10" Pipeline w/complete installation	2.17	Miles	$ 612,761	$ 542
Contingency	20%		$ 1,430,365	
Design & Constr Management	25%		$ 1,787,957	
Subtotal			**$ 10,370,149**	**$ 13,783**
Pump Stations				
Pump Stations	13	EA	$ 2,350,560	$ 446,390
Contingency	20%		$ 470,112	
Design & Constr Management	25%		$ 587,640	
Subtotal			**$ 3,408,312**	**$ 446,390**
TOTAL COSTS			**$ 23,771,861**	**$ 1,671,317**

Table E.7

Lubbock Area Regional Solution - Treatment Plant at Lamesa

Summary of Cost Components

Item	Quantity	Unit	Capital	O&M
Wells				
New wells	8	EA	$ 540,000	$ 96,638
Contingency	20%		$ 108,000	
Design & Constr Management	25%		$ 135,000	
Subtotal			**$ 783,000**	**$ 96,638**
Treatment				
RO Treatment Plant	1	EA	$ 2,156,000	$ 318,331
Contingency	20%		$ 431,200	
Design & Constr Management	25%		$ 539,000	
Subtotal			**$ 3,126,200**	**$ 318,331**
Pipeline				
4" Pipeline w/complete installation	33.30	Miles	$ 3,097,199	$ 9,159
6" Pipeline w/complete installation	15.15	Miles	$ 1,878,740	$ 4,166
8" Pipeline w/complete installation	22.89	Miles	$ 4,064,030	$ 6,294
Contingency	20%		$ 1,807,994	
Design & Constr Management	25%		$ 2,259,992	
Subtotal			**$ 13,107,955**	**$ 19,618**
Pump Stations				
Pump Stations	5	EA	$ 349,920	$ 107,592
Contingency	20%		$ 69,984	
Design & Constr Management	25%		$ 87,480	
Subtotal			**$ 507,384**	**$ 107,592**
TOTAL COSTS			**$ 17,524,539**	**$ 542,180**

Table E.8

Lubbock Area Regional Solution - Treatment Plant at Brownfield

Summary of Cost Components

Item	Quantity	Unit	Capital		O&M	
Wells						
New wells	48	EA	$	3,240,000	$	579,281
Contingency	20%		$	648,000		
Design & Constr Management	25%		$	810,000		
Subtotal			**$**	**4,698,000**	**$**	**579,281**
Treatment						
RO Treatment Plant	1	EA	$	9,812,000	$	1,677,715
Contingency	20%		$	1,962,400		
Design & Constr Management	25%		$	2,453,000		
Subtotal			**$**	**14,227,400**	**$**	**1,677,715**
Pipeline						
4" Pipeline w/complete installation	3.43	Miles	$	294,666	$	943
6" Pipeline w/complete installation	16.36	Miles	$	2,032,204	$	4,499
8" Pipeline w/complete installation	1.01	Miles	$	209,900	$	276
24" Pipeline w/complete installation	16.66	Miles	$	9,251,686	$	4,583
30" Pipeline w/complete installation	24.72	Miles	$	17,298,093	$	6,798
Contingency	20%		$	5,817,310		
Design & Constr Management	25%		$	7,271,637		
Subtotal			**$**	**42,175,496**	**$**	**17,099**
Pump Stations						
Pump Stations	6	EA	$	699,075	$	192,017
Contingency	20%		$	139,815		
Design & Constr Management	25%		$	174,769		
Subtotal			**$**	**1,013,659**	**$**	**192,017**
TOTAL COSTS			**$**	**62,114,555**	**$**	**2,466,112**

Table E.9
Lubbock Area Regional Solution (LARS)
Cost of Service

Component	Lubbock	Lamesa	Brownfield	Combined
Capital Cost	$ 23,771,860.83	$ 17,524,538.78	$ 62,114,554.96	$ 103,410,954.58
Annual O&M	$ 1,671,316.90	$ 542,180.24	$ 3,951,810.23	$ 6,165,307.37
Annualized 20 yr., 6%	$ 3,743,856.06	$ 2,070,049.39	$ 9,367,240.19	$ 15,181,145.64
Population	11,994	2,037	9,901	$ 23,932.00
Connections	3,218	741	4,107	$ 8,066.00
Annualized/Population	$ 312.14	$ 1,016.22	$ 946.09	$ 758.15
Annualized/Connection	$ 1,163.41	$ 2,793.59	$ 2,280.80	$ 2,079.27
Annualized/Connection as % of MHI*	3.05%	7.36%	6.00%	5.47%
Annualized/Connection/Month	**$ 96.95**	**$ 232.80**	**$ 190.07**	**$ 173.27**
Annual O&M/Population	$ 139.35	$ 266.17	$ 399.13	$ 268.21
Annual O&M/Connection	$ 519.37	$ 731.69	$ 962.21	$ 737.76
Annual O&M/Connection as % of MHI*	1.35%	1.91%	2.52%	1.93%
Annual O&M/Connection/Month	**$ 43.28**	**$ 60.97**	**$ 80.18**	**$ 61.48**

* The "percentage of MHI" is based on the MHI from the 2000 Census for Lubbock County and the census value has been marked up to reflect 2006 inflation adjusted dollars at $37,863.

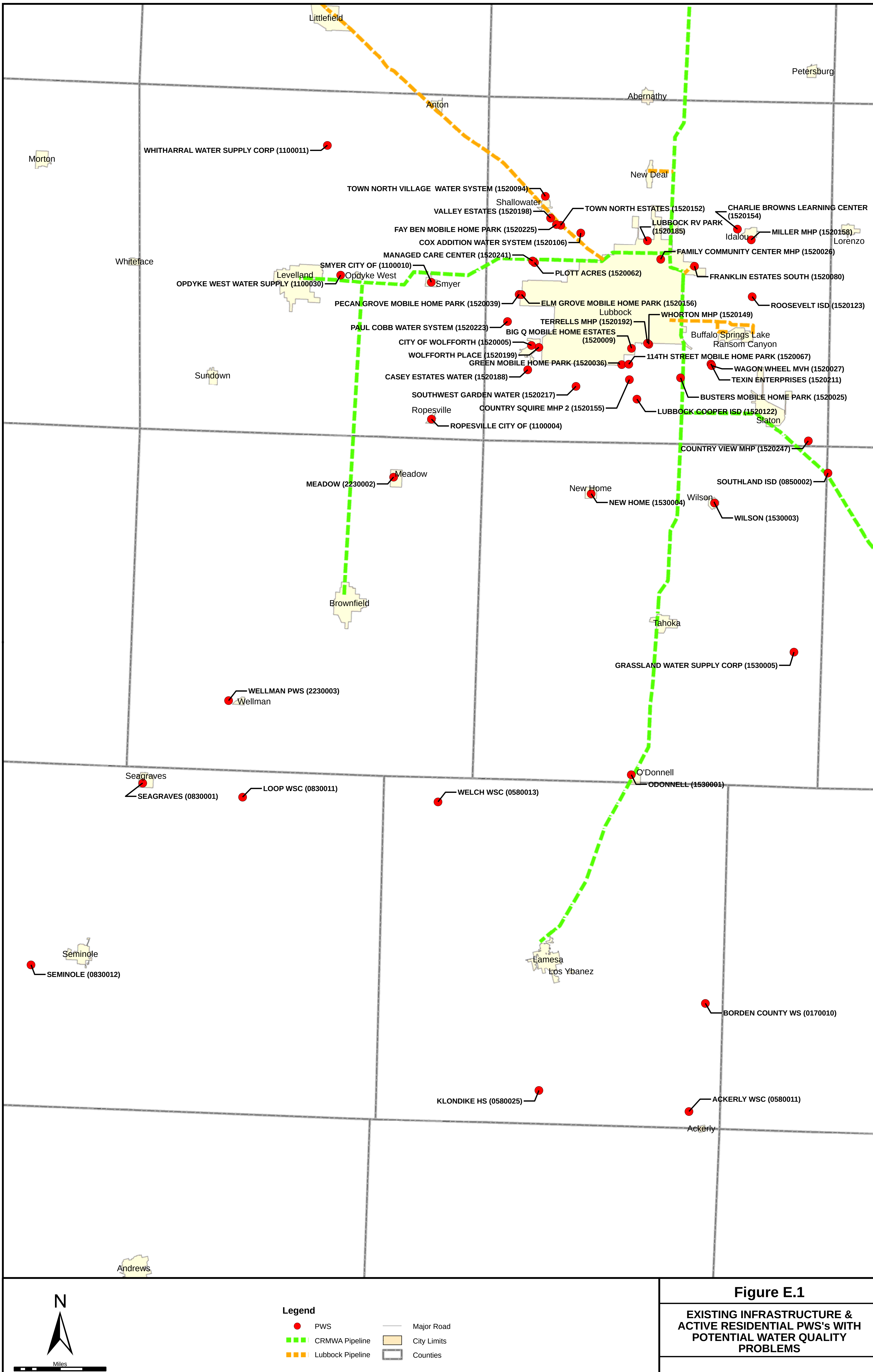


Figure E.1

EXISTING INFRASTRUCTURE & ACTIVE RESIDENTIAL PWS's WITH POTENTIAL WATER QUALITY PROBLEMS

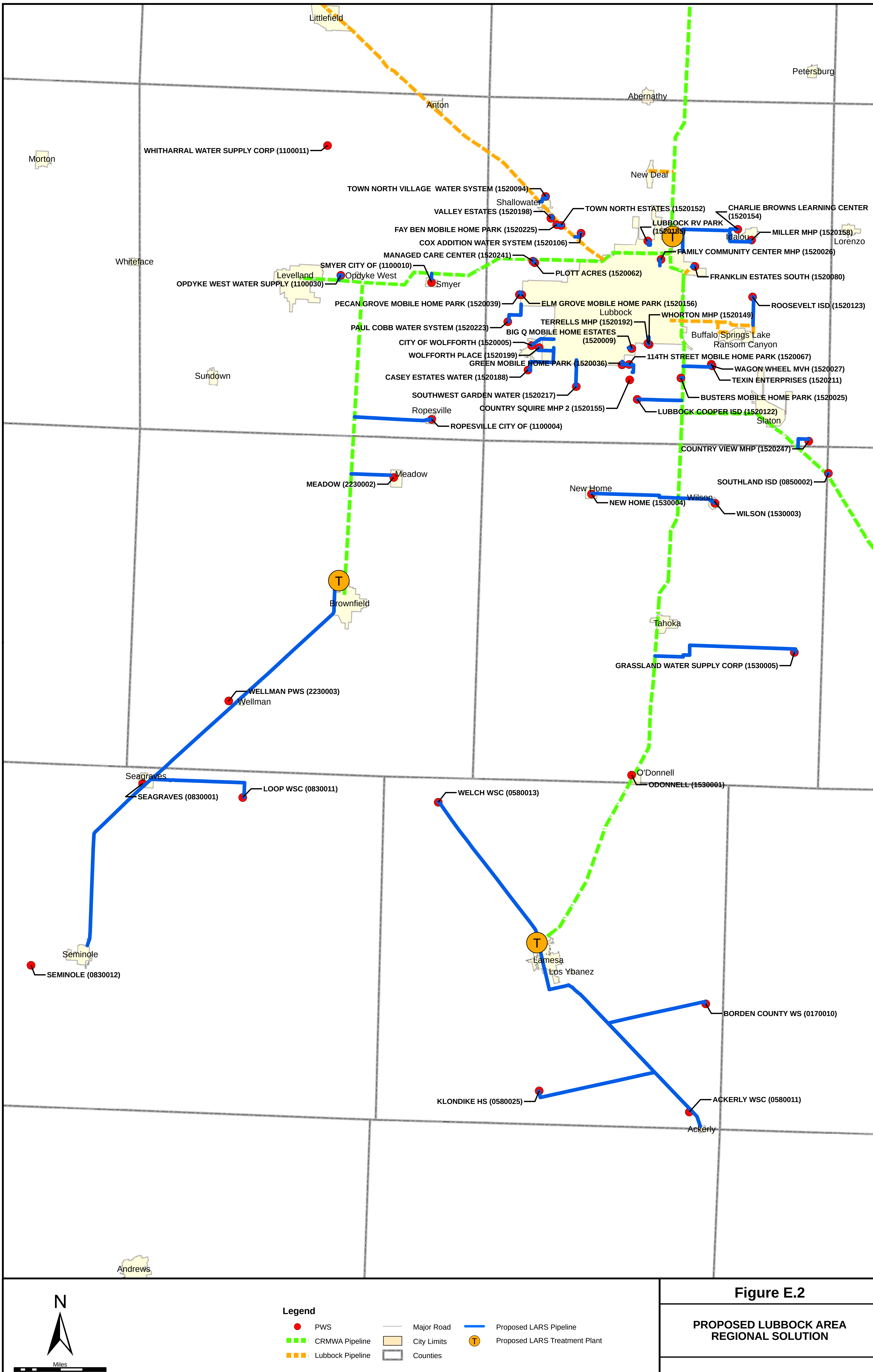


Figure E.2

PROPOSED LUBBOCK AREA REGIONAL SOLUTION

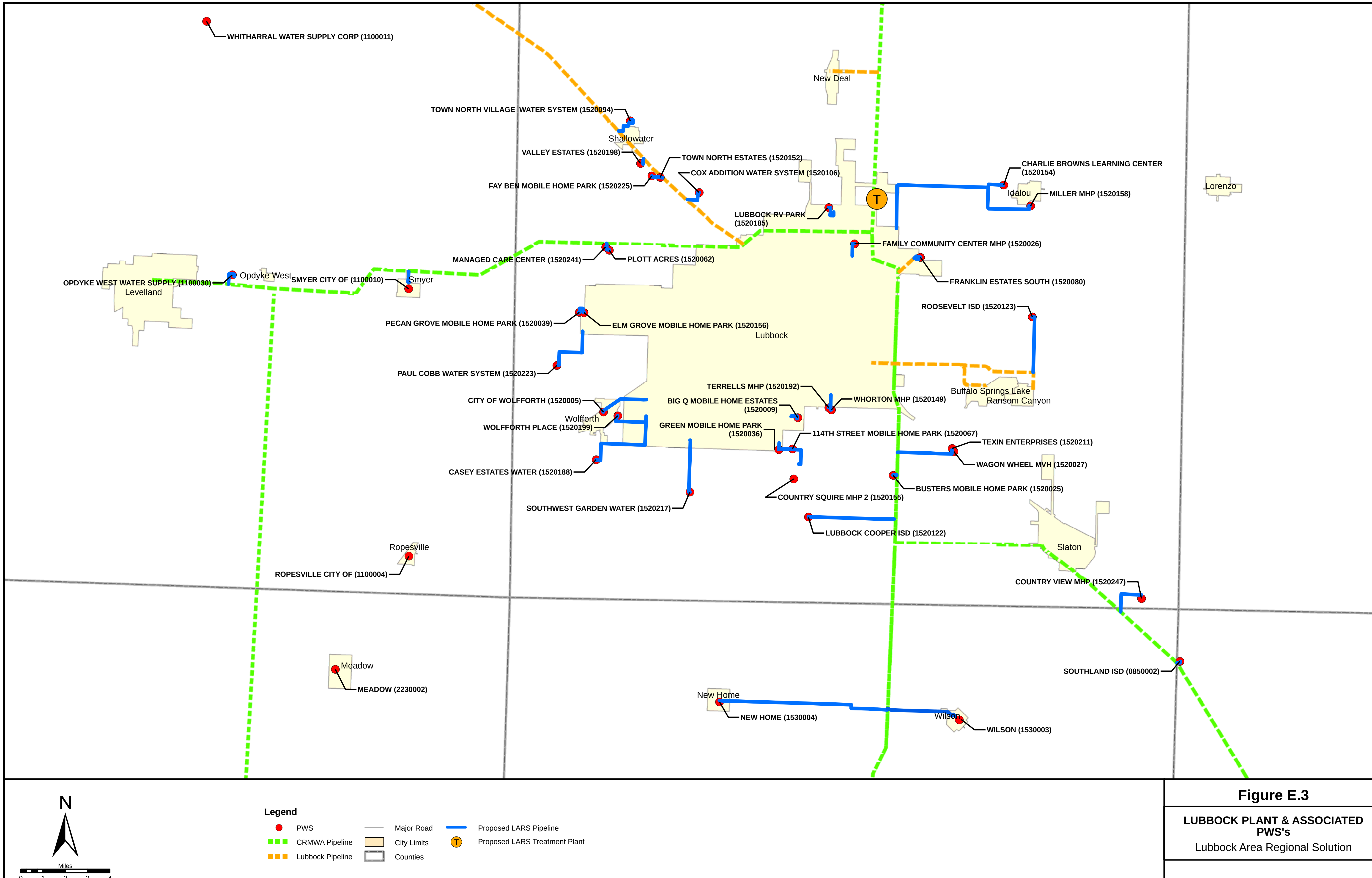


Figure E.3

LUBBOCK PLANT & ASSOCIATED PWS's

Lubbock Area Regional Solution

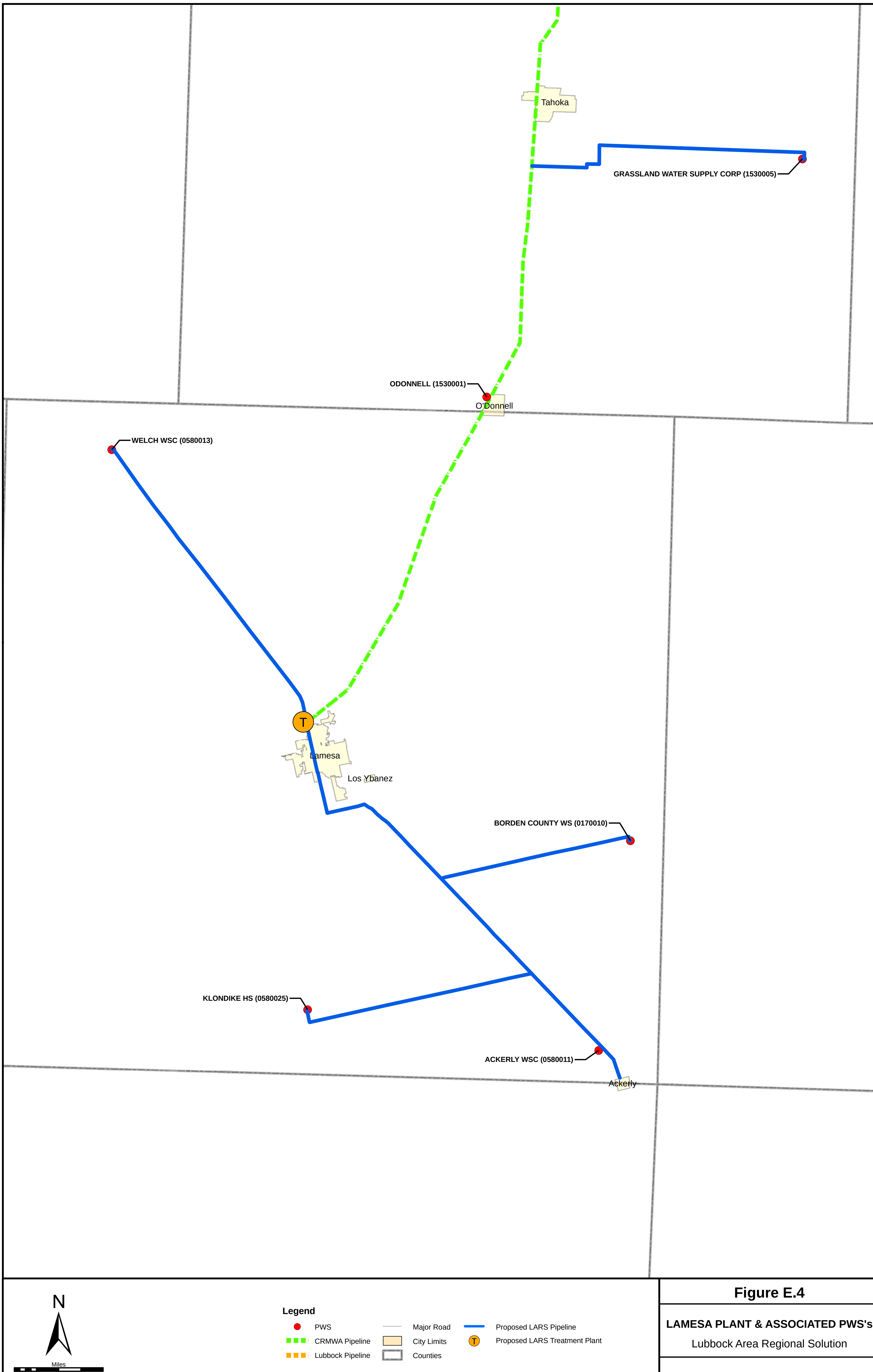


Figure E.4

LAMESA PLANT & ASSOCIATED PWS's

Lubbock Area Regional Solution

Figure E.5

BROWNFIELD PLANT & ASSOCIATED PWS's

Lubbock Area Regional Solution

Attachment E1
Texas Community Development Block Grants

Introduction

Every year, the U.S. Department of Housing and Urban Development (HUD) provides federal Community Development Block Grant (CDBG) funds directly to states, which, in turn, provide the funds to small, rural cities with populations of less than 50,000, and to counties that have a non-metropolitan population under 200,000 and are not eligible for direct funding from HUD. These small communities are called “non-entitlement” areas because they must apply for CDBG dollars through state agencies. The grants may be used for community and economic development activities, but are primarily used for housing rehabilitation, wastewater and drinking water facilities, public works facilities, and economic development. Seventy percent of grant funds must be used for activities that principally benefit low to moderate-income persons.

CDBG funds are administered through the Office of Rural Community Affairs (ORCA) and the Texas Department of Agriculture (TDA). ORCA administers the Texas Community Development Block Grant Program (Texas CDBG) and TDA administers the Texas Capital Fund through an interagency agreement between ORCA and TDA. ORCA was created not only to focus on rural issues, but to monitor government performance, research problems and find solutions, and to coordinate rural programs among state agencies. TDA offers the infrastructure development program as part of the Texas Capital Fund (TCF), which provides assistance with public infrastructure projects needed to by businesses to create or retain jobs for low and moderate income persons.

ORCA’s CDBG program of Texas is the largest in the nation. The rural-focused program serves approximately 1,017 eligible rural communities, 245 rural counties, and provides services to over 375,000 low- to moderate-income beneficiaries each year. Of the 1,017 communities eligible for CDBG funds, 740 have a population of less than 3,000, and 424 have a population of less than 1,000. The demographics and rural characteristics of Texas have shaped a program that focuses on providing basic human needs and sanitary infrastructure to small rural communities in outlying areas.

Eligible Applicants

Eligible applicants are nonentitlement general purpose units of local government, including cities and counties that are not participating or designated as eligible to participate in the entitlement portion of the federal CDBG. Nonentitlement cities that are not participating in urban county programs through existing participation agreements are eligible applicants (unless the city’s population is counted toward the urban county CDBG allocation).

Nonentitlement cities are located predominately in rural areas and are cities with populations less than 50,000 thousand persons; cities that are not designated as a central city of a metropolitan statistical area; and cities that are not participating in urban county programs. Nonentitlement counties are also predominately rural in nature and are counties that generally have fewer than 200,000 persons in the nonentitlement communities and unincorporated areas located in the county.

Eligible Activities

Eligible activities under the Texas CDBG Program are listed in 42 United States Code (USC) Section 5305. The Texas CDBG staff reviews all proposed project activities included in applications for all fund categories. The Texas Department of Agriculture determines the eligibility of activities included in TCF applications.

All proposed activities must meet one of the following three National Program Objectives:

1. Benefit principally low- and moderate-income persons; or
2. Aid in the elimination of slums or blight; or
3. Meet other community development needs of particular urgency that represent an immediate threat to the health and safety of residents of the community.

Ineligible Activities

In general, any type of activity not described or referred to in 42 USC Section 5305 is ineligible. Specific activities ineligible under the Texas CDBG Program are:

1. Construction of buildings and facilities used for the general conduct of government (*e.g.*, city halls, courthouses, *etc*.);
2. Construction of new housing, except as last resort housing under 49 CFR Part 24 or affordable housing through eligible subrecipients in accordance with 24 CFR 570.204;
3. Financing of political activities;
4. Purchases of construction equipment (except in limited circumstances under the STEP);
5. Income payments, such as housing allowances; and
6. Most O&M expenses (including smoke testing, televising/video taping line work, or any other investigative method to determine the overall scope and location of the project work activities)

The TCF will not accept applications in support of public or private prisons, racetracks, and projects that address job creation/retention through a government supported facility. The TCF Program may be used to financially assist/facilitate the relocation of a business when certain requirements, as defined in the application guidelines, are met.

Primary Beneficiaries

The primary beneficiaries of the Texas CDBG Program are low to moderate income persons as defined under HUD, Section 8 Assisted Housing Program (Section l02(c)). Low income families are defined as those earning less than 50 percent of the area MHI. Moderate income families are defined as those earning less than 80 percent of the area MHI. The area median family can be based on a metropolitan statistical area, a non-metropolitan county, or the statewide non-metropolitan MHI figure.

Section 108 Loan Guarantee Program

Section 108 is the loan guarantee provision of the Texas CDBG Program. Section 108 provides communities with a source of financing for economic development, housing rehabilitation, public facilities, and large-scale physical development projects. This makes it one of the most potent and important public investment tools that HUD offers to local governments. It allows these local governments to transform a small portion of their CDBG funds into federally guaranteed loans large enough to pursue physical and economic revitalization projects that can renew entire neighborhoods. Such public investment is often needed to inspire private economic activity, providing the initial resources, or simply the confidence that private firms and individuals may need to invest in distressed areas. Section 108 loans are not risk-free; however, local governments borrowing funds guaranteed by Section 108 must pledge their current and future CDBG allocations to cover the loan amount as security for the loan.

The loan is made by a private lender to an eligible nonentitlement city or county. HUD guarantees the loan; however, Texas CDBG must pledge the state's current and future CDBG nonentitlement area funds to cover any losses. To provide eligible nonentitlement communities an additional funding source, the State is authorizing a loan guarantee pilot program for 2008 consisting of one application up to a maximum of $500,000 for a particular project. An application guide containing the submission date and qualifications will be available for applicants interested in being selected as the pilot project under this program.

APPENDIX F
ANALYSIS OF SHARED SOLUTIONS FOR OBTAINING WATER FROM DENVER CITY

F.1 OVERVIEW OF METHOD USED

There are a few small PWSs with water quality problems located in the vicinity of the City of Wellman PWS that could benefit from joining together and cooperating to share the cost for obtaining compliant drinking water. This cooperation could involve creating a formal organization of individual PWSs to address obtaining compliant drinking water, consolidating to form a single PWS, or having the individual PWSs taken over or bought out by a larger regional entity.

The small PWSs with water quality problems near the City of Wellman are listed in Table F.1, along with their average water consumption and estimates of the capital cost for each PWS to construct an individual pipeline. It is assumed for this analysis that all the systems would participate in a shared solution.

This analysis focuses on compliance alternatives related to obtaining water from large water providers interested in providing water outside their current area, either by wholesaling to PWSs, or by expanding their service areas. This type of solution is most likely to have the best prospects for sustainability, and a reliable provision of compliant drinking water.

The purpose of this analysis is to approximate the level of capital cost savings that could be expected from pursuing a shared solution versus a solution where the study PWS obtains compliant drinking water on its own. Regardless of the form a group solution would take, water consumers would have to pay for the infrastructure needed for obtaining compliant water. To keep this analysis as straightforward and realistic as possible, it is assumed the individual PWSs would remain independent, and would share the capital cost for the infrastructure required. Also, to maintain simplicity, this analysis is limited to estimating capital cost savings related to pipeline construction, which is likely to be by far the largest component of the overall capital cost. A shared solution could also produce savings in O&M expenses as a result of reduction in redundant facilities and the potential for shared O&M resources, and these savings would have to be evaluated if the PWSs are interested in implementing a shared solution.

There are many ways pipeline capital costs could be divided between participating PWSs, and the final apportioning of costs would likely be based on negotiation between the participating entities. At this preliminary stage of analysis it is not possible to project results from negotiations regarding cost sharing. For this reason, three methods are used to allocate cost between PWSs in an effort to give an approximation of the range of savings that might be attainable for an individual PWS.

Method A is based on allocating capital cost of the shared pipeline solution proportionate to the amount of water used by each PWS. In this case, the capital cost for the shared pipeline and the necessary pump stations is estimated, and then this total capital cost is allocated based on the fraction of the total water used by each PWS. For example, PWS #1 has an average daily water use of 0.1 mgd and PWS #2 has an average daily use of 0.3 mgd. Using this method, PWS #1 would be allocated 25 percent of the capital cost of the shared solution. This method is a reasonable method for allocating cost when all the PWSs are different in size but are relatively equidistant from the shared water source.

Method B is also based on allocating capital cost of the shared pipeline solution proportionate to the amount of water used by the PWSs. However, rather than allocating the *total* capital cost of the shared solution between each participating PWS, this approach splits the shared pipeline into segments and allocates flow-proportional costs to the PWSs using each segment. Costs for a pipeline segment are not shared by a PWS if the PWS does not use that particular segment. For example, PWS #1 has an average daily water use of 0.3 mgd and PWS #2 has an average daily use of 0.2 mgd. A 3-mile long pipeline segment is common to both PWSs, while PWS #2 requires an additional 4-mile segment. Using this method, PWS #2 would be allocated 40 percent of the cost of the 3-mile segment and 100 percent of the cost of the 4-mile segment. This method is a reasonable method for allocating cost when all the PWSs are different in size and are located at different distances from the shared water source.

Method C is based on allocating capital cost of the shared pipeline solution proportionate to the cost each PWS would have to pay to obtain compliant water if it were to implement an individual solution. In this case, the total capital cost for the shared pipeline and the necessary pump stations is estimated as well as the capital cost each PWS would have for obtaining its own pipeline. The total capital cost for the shared solution is then allocated between the participating PWSs based on what each PWS would have to pay to construct its own pipeline. For example, the individual solution cost for PWS #1 is $4 million and the individual solution cost for PWS #2 is $1 million. Using this method, PWS #1 would be allocated 80 percent of the cost of the shared solution. This method is a reasonable method for allocating cost when the PWS are located at different distances from the water source.

For any given PWS, all three of these methods should generate costs for the shared solution that produce savings for the PWS over an individual solution. However, for different PWSs participating in a shared solution, each of these three methods can produce savings of varying magnitudes: for one PWS, Method A might show the best cost savings while for another Method C might provide the best savings. For this reason, this range is considered to be representative of possible savings that could result from an agreement that should be fair and equitable to all parties involved.

F.2 SHARED SOLUTION FOR OBTAINING WATER FROM DENVER CITY

This alternative would consist of constructing 14 miles of 12-inch joint pipeline from Denver City to a split and a 2-mile long 10-inch pipeline would connect the split to the City of Seagraves. The City of Wellman and the City of Loop would be connected to the split via 4-inch pipelines. The pipeline routing is shown in Figure F.1 at the end of this appendix. It is assumed two pump stations would be required to transfer the water from Denver City to the three public water systems.

The capital costs for each pipe segment and the total capital cost for the shared pipeline are summarized in Table F.2. Table F.3 shows the capital costs allocated to each PWS using Method A. Table F.4 shows the capital costs allocated to each PWS using Method B. Table F.5 shows the allocation of pipeline capital costs to each of the PWSs using Method C, as described above. Table F.6 provides a summary of the pipeline capital costs estimated for each PWS, and the savings that could be realized compared to developing individual pipelines. More detailed cost estimates for the pipe segments are shown at the end of this appendix in Tables F.7 through F.12.

Based on these estimates, the range of pipeline capital cost savings to the City of Wellman could be between $1.46 million to $3.04 million if they were to implement a shared solution like this, which would be a savings between 42 to 87 percent. These estimates are hypothetical and are only provided to approximate the magnitude of potential savings if this shared solution is implemented as described.

Table F.1
Summary Information for PWSs Participating in Shared Solution

PWS	PWS #	Average Water Demand (mgd)	Water Demand as Percent of Total	Pipeline Capital Cost for Individual Solutions for Wellman, Loop & Seagraves	Percent of Sum of Capital Costs for Individual Solutions for Wellman, Loop & Seagraves
Seagraves	0830001	0.344	83%	$ 4,145,957	36%
Loop	0830011	0.040	10%	$ 3,841,391	33%
Wellman	2230003	0.028	7%	$ 3,494,343	30%
	Totals	**0.412**	**100%**	**$ 11,481,692**	**100%**

Table F.2
Capital cost for Shared Pipeline from Denver City to Wellman, Loop & Seagraves

Pipe Segment	Capital Cost
Pipe 1	$ 3,633,235
Pipe 2	$ 360,941
Pipe A	$ 514,557
Pipe B	$ 1,211,266
Pipe C	$ 959,765
Totals	**$ 6,679,765**

Table F.3
Pipeline Capital Cost Allocation by Method A
Shared Pipeline Assement for Wellman, Loop & Seagraves

PWS	PWS #	Percentage Based On Flow	Total Costs
Seagraves	0830001	83%	$ 5,577,279
Loop	0830011	10%	$ 648,521
Wellman	2230003	7%	$ 453,965
	Totals	**100%**	**$ 6,679,765**

Table F.4
Pipeline Capital Cost Allocation by Method B
Shared Pipeline Assesment for Wellman, Loop & Seagraves

Pipeline Segment	Pipe Segment Capital Cost	Seagraves		Loop		Wellman	
		Percent Allocation Based on Water Use	Allocated Cost	Percent Allocation Based on Water Use	Allocated Cost	Percent Allocation Based on Water Use	Allocated Cost
Pipe 1	$ 3,633,235	83%	$ 3,033,575	10%	$ 352,741	7%	$ 246,919
Pipe 2	$ 360,941	0%	$ -	59%	$ 212,318	41%	$ 148,623
Pipe A	$ 514,557	100%	$ 514,557	0%	$ -	0%	$ -
Pipe B	$ 1,211,266	0%	$ -	100%	$ 1,211,266	0%	$ -
Pipe C	$ 959,765	0%	$ -	0%	$ -	100%	$ 959,765
Totals	**$ 6,679,765**		**$ 3,548,132**		**$ 1,776,326**		**$ 1,355,307**

Table F.5
Pipeline Capital Cost Allocation by Method C
Shared Pipelilne Assessment for Wellman, Loop & Seagraves

PWS	PWS #	Cost for Individual Pipelines	Percentage based on Individual Solutions	Allocated Capital Cost
Seagraves	0830001	$ 4,145,957	36%	$ 2,412,015
Loop	0830011	$ 3,841,391	33%	$ 2,234,826
Wellman	2230003	$ 3,494,343	30%	$ 2,032,923
	Totals	**$ 11,481,692**	**100%**	**$ 6,679,765**

Table F.6
Pipeline Capital Cost Summary
Shared Pipelilne Assessment for Wellman, Loop & Seagraves

PWS	Individual Pipeline Capital Costs	Shared Solution Capital Cost Allocation			Shared Solution Cost Savings			Shared Solution Percentage Savings		
		Method A	**Method B**	**Method C**	**Method A**	**Method B**	**Method C**	**Method A**	**Method B**	**Method C**
0830001	$ 4,145,957	$ 5,577,279	$ 3,548,132	$ 2,412,015	$ (1,431,322)	$ 597,825	$ 1,733,942	-35%	14%	42%
0830011	$ 3,841,391	$ 648,521	$ 1,776,326	$ 2,234,826	$ 3,192,870	$ 2,065,065	$ 1,606,565	83%	54%	42%
2230003	$ 3,494,343	$ 453,965	$ 1,355,307	$ 2,032,923	$ 3,040,379	$ 2,139,037	$ 1,461,421	87%	61%	42%
Totals	**$ 11,481,692**	**$ 6,679,765**	**$ 6,679,765**	**$ 6,679,765**	**$ 4,801,927**	**$ 4,801,927**	**$ 4,801,927**			

Table F.7

Main Link # 1		
Total Pipe Length	14.41	miles
Number of Pump Stations Needed	1	
Pipe Size	12"	inches

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	1	n/a	n/a	n/a
Number of Crossings, open cut	-	n/a	n/a	n/a
PVC water line, Class 150, 12"	76,101	LF	$ 27	$ 2,054,727
Bore and encasement, 12"	200	LF	$ 240	$ 48,000
Open cut and encasement, 12"	-	LF	$ 130	$ -
Gate valve and box, 12"	16	EA	$ 1,965	$ 31,440
Air valve	15	EA	$ 2,050	$ 30,750
Flush valve	16	EA	$ 1,025	$ 16,400
Metal detectable tape	76,101	LF	$ 2.00	$ 152,202
Subtotal				**$ 2,333,519**
Pump Station(s) Installation				
Pump	2	EA	$ 8,000	$ 16,000
Pump Station Piping, 12"	2	EA	$ 3,300	$ 6,600
Gate valve, 12"	4	EA	$ 1,960	$ 7,840
Check valve, 12"	2	EA	$ 3,180	$ 6,360
Electrical/Instrumentation	1	EA	$ 10,250	$ 10,250
Site work	1	EA	$ 2,560	$ 2,560
Building pad	1	EA	$ 5,125	$ 5,125
Pump Building	1	EA	$ 10,250	$ 10,250
Fence	1	EA	$ 6,150	$ 6,150
Tools	1	EA	$ 1,025	$ 1,025
100,000 gal ground storage tank	1	EA	$ 100,000	$ 100,000
Subtotal				**$ 172,160**
Subtotal of Component Costs				**$ 2,505,679**
Contingency	20%			$ 501,136
Design & Constr Management	25%			$ 626,420
TOTAL CAPITAL COSTS				**$ 3,633,235**

Table F.8

Main Link # 2
Total Pipe Length 2.24 miles
Number of Pump Stations Needed 1
Pipe Size 04" inches

Capital Costs

Cost Item	Quantity	Unit	Unit Cost		Total Cost	
Pipeline Construction						
Number of Crossings, bore	-	n/a	n/a		n/a	
Number of Crossings, open cut	-	n/a	n/a		n/a	
PVC water line, Class 200, 04"	11,840	LF	$	12	$	142,080
Bore and encasement, 10"	-	LF	$	240	$	-
Open cut and encasement, 10"	-	LF	$	130	$	-
Gate valve and box, 04"	3	EA	$	710	$	2,130
Air valve	3	EA	$	2,050	$	6,150
Flush valve	3	EA	$	1,025	$	3,075
Metal detectable tape	11,840	LF	$	2.00	$	23,680
Subtotal					**$**	**177,115**
Pump Station(s) Installation						
Pump	2	EA	$	8,000	$	16,000
Pump Station Piping, 04"	2	EA	$	550	$	1,100
Gate valve, 04"	4	EA	$	710	$	2,840
Check valve, 04"	2	EA	$	755	$	1,510
Electrical/Instrumentation	1	EA	$	10,250	$	10,250
Site work	1	EA	$	2,560	$	2,560
Building pad	1	EA	$	5,125	$	5,125
Pump Building	1	EA	$	10,250	$	10,250
Fence	1	EA	$	6,150	$	6,150
Tools	1	EA	$	1,025	$	1,025
10,000 gal ground storage tank	1	EA	$	15,000	$	15,000
Subtotal					**$**	**71,810**
Subtotal of Component Costs					**$**	**248,925**
Contingency	20%				$	49,785
Design & Constr Management	25%				$	62,231
TOTAL CAPITAL COSTS					**$**	**360,941**

Table F.9

Segment A

Seagraves

Private Pipe Size	10"	
Total Pipe Length	1.93	miles
Total PWS annual water usage	125.6	MG
Number of Pump Stations Needed	0	

Capital Costs

Cost Item	**Quantity**	**Unit**	**Unit Cost**		**Total Cost**	
Pipeline Construction						
Number of Crossings, bore	1	n/a	n/a		n/a	
Number of Crossings, open cut	-	n/a	n/a		n/a	
PVC water line, Class 150, 10"	10,178	LF	$	27	$	274,806
Bore and encasement, 12"	200	LF	$	240	$	48,000
Open cut and encasement, 12"	-	LF	$	130	$	-
Gate valve and box, 10"	3	EA	$	1,510	$	4,530
Air valve	2	EA	$	2,050	$	4,100
Flush valve	3	EA	$	1,025	$	3,075
Metal detectable tape	10,178	LF	$	2.00	$	20,356
Subtotal					**$**	**354,867**
Pump Station(s) Installation						
Pump	-	EA	$	8,000	$	-
Pump Station Piping, 10"	-	EA	$	2,115	$	-
Gate valve, 10"	-	EA	$	1,510	$	-
Check valve, 10"	-	EA	$	2,520	$	-
Electrical/Instrumentation	-	EA	$	10,250	$	-
Site work	-	EA	$	2,560	$	-
Building pad	-	EA	$	5,125	$	-
Pump Building	-	EA	$	10,250	$	-
Fence	-	EA	$	6,150	$	-
Tools	-	EA	$	1,025	$	-
10,000 gal ground storage tank	-	EA	$	15,000	$	-
Subtotal					**$**	**-**
Subtotal of Component Costs					**$**	**354,867**
Contingency	20%				$	70,973
Design & Constr Management	25%				$	88,717
TOTAL CAPITAL COSTS					**$**	**514,557**

Table F.10

Segment B

Loop

Private Pipe Size	04"	
Total Pipe Length	9.17	miles
Total PWS annual water usage	14.6	MG
Number of Pump Stations Needed	0	

Capital Costs

Cost Item	Quantity	Unit	Unit Cost		Total Cost	
Pipeline Construction						
Number of Crossings, bore	1	n/a	n/a		n/a	
Number of Crossings, open cut	11	n/a	n/a		n/a	
PVC water line, Class 200, 04"	48,429	LF	$	12	$	581,148
Bore and encasement, 10"	200	LF	$	240	$	48,000
Open cut and encasement, 10"	550	LF	$	130	$	71,500
Gate valve and box, 04"	10	EA	$	710	$	7,100
Air valve	10	EA	$	2,050	$	20,500
Flush valve	10	EA	$	1,025	$	10,250
Metal detectable tape	48,429	LF	$	2.00	$	96,858
Subtotal					**$**	**835,356**
Pump Station(s) Installation						
Pump	-	EA	$	8,000	$	-
Pump Station Piping, 04"	-	EA	$	550	$	-
Gate valve, 04"	-	EA	$	710	$	-
Check valve, 04"	-	EA	$	755	$	-
Electrical/Instrumentation	-	EA	$	10,250	$	-
Site work	-	EA	$	2,560	$	-
Building pad	-	EA	$	5,125	$	-
Pump Building	-	EA	$	10,250	$	-
Fence	-	EA	$	6,150	$	-
Tools	-	EA	$	1,025	$	-
30,000 gal ground storage tank	-	EA	$	40,000	$	-
Subtotal					**$**	**-**
Subtotal of Component Costs					**$**	**835,356**
Contingency	20%				$	167,071
Design & Constr Management	25%				$	208,839
TOTAL CAPITAL COSTS					**$**	**1,211,266**

Table F.11

Segment C
Wellman

Private Pipe Size	04"	
Total Pipe Length	8.23	miles
Total PWS annual water usage	10.2	MG
Number of Pump Stations Needed	0	

Capital Costs

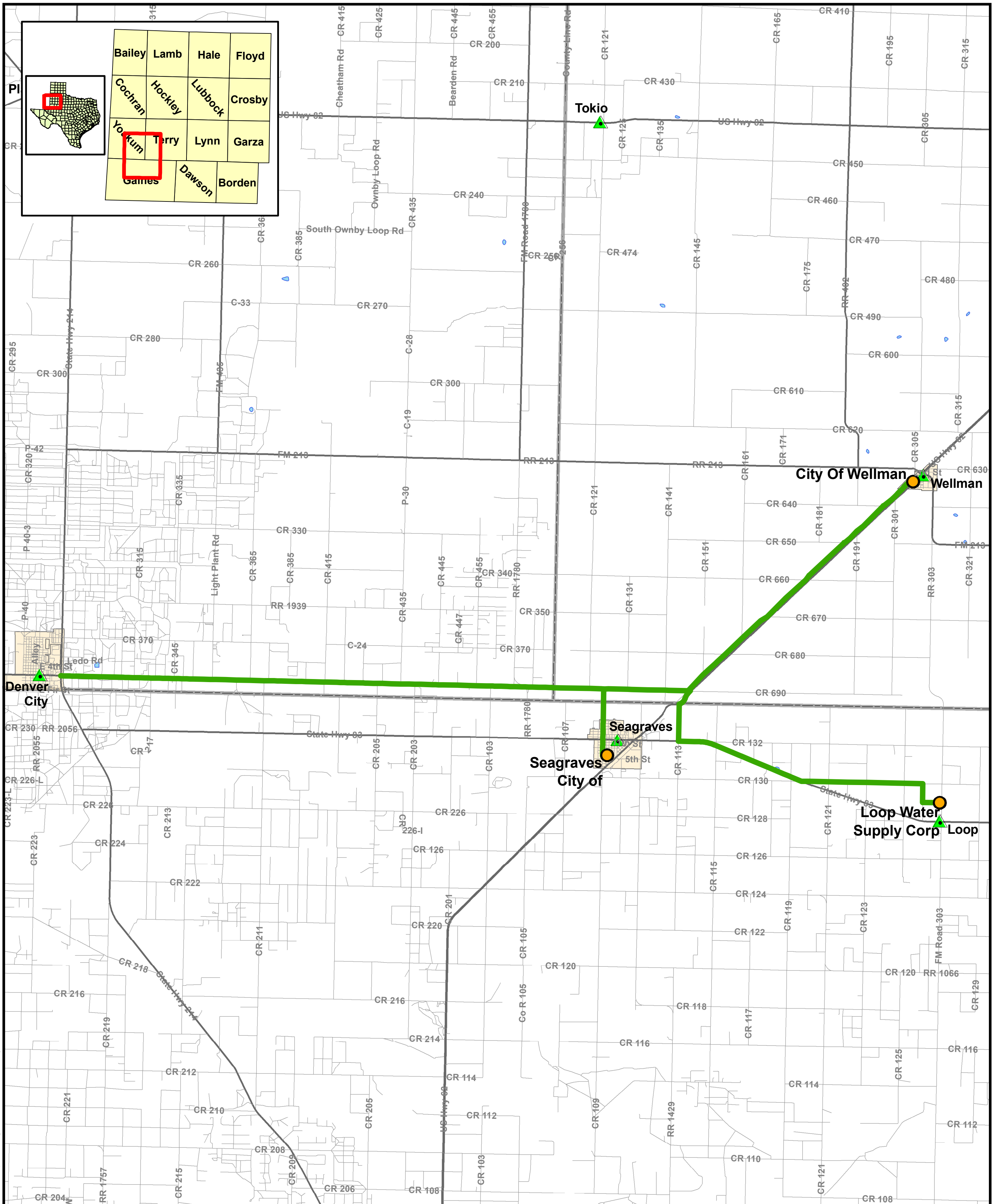
Cost Item	**Quantity**	**Unit**	**Unit Cost**		**Total Cost**	
Pipeline Construction						
Number of Crossings, bore	-	n/a	n/a		n/a	
Number of Crossings, open cut	3	n/a	n/a		n/a	
PVC water line, Class 200, 04"	43,453	LF	$	12	$	521,436
Bore and encasement, 10"	-	LF	$	240	$	-
Open cut and encasement, 10"	150	LF	$	130	$	19,500
Gate valve and box, 04"	9	EA	$	710	$	6,390
Air valve	9	EA	$	2,050	$	18,450
Flush valve	9	EA	$	1,025	$	9,225
Metal detectable tape	43,453	LF	$	2.00	$	86,906
Subtotal					**$**	**661,907**
Pump Station(s) Installation						
Pump	-	EA	$	8,000	$	-
Pump Station Piping, 04"	-	EA	$	550	$	-
Gate valve, 04"	-	EA	$	710	$	-
Check valve, 04"	-	EA	$	755	$	-
Electrical/Instrumentation	-	EA	$	10,250	$	-
Site work	-	EA	$	2,560	$	-
Building pad	-	EA	$	5,125	$	-
Pump Building	-	EA	$	10,250	$	-
Fence	-	EA	$	6,150	$	-
Tools	-	EA	$	1,025	$	-
10,000 gal ground storage tank	-	EA	$	15,000	$	-
Subtotal					**$**	**-**
Subtotal of Component Costs					**$**	**661,907**
Contingency	20%				$	132,381
Design & Constr Management	25%				$	165,477
TOTAL CAPITAL COSTS					**$**	**959,765**

Table F.12

Line from Seagraves to Denver City
Total Pipe Length 16.34 miles
Number of Pump Stations Needed 1
Pipe Size 12" inches

Capital Costs

Cost Item	Quantity	Unit	Unit Cost	Total Cost
Pipeline Construction				
Number of Crossings, bore	2	n/a	n/a	n/a
Number of Crossings, open cut	-	n/a	n/a	n/a
PVC water line, Class 150, 12"	86,291	LF	$ 27	$ 2,329,868
Bore and encasement, 12"	400	LF	$ 240	$ 96,000
Open cut and encasement, 12"	-	LF	$ 130	$ -
Gate valve and box, 12"	18	EA	$ 1,965	$ 35,370
Air valve	17	EA	$ 2,050	$ 34,850
Flush valve	18	EA	$ 1,025	$ 18,450
Metal detectable tape	86,291	LF	$ 2.00	$ 172,583
Subtotal				**$ 2,687,121**
Pump Station(s) Installation				
Pump	2	EA	$ 8,000	$ 16,000
Pump Station Piping, 12"	2	EA	$ 3,300	$ 6,600
Gate valve, 12"	4	EA	$ 1,960	$ 7,840
Check valve, 12"	2	EA	$ 3,180	$ 6,360
Electrical/Instrumentation	1	EA	$ 10,250	$ 10,250
Site work	1	EA	$ 2,560	$ 2,560
Building pad	1	EA	$ 5,125	$ 5,125
Pump Building	1	EA	$ 10,250	$ 10,250
Fence	1	EA	$ 6,150	$ 6,150
Tools	1	EA	$ 1,025	$ 1,025
100,000 gal ground storage tank	1	EA	$ 100,000	$ 100,000
Subtotal				**$ 172,160**
Subtotal of Component Costs				**$ 2,859,281**
Contingency	20%			$ 571,856
Design & Constr Management	25%			$ 714,820
TOTAL CAPITAL COSTS				**$ 4,145,957**



Legend

Study System
PWS's
Cities
City Limits
Counties
Major Road
Minor Road
CRMWA Pipeline
Lubbock Pipeline
Grass Valley Pipeline
Shared
WM/SG/LP - 1

N

Miles
0 1.5 3

Figure F.1

WELLMAN, SEAGRAVES & LOOP WSC TO DENVER CITY
Shared Pipeline Alternative

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